Proposed DRAFT 2026 Standard Specifications for Municipal Construction

This DRAFT is published for the 60 day comment period:

November 7th – January 7th, 2026

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DIVISION 1 GENERAL REQUIREMENTS

SECTION 1-01 DEFINITIONS AND TERMS

1-01.1 GENERAL

Standard acronyms, abbreviations, definitions, and symbols common to the fields of engineering and construction are used throughout the Contract without further explanation. Acronyms and definitions often used in the Contract are found in Sections 1-01.2 and 1-01.3. Frequently used abbreviations are found in Standard Plan 002. Additional acronyms, definitions, and symbols may be found in the Project Manual or Drawings. Welding symbols are defined in the current edition of the American Welding Society Structural Welding Code.

When used in the Contract, the acronyms listed in Section 1-01.2(1) and terms defined in Section 1-01.3 or pronouns used in place of acronyms and terms have the indicated meanings unless the context implies otherwise.

Words in the plural include singular and vice versa.

Words of a particular gender include any gender.

1-01.2 ABBREVIATIONS

1-01.2(1) ASSOCIATIONS AND MISCELLANEOUS

The following standard acronyms are used throughout the Bid Documents:

A2LA	American Association for Laboratory Accreditation
AAA	American Arbitration Association
AAN	American Association of Nurserymen
AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACIL	American Council of Independence Laboratories
ADA	Americans with Disabilities Act
AGA	American Gas Association
AGC	Associated General Contractors of America
AHERA	Asbestos Hazard Emergency Response Act
AI	Asphalt Institute
AIA	American Institute of Architects
AIHA	American Industrial Hygiene Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ALSC	American Lumber Standards Committee
ANSI	American National Standards Institute
APA	American Plywood Association
API	American Petroleum Institute
APWA	American Public Works Association
ARA	American Railway Association
AREMA	American Railroad Engineering and Maintenance-of-Way Association
ARTBA	American Road and Transportation Builder's Association
ASA	American Standards Association
ASCE	American Society of Civil Engineers
ASLA	American Society of Landscape Architects
ASME	American Society of Mechanical Engineers
ASNS	American Standard for Nursery Stock
ASNT	American Society for Non Destruction Testing
ASSE	American Society of Sanitary Engineering
ASTM	American Society for Testing and Materials
AWCM	Arborist Wood Chip Mulch
AWPA	American Wood Preservers' Association

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AWS	American Welding Society
AWWA	American Water Works Association
BMP	Best Management Practice
BR	Bridge Replacement and Redevelopment Program
CARB	California Air Research Board
CBD	Central Business District
CBE	Combination Business Enterprise
CCTV	Closed-Circuit Television
CDBG	Community Development Block Grant
CDF	Controlled Density Fill
CESCL	Certified Erosion and Sediment Control Lead
CFR	Code of Federal Regulations
CLI	Chain Link Institute
CPESC	Certified Professional in Erosion and Sediment Control
CPM	Critical Path Method
CRAB	County Road Administration Board
CRSI	Concrete Reinforcing Steel Institute
CRT	Controlled Releasing Terminal
CSECP	Construction Stormwater and Erosion Control Plan
CSI	Construction Specifications Institute
CWA	Community Workforce Agreement
DBE	Disadvantaged Business Enterprise
DBH	Diameter at Breast Height
DBRA	Davis Bacon and Related Acts
DIPRA	Ductile Iron Pipe Research Association
ECY	Washington State Department of Ecology
EE	Engineer's Estimate
EEI	Edison Electric Institute
EEO	Equal Employment Opportunity
EPA	Environmental Protection Agency
ESCBMP	Erosion and Sedimentation Control Best Management Practices
ESD	Employment Security Department
FAS	Department of Finance and Administrative Services
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FSS	Federal Specifications and Standards, General Services Administration
FTA	Federal Transit Administration
HPMA	Hardwood Plywood Manufacturers Association
HUD	United States Department of Housing and Urban Development
IAPMO	International Association of Plumbers and Mechanical Officials
ICEA	Insulated Cable Engineers Association
ICOR	Interagency Commission on Outdoor Recreation
IEEE	Institute of Electrical and Electronic Engineers
IES	Illuminating Engineering Society
IMSA	International Municipal Signal Association
IPCEA	Insulated Power Cable Engineers' Association
ISA	International Society of Arboriculture
ISTEA	Intermodal Surface Transportation Efficiency Act
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation Systems
JAC	Joint Administrative Committee

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KCM	King County METRO
LED	Light Emitting Diode
LPI	Lighting Protection Institute
MBE	Minority Business Enterprise
MTCA	Washington Model Toxics Control Act
MSHA	Mine Safety and Health Act
MUTCD	Manual on Uniform Traffic Control Devices
MWBE	Minority and Women Business Enterprise
NACE	National Association of Corrosion Engineers
NAPA	National Asphalt Pavement Association
NCMA	National Concrete Masonry Association
NCSPA	National Corrugated Steel Pipe Association
NEC	National Electrical Code
NECA	National Electrical Contractors Association
NEMA	National Electrical Manufacturer's Association
NEPA	National Environmental Policy Act
NESC	National Electrical Safety Code
NETA	International Electric Testing Association
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NHS	National Highway System
NPCA	National Precast Concrete Association
NPDES	National Pollution Discharge Elimination System
NRMCA	National Ready Mix Concrete Association
NRCA	National Roofing Contractors Association
NSF	National Sanitation Foundation
NTCIP	National Transportation Communication for ITS Protocol
NTP	Notice to Proceed
NTPEP	National Transportation Product Evaluation Program
OMWBE	Office of Minority and Women's Business Enterprises
OSHA	Occupational Safety and Health Administration
PACP	Pipeline Assessment and Certification Program
PC	Purchasing and Contracting
PCA	Portland Cement Association
PDF	Portable Document Format
P/PCI	Precast/Prestressed Concrete Institute
PORT	Port of Seattle
PPI	Plastic Pipe Institute
PSCAA	Puget Sound Clean Air Agency
PW	Public Works
PW#	Public Works Number
RCA	Recycled Concrete Aggregate
RCW	Revised Code of Washington
REA	Rural Electrification Association
ROW	Right of Way
RRP	Railway Highway Grade Crossing Program
SCADA	Supervisory Control and Data Acquisition
SAC	Washington State Apprenticeship and Training Council
SAE	Society of Automotive Engineers
SBRC	Supplemental Bidder Responsibility Criteria
SCS	Soil Conservation Service

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SCL	Seattle City Light
SDCI	Seattle Department of Construction and Inspections
SDOT	Seattle Department of Transportation
SDS	Safety Data Sheet
SEPA	State Environmental Policy Act
SKCDPH	Seattle King County Department of Public Health
SMC	Seattle Municipal Code
SP	Spill Plan
SPP	Serial Port Protocol
SPR	Seattle Parks and Recreation
SPU	Seattle Public Utilities
SOP	Standard Operating Procedure
SSPC	Society of Protective Coatings
SSPC	Steel Structures Painting Council
STA	Seal of Testing Insurance
STCM	Seattle Traffic Control Manual
SWPPP	Stormwater Pollution Prevention Plan
TCM	Traffic Control Manager
TCP	Traffic Control Plan
TCS	Traffic Control Supervisor
TDP	Temporary Discharge Plan
TVSPP	Tree, Vegetation and Soil Protection Plan
UBI	Unified Business Identifier
UL	Underwriters Laboratory
UMTA	Urban Mass Transit Administration
USACE	United States Army Corps of Engineers
USCGS	United States Coastal and Geodetic Survey
USDA	United States Department of Agriculture
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
USPS	United States Postal Service
VCP	Vitrified Clay Pipe
WAC	Washington Administrative Code
WACA	Washington Aggregates and Concrete Association
WALP	Washington Association of Landscape Professionals
WAQTC	Western Alliance for Quality Transportation Construction
WBE	Women's Business Enterprise
WCLIB	West Coast Lumber Inspection Bureau
WISHA	Washington Industrial Safety and Health Administration
WMBE	Women or Minority Business Enterprise
WRI	Wire Reinforcement Institute
WSATC	Washington State Apprenticeship and Training Council
WSDOT	Washington State Department of Transportation
WSDSHS	Washington State Department of Social and Health Services
WSEM	Washington State Energy Management
WWPA	Western Wood Products Association

1-01.2(2) BID ITEMS OF WORK AND UNITS OF MEASUREMENT

Standard abbreviations are included on Standard Plan 002. Standard symbols are included on Standard Plan 003. When abbreviations are used in the Bid Form to denote Bid Items of Work and units of measurement, each abbreviated term has the meaning specified for it as noted in the subparagraph immediately above unless a Bid Item measurement or payment description specifies another meaning.

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1-01.3 DEFINITIONS

As used in this Contract, the terms listed below are defined as indicated. Unless the Contract specifically indicates otherwise, the definitions of electrical and electronic abbreviations, terms and phrases used in the Contract are those contained in the official edition of the IEEE Dictionary of Electrical and Electronic Terms.

Definitions for street designations and classifications are found in the current edition of Seattle's Rights of Way Improvements Manual. The manual applies solely to street Rights of Way and does not apply to Rights of Way dedicated solely for utility purposes.

ACCEPTABLE WORK SITE

A Work Site that is appropriate, productive, safe, free from bullying, hazing or harassment. An Acceptable Work Site is free from behaviors that may impair production or undermine the integrity of the work conditions including but not limited to job performance, safety, productivity, or efficiency of workers.

ADDENDUM

A document issued to all Bidders before the Bid Opening Date identified as an Addendum, which modifies or clarifies the Bid Documents and Contract.

ADDITIVE

Additional Work identified separately in the Bid, which may be awarded at the discretion of the Owner.

ADVERTISEMENT FOR BIDS

The official public notice soliciting Bids for Work and published in the City's official newspaper and on-line solicitation website.

AFFIDAVIT

A written document in which the signer swears under oath before a notary public or someone authorized to take oaths that the statements in the document are true.

AFFIRMATIVE EFFORTS

The good faith efforts for inclusion of women and minority-owned firms (WMBEs) documented in the Inclusion Plan form as part of a Bid.

AGREEMENT FORM

The Owner-provided form with authorized signatures of the Contractor and the Owner to Execute the Contract.

ALTERNATE

Work or Bid Items, identified separately in the Bid Documents, which permits a choice of different methods or Materials of construction for performing the same Work.

APPRENTICE

Any worker enrolled in an Apprentice Training Program.

APPRENTICE TRAINING PROGRAM

A program registered and in compliance with the Washington State Apprenticeship and Training Council as defined by RCW 49.04, WAC 296-05-011, and WAC 296-05-013.

ARCHITECT

An individual licensed and registered in the State of Washington to practice architecture.

AS-BUILT

Electronic files of the conformed Drawings incorporating all changes to the Work. Shop Drawings and supplemental Drawings must be included where relevant.

ASSISTANT

The Engineer's authorized representative assigned to make detailed inspection of the Work.

AWARD

The Owner's decision to accept the lowest responsive Bid of a responsible Bidder for the Work, and establish the Contract.

BASE BID

The sum of Bid Item amounts (extensions) or the lump sum Bid on the Bid Form, excluding Alternates, Additives, and Deductives.

BID

The price the Bidder offers, to perform the Work.

BIDDER

A business (sole proprietor, individual, partnership, firm, corporation, limited liability company or joint venture, etc.) submitting a Bid.

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BID DOCUMENTS

The parts of the proposed Contract which may include the Advertisement for Bids, Bid Form, Agreement Form, Project Manual, Drawings, Addenda and any other documents incorporated into the Contract by reference.

BID FORMS

The forms provided by the Owner on OpenGov that must be submitted with a Bid.

BID GUARANTY

Bid bond, cashier's check or certified check accompanying the Bid, which is the guarantee that the Bidder will enter into the Contract with the Owner to perform the Work if Awarded the Contract.

BID ITEM

A unit of Work that is to be performed as part of the project by the Contractor as detailed in the Contract.

CAPABILITY OR CAPABLE

The City's determination that a business is able to perform the Work in question.

CERTIFIED EROSION AND SEDIMENT CONTROL LEAD (CESCL)

A Contractor employee responsible for erosion and sediment control, water quality protection, and implementation of the Construction Stormwater and Erosion Control Plan (CSECP), who holds a Certificate of Training in Construction Site Erosion and Sediment Control from a course approved by the Washington State Department of Ecology.

CHANGE ORDER

A written order issued by the Engineer to the Contractor directing and/or authorizing a change to the Contract. A Change Order establishes the basis of payment and time adjustments for the Work affected by the change.

CITY

The City of Seattle.

COMMERCIALLY USEFUL FUNCTION

Any activity by the Contractor, Subcontractor, or Materialperson that, in the Owner's opinion, is included in the Contract and necessary to allow Work to progress.

COMMUNITY WORKFORCE AGREEMENT (CWA)

The CWA is the agreement executed between the Director, on behalf of the City, and signatory labor unions that represent the trades and crafts that have workers who typically perform on City public works projects.

CONTAMINATED MATERIAL(S)

Soil/material/debris/liquid that contains contaminant levels above the more stringent of their respective applicable MTCA Method A cleanup level, Method B cleanup level, or Table 749-2 level, all for unrestricted land use per current Chapter 173-340 WAC, or that contains asbestos, or that contains radionuclides above natural background levels as defined by WAC 173-340-200.

CONTAMINATED MATERIAL(S) NOT DESIGNATED AS DANGEROUS WASTE OR TSCA WASTE

Contaminated Material(s) that contains contaminants at levels below that which would cause it to be designated as Dangerous Waste(s) or TSCA Waste(s).

CONTRACT

The comprehensive written documents between the Owner and Contractor which contain the entire obligations of both parties including, but not limited to; the signed Agreement Form, Bid, conditions of the Contract, Project Manual, Drawings, Standard Specifications, Standard Plans, Addenda, certifications, supplemental agreements, Change Orders and all other documents specifically incorporated by reference.

CONTRACT PRICE

The total amount of the Contract, based on the Bid, with any adjustments, including all selected Alternates, Additives, or Deductives, and all applicable taxes.

CONTRACT TIME

The period of time established by the Contract within which the Work must be physically completed.

CONTRACTOR

The business contracting with the Owner to complete the Work.

CORE EMPLOYEE

An employee of an Open-Shop Contractor that meets the Core Employee criteria established under the CWA.

CORE WORKER

See Core Employee.

COVERED PROJECT

A City public works project with a project budget at or above $5M that is not federally funded, in a remote area or otherwise not subject to the CWA.

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CULVERT

Drainage Structure that may, or may not, directly support traffic and that extends across and beneath a highway, street, driveway, alley, arterial, or other public way.

DANGEROUS WASTE(S)

Solid wastes designated in WAC 173-303-070 through 173-303-100 as dangerous, or extremely hazardous or mixed waste. Dangerous Waste(s) includes all federal hazardous waste, plus certain wastes exhibiting characteristics based on toxicity or persistence.

DATES

1. Bid Due Date: The day and time the Bids are due.
2. Bid Opening Date: The day on which the Owner publicly opens and reads the Bids.
3. Execution Date: The date the Owner and Contractor enter into a Contract after receipt of the necessary bond, insurance, and any other required documents, as evidenced by the authorized signatures on the Agreement Form.
4. Notice to Proceed Date: The day on which the Contract Time starts. The Notice to Proceed Date is counted as the first Working Day of Contract Time.
5. Substantial Completion Date: The day the Engineer determines the Owner has full and unrestricted use and benefit of the completed Work, from an operational and safety standpoint. Only minor incidental Work, replacement of temporary substitute facilities, or correction or repair may remain for the Physical Completion of the Contract.
6. Physical Completion Date: The day the Owner determines that all Work is physically complete. Not all documentation required by the Contract and by law needs to be furnished by the Contractor by this date.
7. Completion Date: The day, certified in writing by the Owner, when all Work is determined to be complete and all obligations of the Contractor under the Contract are fulfilled. All documentation required by the Contract and by law must be furnished before establishment of this date.

DAY

Unless otherwise specified, day(s) are the same as Calendar Day(s).

1. Business Day: Any Day except Saturday, Sunday, or Holiday.
2. Calendar Day: The time period of 24 hours measured from midnight to the next midnight.
3. Non-Working Day: The following are Non-Working Days:
    a. Saturday
    b. Sunday
    c. Holiday
    d. A Day on which the Engineer issues a suspension order for an excusable delay or a Day declared an Unworkable Day.
    e. A Day the Contract specifically requires the Contractor to suspend the Work.
4. Working Day: A Day not otherwise defined as a Non-Working Day.
5. Unworkable Day: A Working Day that the Engineer declares to be unworkable because of unsuitable weather, or another condition beyond the control of the Contractor that prevents ongoing or scheduled work on the critical path.

DECLARATION

The statement on the Bid Form in which the Contractor acknowledges the terms and conditions of the Contract and receipt and understanding of Addenda.

DEDUCTIVE

A supplemental unit of Work or group of Bid Items identified separately in the Bid that may, at the discretion of the Owner, be deducted from the base Bid prior to Award.

DIRECTOR

The Director of Purchasing and Contracting, FAS.

DISADVANTAGED BUSINESS ENTERPRISE (DBE)

An OMWBE certified small business that is 51 percent or more owned by 1 or more individuals who are both socially and economically disadvantaged or, in the case of a corporation, in which 51 percent or more of the stock is owned by 1 or more such individuals; and whose management and daily business operations are controlled by 1 or more of the socially and economically disadvantaged individuals who own it.

DISPATCH

The process by which a union refers workers for employment to Contractors as provided in the CWA.

DRAWINGS

The graphic or pictorial form of the design, location, dimensions, Materials, and other information regarding the Work.

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DUAL BENEFITS

When Open-Shop Contractor or Subcontractor contributes into both an existing employer-sponsored benefit plans while also making required payments into a Trust Fund.

ECONOMICALLY DISTRESSED AREA, ECONOMICALLY DISTRESSED ZIP CODES

A geographic area defined by ZIP code and found by the Director to have a high concentration of individuals; 1) living at or below 200% of the Federal Poverty Level; 2) unemployed; and or 3) without a college degree, as compared to other ZIP codes. King County ZIP codes with a high density per acre of at least 2 of the 3 criteria will be identified as Economically Distressed Areas. There are 2 classes of such ZIP codes: tier 1 ZIP codes located within the City of Seattle and tier 2 ZIP codes located within King County and outside the City of Seattle.

ELECTRICAL SAFETY OBSERVER

The Assistant assigned to monitor electrical safety, unless indicated otherwise in the Contract.

ELECTRONIC SIGNATURE

An electronic sound, symbol, or process attached to or logically associated with a contract or other record and executed or adopted by a person with the intent to sign the record. Electronic Signature may include, but is not limited to, signatures produced through proprietary software programs such as DocuSign or Adobe Sign.

EMAIL HEADER

Data included in email messages identifying transaction date, time, sender, active email server identification and recipient of the message.

EMAIL TIME STAMP

The time which the sender transmitted the email as determined by the City's interpretation of the data embedded in the Email Header.

ENGINEER

The Owner's representative, or Assistant, who administers the Work of this project.

EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICES (ESCBMPS)

The required on-site construction practices and devices that prevent, reduce, or treat erosion and sedimentation and maintain surface water quality.

HELMETS TO HARDHATS

A nonprofit program that connects National Guard, Reserve, retired and transitioning active-duty military service members with skilled training and quality career opportunities in the construction industry.

HOLIDAY

Per SMC 4.20.190 and RCW 1.16.050, Holidays for the City of Seattle are:

1. First Day of January (New Year's Day)
2. Third Monday of January (Dr. Martin Luther King, Jr.'s Birthday)
3. Third Monday of February (President's Day)
4. Last Monday of May (Memorial Day)
5. June 19 (Juneteenth)
6. Fourth Day of July (Independence Day)
7. First Monday of September (Labor Day)
8. Second Monday of October (Indigenous Peoples' Day)
9. Eleventh Day of November (Veterans' Day)
10. Fourth Thursday of November and the Friday immediately following (Thanksgiving Day)
11. Twenty fifth Day of December (Christmas Day)

When any Holiday falls on a Sunday, the following Monday is considered a Holiday. When any Holiday falls on a Saturday, the preceding Friday is considered a Holiday. Holidays are Non-Working Days.

INCLUSION PLAN

The Contractor's plan provided on the Owner-provided form, that documents the proposed and/or guaranteed utilization of WMBE on the Contract.

INSPECTOR

See Engineer.

JOB SITE

See Project Site.

JOB AND TRAINING ADVISOR

The City employee or third party entity named by the City that facilitates the hiring of Priority Workers in collaboration with Contractors and Dispatch.

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JOURNEY-LEVEL

An individual who has sufficient skills and knowledge of an occupation, either through a formal Apprentice Training Program or through practical on-the-job work experience, to be recognized by a state or federal registration agency and/or an industry as being fully qualified to perform the work of the occupation. Practical experience must be equal to or greater than the term of apprenticeship.

LABORATORY

The materials Laboratory of the Engineer or such other laboratories authorized in writing by the Engineer.

LABOR HOURS

Hours performed on projects by workers who are subject to prevailing wages under RCW 39.12.

LETTERS OF ASSENT

The letter that is required of all Contractors and Subcontractors of all tiers working on Covered Projects that commits the Contractor and Subcontractor to be bound to the City of Seattle CWA.

LIQUIDATED DAMAGES

The amount stated in the Contract to be paid to the Owner by the Contractor, for each Working Day of delay in achieving the Substantial Completion Date and the amounts stated in the Contract to be paid after Substantial Completion and until the Physical Completion Date is achieved. Such obligation is not construed as a penalty, and may be deducted by the Owner from any payments which are due or become due to the Contractor.

MATERIALS

Any substance specified for use in the project that enters into and forms a part of the finished Work.

MATERIALPERSON

The supplier that furnishes material, supply, commodity, equipment, or manufactured or fabricated products and does not perform labor at the Project Site.

MINERAL AGGREGATE

Rock, gravel, sand or a blend thereof, with properties defined in the Standard Specifications.

NON-MANUAL POSITION

A job position on a public works project that is not primarily for the purpose of performing physical construction work, including but not limited to, superintendents, supervisors, staff engineers, quality control and quality assurance personnel, time keepers, mail carriers, clerks, office workers, messengers, guards, safety personnel, emergency medical and first aid technicians and other engineering, administrative supervisory and management employees.

NOTICE OF INTENT TO AWARD

Written notice from the Owner to the apparent low Bidder signifying acceptance of the Bid.

NOTICE TO PROCEED

Written notice from the Engineer to the Contractor authorizing and directing the Contractor to proceed with the Work stating the date on which the Contract Time starts.

ON-SITE ELECTRICAL LEAD

The Contractor's on-site representative responsible for and authorized to resolve electrical safety related issues including those raised by the Engineer, Assistant, or Electrical Safety Observer.

OPEN-SHOP APPRENTICE

An employee of an Open-Shop Contractor that meets the criteria established under Article XI, Section 2 of the CWA.

OPEN-SHOP CONTRACTOR

A Contractor that is not signatory to a collective bargaining agreement with a Union representing the trade(s) of the Contractor’s workers, also known as non-union Contractors.

OWNER

The City of Seattle.

PAYMENT AND PERFORMANCE BOND

The approved form of security, furnished by the Contractor and the Contractor’s Surety, guaranteeing faithful Contract performance and payment to persons supplying labor and Materials for the project. The Owner will provide the Payment and Performance Bond form to the Contractor.

PHYSICAL COMPLETION

See Dates.

PRE-APPRENTICE TRAINING PROGRAM

An education-based program, recognized by the State of Washington Apprenticeship and Training Council and endorsed by one or more registered apprenticeship sponsors, with a focus on educating and training students to meet or exceed minimum qualifications for entry into an Apprentice Training Program.

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PRIORITY HIRE

The Priority Hire ordinance (SMC Ch. 20.37) prioritizes workers living in economically distressed ZIP codes and preferred entry candidates for hire on Covered Projects and sets aspirational goals for hiring women and people of color.

PRIORITY WORKER

An individual prioritized for recruitment, training and employment opportunities because the individual is a Resident in an Economically Distressed Area.

PROJECT LABOR AGREEMENT

See Community Workforce Agreement.

PROJECT MANUAL

The compilation of the requirements for the Work related to a specific project. The Project Manual includes, but is not limited to, the requirements for Bids, Agreement Form, conditions of the Contract, Special Provisions, revised Standard Plans, and Addenda.

PROJECT SITE

The geographic location, defined in the Contract, where the Work is to be performed.

REAL PROPERTY

Land and improvements permanently affixed to the land.

RED-LINE DRAWINGS

Full size (at least 22” by 34”) prints or electronic files of the conformed Drawings used by the Contractor to mark-up and record changes to the daily Work.

RESIDENT

A person who provides evidence, to the satisfaction of the Director, demonstrating that the person lives at a particular address.

RECORD DRAWINGS

As-Built Drawings in AutoCAD or AutoCAD Civil 3D electronic format in accordance with the City of Seattle’s CAD Resource Website: www.Seattle.gov/util/CAD

RIGHT OF WAY

Real property secured and reserved for public or private transportation, utility, or other purposes.

SEWER

Any pipe, conduit, or Structure intended to carry sewage and other waste liquids, excluding discharges prohibited by SMC 21.16 (the side Sewer Code).

SHOP DRAWINGS

Working Drawings, shop plans, erection plans, falsework plans, framework plans, cofferdam, cribbing and shoring plans, bending diagrams for reinforcing steel, retaining wall designs, schematic diagram, or any other supplementary plans or similar information that the Contractor submits to the Engineer for acceptance.

SPECIAL PROVISIONS

Supplemental provisions and modifications to the Standard Specifications that apply to an individual project and that are designated by the Owner and found in the Project Manual.

SPECIFICATIONS

Written technical descriptions of materials, equipment, construction systems, standards, and workmanship that, with the Drawings and other Contract documents, detail the requirements for the Work.

STANDARD PLANS

The current edition of The City of Seattle Standard Plans for Municipal Construction adopted by the Owner as modified by updates found in the appendix of the Project Manual.

STANDARD SPECIFICATIONS

The current edition of The City of Seattle Standard Specifications for Road, Bridge, and Municipal Construction adopted by the Owner and supplemented by the current edition of the City of Seattle Traffic Control Manual for In Street Work.

STATE

The State of Washington.

STORM DRAIN

A pipe, conduit, or Structure intended to collect and convey rainwater and other permissible discharges as identified in SMC 22.800-22.808, the Stormwater Code.

STRUCTURES

Bridges, Culverts, walls, buildings, foundations, water tanks, transmission towers, cribbing, caissons, or cofferdams, and other similar features that are classified as Structures in the Contract.

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SUBCONTRACTOR

A business contracted to perform a portion of Work under the Contractor or subcontracted at any tier.

SUBSTANTIAL COMPLETION

See Dates.

SUPPLIER

See Materialperson.

SUPPLIES

Any substance or matter used or consumed in construction of the project and its appurtenances that do not become part of the Structure or improvement.

SURETY

A company that is bound with the Contractor to ensure:

1. Faithful performance on the Contract, and
2. Payment of laborers, mechanics, Subcontractors and Materialperson and all entities that source any provisions and Supplies for the Work.

TRAFFIC CONTROL MANUAL FOR IN STREET WORK (STCM)

The Seattle Traffic Control Manual (STCM), is the City of Seattle guide for Work within the Right of Way, used in conjunction with and as a supplement to the Manual on Uniform Traffic Control Devices (MUTCD), as modified and adopted by the Washington State Department of Transportation (WSDOT).

TRAINING PROGRAMS

Pre-apprenticeship and/or registered Apprenticeship Training Programs.

TSCA WASTE(S)

Soil/material/debris/liquid of any kind that contains polychlorinated biphenyls (PCBs) at a level that equals or exceeds 50 parts per million, and oil of any kind that contains PCBs at a level that equals or exceeds 2 parts per million. TSCA Waste(s) is regulated by the Federal Toxic Substances Control Act.

UNION

A representative labor organization whose members collectively bargain with employers to set the wages and working conditions in their respective trade or covered scope of work.

WATER MAIN

A water supply pipe for public or community use.

WMBE GOAL

The voluntary commitment by the Contractor for the Work that will be awarded, performed and paid to WMBEs.

WOMEN OR MINORITY BUSINESS (WMBE)

A business that self-identifies or is certified by the Office of Minority and Women's Business Enterprise (OMWBE) to be at least 51 percent owned by women and/or minority group members including, African Americans, Native Americans, Asians/Pacific Islanders, and Hispanics/Latinos.

WORK

The provision of all labor, Materials, equipment, Supplies, and everything needed to complete the project.

WORK SITE

The Project Site and any field or company offices used for the project, or other locations used in conjunction with the project where Work is performed.

SECTION 1-02 BID PROCEDURES AND CONDITIONS

1-02.1 RESPONSIBLE BIDDER

For a Bidder to be considered responsible, the Bidder must meet all criteria in this section and must provide the Supplemental Bidder Responsibility Criteria form (SBRC) along with any documentation necessary for the Owner to establish that the Bidder can meet expectations and perform the Work. The documentation must demonstrate that the Bidder is experienced in performing the Work based on the firm's completion of past work and the firm's compliance with legal and contractual requirements. The Owner may take whatever action is necessary to establish the ability of the Bidder to perform the Work to the Owner's satisfaction.

To be considered responsible, the Bidder must meet the following mandatory responsibility criteria:

1. At the time of Bid submittal, have a certificate of registration in compliance with Chapter 18.27 RCW;
2. At the time of Bid submittal, have a current State unified business identifier number;
3. If required by the business type, have industrial insurance coverage for the Bidders' employees working in Washington as required in Title 51 RCW, an employment security department number as provided in Title 50 RCW,

and a State excise tax registration number as provided in Title 82 RCW. If the Contractor has no employees, the Contractor must comply with the alternative election process and provide documentation under Title 50 and Title 51;

4. Not be disqualified from bidding on any public works contract under RCW 39.06.010 or 39.12.065 and not listed on the US Government's System of Award Management database (http://www.sam.gov/) with an active exclusion; and
5. Prior to Notice of Intent to Award, have received training on the requirements related to public works and prevailing wage by Labor and Industries or approved training provider per RCW 39.04.350, chapter 39.12. Bidders are exempt from training if Bidder has been in business with active unified business identifier number for 3 or more years and have performed work on 3 or more public works projects.
6. Meet the supplemental criteria in Section 1-02.2. (Apparent low Bidder only.)

The apparent low Bidder, see Section 1-03.1(3), must also demonstrate compliance with the following City requirements:

a. The Bidder must show substantial compliance with social equity Contract requirements on past projects or evidence to responsibly perform, including, but not limited to, compliance with the Inclusion Plan, Social Equity Plan, or Community Workforce Agreement.
b. The Bidder must have a current Seattle Business License and must be current on all Business and Occupancy Taxes pursuant to SMC 5.55.030 A, before Award when the Work is in the City of Seattle, the Bidder conducts business in the City of Seattle, or the Contractor owes Taxes to the City of Seattle.
c. The Bidder must not owe any monetary disincentive assessments or penalties regarding Apprentice Utilization on prior projects before Award.
d. The Bidder must be registered on the City of Seattle's Procurement Portal, powered by OpenGov, before Award: https://procurement.opengov.com/portal/seattle.
e. Equal Benefits (SMC 20.45): Except as may be provided in the Equal Benefits Program Rules, the apparent low Bidder must submit the Equal Benefits Declaration as part of the SBRC.
f. Labor Standards (SMC 14.16,14.17,14.19,14.20): Except as may be provided in the Office of Labor Standards rules, the Apparent Low Bidder must demonstrate compliance with the City's fair labor standards.
g. Campaign Contributions (SMC 2.04): The Bidder must not be found in violation of earning more than $250,000 in City contracts in the last fiscal year and contributed to a City elected official's campaign.
h. The Bidder must comply with any additional requirements as a condition of state or federal funding, loans, or grants for the Work.

The Bidder may request that the supplemental bidder responsibility criteria be modified. Such request must be submitted to PC via the submittal methods listed on the SBRC before 5:00 p.m., 5 Business Days before the Bid Opening Date. The request must be marked, Request to Modify Supplemental Bidder Responsibility Criteria – PW#_____. If the City determines a modification is necessary, an Addendum to the Bid Documents will be issued to identify the new criteria.

It is the sole opinion of the Owner if the Bidder is considered responsible. If the Owner determines a Bidder to be not responsible, the Owner will provide, by email or other writing, the reasons for the determination. The Bidder may protest the determination within the time period specified in Section 1-03.6 by presenting additional information to the Owner. The Owner will consider the additional information before issuing its final determination. If the final determination affirms that the Bidder is not responsible, the Owner will not Execute a Contract with any other Bidder until 2 Business Days after the Bidder determined to be not responsible has been sent the final determination.

Additionally, the Bidder must verify the mandatory and supplemental responsibility criteria for each Subcontractor. Likewise, a Subcontractor of any tier that hires other Subcontractors must verify responsibility criteria for each. Verification must include that each Subcontractor, during subcontract execution, meets the responsibility criteria listed in items in Section 1-02.1 and 1-02.2 and possesses an electrical or plumbing Contractor license, if required by Chapter 19.28 RCW, or an elevator Contractor license, if required by Chapter 70.87 RCW. This verification requirement and the responsibility criteria are included in every public works Contract and subcontract of every tier.

If the Bidder fails to supply documentation or falsely represents the information, the Owner may reject the Bidder as not responsible by taking the following actions:

1) Rejection of the Bidder's Bid under Section 1-02.14;
2) Revocation of the Award;
3) Termination of the Contract under Section 1-08.10; or
4) Proceeding with debarment under Section 1-08.10(8).

1-02.2 SUPPLEMENTAL BIDDER RESPONSIBILITY CRITERIA FORM (SBRC)

The apparent low Bidder must submit the SBRC and any additional documentation to PC within 3 Business Days of receipt of the request or as otherwise acceptable to PC. The documentation must detail the Bidder's, or Subcontractor's, experience with the precise experience requirements as stated in the Contract.

1. Compliance History

   The Bidder must answer questions on the SBRC demonstrating their compliance history and capabilities in performing these categories. The Owner may use a Bidder's past compliance history as part of the determination of responsibility.

2. Personnel

The Bidder certifies, by submitting the SBRC, that it will assign the named personnel to the Project. In the event it becomes necessary for the Bidder to substitute personnel during the life of the Contract, the following provisions apply:

a. Before substituting a new project manager or superintendent, the Contractor must submit for the approval of the Owner, a current resume for the new personnel documenting that the new personnel comply with the supplemental bidder responsibility criteria established for the project.

b. The Owner may suspend the project if the Contractor substitutes a project manager or superintendent without the Owner's approval. The Contractor is fully liable for the additional costs resulting from the suspension of work and no adjustments in Contract Time resulting from the suspension of work will be allowed.

3. Work Experience

If specific work experience criteria are required in the Project Manual, the Bidder must document on the SBRC that it meets the specified criteria.

The Owner will verify that the specified work experience criteria is met by the apparent low Bidder. It is the Bidder's responsibility to verify that the names and phone numbers provided for references are current to ensure the Owner's ability to contact references and verify Bidder work experience. If the Owner is unable to contact references to verify Bidder or Subcontractor experience due to circumstances beyond its control, the Owner reserves the right to determine work experience based on the information available to the Owner.

If the Project Manual contains additional project specific supplemental bidder responsibility criteria in the Special Provisions, the Owner will verify that those criteria are met by the apparent low Bidder.

1-02.3 ESTIMATED QUANTITIES

The quantities shown on the Bid Form are estimates, and are stated for Bid comparison purposes only. The Owner does not warrant, expressly or by implication, that the actual quantities of the Work will correspond with those estimated. The Engineer may increase or decrease the amount of any Bid Item of Work, or change the Work as necessary. Payment will be made on the basis of the actual quantities of each Bid Item of Work completed as specified in the Contract.

1-02.4 EXAMINATION OF BID DOCUMENTS AND PROJECT SITE

1-02.4(1) GENERAL

Bid Documents are available for download at: http://www.seattle.gov/purchasing-and-contracting/construction-contracting.

The Bidder is responsible for examining the Bid Documents. Submittal of a Bid is evidence that the Bidder has made these examinations and understands all requirements of the Bid process and for the performance of the Work. By submitting a Bid, the Bidder further warrants, agrees, and acknowledges that they:

1. Have taken all steps necessary to ascertain the full scope, nature, and location of the Work.
2. Have investigated and are satisfied as to the general and local conditions that can affect the Work and its cost, including but not limited to:
   a. Conditions bearing on acquisition, transportation, disposal, handling, and storage of materials;
   b. Availability of labor, materials, water, electric power, and roads;
   c. Uncertainties of weather, river stages, tides, or similar physical conditions at the Project Site;
   d. Conformation and condition of the ground;
   e. The equipment and facilities needed preliminary to and during Work; and
   f. Site and environmental conditions which by statute, law, or regulation require specific training and certifications for employees.
3. Are satisfied as to the character, quality, and quantity of surface and subsurface information or obstacles that may be encountered insofar as this information can reasonably be ascertained from an inspection of the Project Site, including Materials sites, as well as from the Bid Documents and other information made a part of this Contract.
4. Are satisfied that adequate time has been allowed for Physical Completion of the project.
5. Take responsibility for properly estimating the difficulty and cost of performing the Work.
6. Are familiar with and will comply with all federal, state, and local laws, ordinances; and regulations that might affect the Work or those engaged in the Work. The Bidder is not relieved of this obligation because of the Bidder's misunderstanding or ignorance of such requirements.
7. Are satisfied that their Bid Items prices reflect their cost for completing the Work, including Materials, labor, equipment, and costs including insurance and bonding.

The Bidder has a responsibility to ask about any perceived defect or ambiguity in the Bid Documents. Bidders who need an explanation or clarification of the Bid Documents must make this request in writing before 5:00 p.m. on that Thursday preceding the Bid opening. A claim will not be allowed if a Bidder failed to request clarification or if a reasonably prudent contractor would have discovered such defects or ambiguities while preparing their Bid.

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1-02.4(2) SUBSURFACE INFORMATION

If the Engineer has made a subsurface investigation of the Project Site of the proposed Work, the boring log data, soil sample test data, and geotechnical reports accumulated by the Engineer will be provided for inspection by the Bidders. The boring logs are part of the Contract. However, the Engineer makes no representation, guaranty, or warranty, expressed or implied, that:

1. The Bidder's interpretation from the boring logs or geotechnical reports is correct;
2. Moisture conditions and indicated water tables do not vary from those found at the time the borings were made;
3. The ground at the location of the borings has not been physically disturbed or altered after the boring was made; and
4. The conditions, materials, or proportions of the materials is consistent between the specific borings.

In addition to the above data, SDCI has geotechnical reports for private property located in an Environmentally Critical Area Geographically Hazardous zone if the private property has been under SDCI permit review. This data is available for the Contractor's review at: SDCI, Soils Reports, 700 Fifth Avenue, 22nd Floor, Seattle, WA 98104, (206) 684-8950.

The availability of subsurface information from the Engineer does not relieve the Bidder or the Contractor of any responsibility to make examinations and investigations as required by Section 1-02.4(1) and any other responsibility under the Contract, or as may be required by law.

1-02.5 FORM AND STYLE OF BID

A Bid must only be submitted on the Bid Form provided on OpenGov. A price must be submitted for each Bid Item listed.

The Bidder must not make a stipulation on the Bid Forms or qualify the Bid in any manner. A Bid amount must be included for every Bid Item listed on the Bid Form. A person authorized to legally bind the Bidder must provide an Electronic Signature on the Declaration page.

1-02.6 ADDENDA

If the Engineer determines modifications or clarifications to the Bid Documents are required before the Bid Opening Date, they will be provided by Addendum. Oral explanations, interpretations, or instructions are not binding on the Owner. Only modifications or clarifications issued by a written Addendum are binding. Notifications of Addenda and other project information will only be sent to official plan holders who downloaded or ordered documents through the City's official electronic Bid solicitation website, including plan centers that obtained documents through the website. A link to the current electronic Bid solicitation website is found at http://www.seattle.gov/purchasing-and-contracting/construction-contracting. All Bidders are encouraged to check the electronic Bid solicitation website for Addenda at least 24 hours before Bid Opening.

The Bidder must acknowledge receipt of each Addendum by checking the appropriate boxes on OpenGov.

1-02.7 BID GUARANTY

The Bid Guaranty must be equal to 5 percent of the maximum Bid amount that could be awarded based on the Bidder's Bid, including Base Bid, sales tax, Alternates, Additives, and Deductives, if applicable. A Bid will not be accepted or considered unless accompanied by a Bid Guaranty with power of attorney.

A Bid must be accompanied by a Bid Guaranty in the form of:

1. A certified or cashier's check payable to The City of Seattle; or
2. A Bid bond on the form issued by the Surety and accompanied by power of attorney.

Bid bonds must be issued by a Surety company that is authorized to do business in the State of Washington and appears on the current list of authorized insurance companies published by the Office of the Washington State Insurance Commissioner.

Bid bonds must be original and contain the following:

a. Project name and public works number (PW#);
b. The City of Seattle named as oblige;
c. The amount of the Bid bond stated as 5 percent of the maximum Bid amount that could be awarded (including sales tax);
d. The signature and title of the Bidder's officer who is legally authorized to bind the Bidder; and
e. The signature of the Surety's officer empowered to sign the bond and the power of attorney.

A Bid Guaranty must accompany all Bids. Bidders must upload a scanned copy of the wet signed and notarized Bid Guaranty through OpenGov as a PDF file. The Bidder must mail Bid Guaranty originals with a postmark no later than one Business Day following the Bid Opening Date. PC will not accept Electronic Signatures or electronic notarizations on the Bid Guaranty originals. Mail original Bid Guaranty documents to:

FAS - Purchasing and Contracting
City of Seattle
P.O. Box 94687

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Seattle, WA 98124-4687

A Bid may be declared non-responsive if a Bidder submitting an electronic Bid fails to mail a hard copy original of the Bid Guaranty with the required USPS postmark.

1-02.8 NONCOLLUSION REQUIREMENT

The Bidder declares by signing the Declaration that they have not, either directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free, competitive bidding in the preparation and submission of its Bid. The Bidder and other potential Bidders or participants in collusion may be declared not responsible under Section 1-02.14 and may be debarred under SMC Chapter 20.70.

1-02.9 BID SUBMITTAL

1-02.9(1) GENERAL

The Bid must be submitted through OpenGov by the time and date specified in the Advertisement for Bids or as modified by Addenda. The Bid, together with the Bid Guaranty and any other required documents due at the Bid submittal deadline, must be submitted through OpenGov. Any required documents that are due after the Bid submittal deadline must be emailed as a PDF file(s) to FAS_PWSecureBid@seattle.gov by the appropriate deadline; OpenGov cannot accept submittals after the Bid submittal deadline.

PC designates the official Bid clock. The Bidder is responsible for the timely submittal of the Bid. A Bid submitted or received after the Bid submittal deadline will not be accepted, unless determined by the Owner that the lateness was outside of the Bidder's control and that there is no bidding advantage to accepting a late Bid.

Bidders must submit Bids electronically through OpenGov by the Bid submittal deadline. PC will accept Electronic Signature for the Declaration and the Bidder/Subcontractor List, if applicable.

Email additional required documents due after the Bid submittal deadline as a PDF File(s) with a maximum individual file size of 15MB. Email additional required documents to FAS_PWSecureBid@seattle.gov by the appropriate deadline.

Identify both the email and the attached PDF file with the full Public Works Contract Number (PW#) and name of the Bidder (e.g. "PW# 2020-001 – Pat's Construction").

Bids must be entered and submitted by 2:00 PM through OpenGov on the Bid Opening Date. OpenGov will not allow any Bid submission after the 2:00 PM Bid submittal deadline. Any required documents that are due after the 2:00 PM deadline must be submitted by email as a PDF file(s) to FAS_PWSecureBid@seattle.gov.

The Email Time Stamp constitutes the official time for electronic submittal receipt for required documents that are due after the Bid submittal deadline and are submitted by email.

If mandatory pre-bid meetings were required as part of the Bid's solicitation, the Bidder's company must be represented on the pre-bid meeting sign-in sheet, or the Bid will not be accepted.

If the Bidder/Subcontractor List is required, it must be included with the Bid Forms as described in RCW 39.30.060.

1-02.9(2) CHANGE OF BID SUBMITTAL DATE

The Owner may change the date and time for Bid submittal. Notification of the change will be by Addendum.

1-02.9(3) BIDDER/SUBCONTRACTOR LIST

In compliance with RCW 39.30.060 for all projects estimated to cost $1,000,000 or more, all Bidders must complete and submit the Bidder/Subcontractor List, Section 0-01.5 of the Project Manual. The completed Bidder/Subcontractor list must identify the Subcontractors the Bidder will contract with for HVAC, plumbing, electrical, structural steel, or rebar installation work; or indicate the Bidder intends to self-perform the work, if awarded the Contract; or that category of work is not applicable. The Bidder/Subcontractor List may be submitted with the Bid Forms or separately within 1 hour of the time and date for Bid Submittal. The Bidder is responsible for the timely delivery of the Bidder/Subcontractor List.

The Bidder may list no more than 1 Subcontractor for each category of work, unless Subcontractors vary with Bid Alternates, Additives, or Deductives, in which case the Bidder must indicate on a separate Bidder/Subcontractor List which Subcontractor will be used for which Alternate, Additive, or Deductive.

If the HVAC, plumbing, electrical, structural steel, or rebar installation specialty is left blank, meaning either the name of a Subcontractor is blank or a checkbox is not checked, the City will accept the blank as self-performance. The Bidder is bound to self-performance of that specialty for the duration of the Project.

The Bid will be rejected as non-responsive if the Bidder/Subcontractor list is not provided. The Bidder/Subcontractor List must be submitted with the Bid Forms as described in RCW 39.30.060.

If awarded the Contract, the Bidder agrees to use the Subcontractors identified on the Bidder/Subcontractor List unless the City agrees to a substitution.

1-02.9(4) INCLUSION PLAN

For all public works projects having an Engineer's Estimate of $300,000 or more, unless waived by PC, all Bidders must complete and submit the Inclusion Plan, Section 0-01.4 of the Project Manual, with the Bid. A Bid will be rejected as non-

responsive for failure to submit a completed Inclusion Plan. The Bidder's completed Inclusion Plan will be given points to determine responsiveness, as directed in the Inclusion Plan.

For the Inclusion Plan, the project type and past performance of WMBE utilization rates will be included in the Advertisement and Project Manual.

1-02.10 MODIFICATION OR WITHDRAWAL OF BID

After submitting a Bid, but prior to the Bid submittal deadline, a Bidder may either (1) withdraw or (2) revise its Bid through OpenGov.

1-02.11 ALTERNATE, ADDITIVE, DEDUCTIVE

The Owner reserves the right to arrange the Bid Form with Alternate, Additive, and/or Deductive items in any order. The Bidder must Bid on all Alternates, Additives, and Deductives in the Bid Form.

1-02.12 PUBLIC OPENING OF BIDS

Bids submitted through OpenGov will be opened and read aloud via Microsoft Teams following the 2:00 PM Bid submittal deadline specified in the Advertisement for Bids or in an Addendum. There is no in-person Bid opening.

Microsoft Teams' call-in information is:

1. Phone number to connect:
    a. 1-206-686-8357 (Seattle) or (United States)
2. Meeting Number ID: 190 706 876# through OpenGov.

1-02.13 IRREGULAR BIDS

The Owner has the right to review Bids for material irregularities. If the Owner determines a Bid to be irregular and rejects it, notification will be sent to the Bidder in writing containing the reason for the determination.

A Bid will be considered irregular and non-responsive if:

1. The authorized Bid Forms are not used;
    a. The completed Bid Forms contains any unauthorized additions, deletions, alternate Bids, or conditions;
    b. The Bidder did not Bid on all Alternates, Additives, or Deductives, when required;
    c. The Bid Guaranty is not included with the Bid;
    d. For projects estimated to cost $1,000,000 or more, the Bidder did not comply with the Bidder/Subcontractor list requirements, see Section 1-02.9(3), Bidder/Subcontractor List;
    e. The Bid does not constitute a definite and unqualified offer to comply with the material terms of the Bid invitation;
    f. The Inclusion Plan is not submitted with the Bid when required; or
    g. The Inclusion Plan does not receive the minimum score as identified in the plan to be considered responsive when submitted with the Bid when required.
2. A Bid may be considered irregular and non-responsive if:
    a. The Bid Guaranty is not complete or not sufficient;
    b. Any of the Bid Item prices are excessively above or below the amount of a reasonable Bid, to the potential detriment of the Owner;
    c. A lump sum Bid is excessively lower than other Bids;
    d. Receipt of Addenda is not acknowledged;
    e. The Bidder is a member of a joint venture or partnership and the joint venture or partnership submits a Bid for the same project. In such an instance, both Bids may be rejected;
    f. The Bid is not properly Executed; or
    g. Proof of license for named subcontractors (if applicable) is not provided per RCW 39.30.60.

1-02.14 DISQUALIFICATIONS OF BIDDERS

A Bidder will be deemed not responsible and its Bid rejected if:

1. The Bidder does not meet the mandatory responsibility criteria in RCW 39.04.350(1) as amended and as specified in Section 1-02.1;
2. The Bidder (apparent low Bidder only) does not meet the Supplemental Bidder Responsibility Criteria as specified in Sections 1-02.1 and 1-02.2, did not provide the completed and signed SBRC or required documentation to evaluate the Bidder qualifications, or fails to disclose or submits false or misleading information on the SBRC or in the attached documentation;
3. Evidence of collusion exists with any other Bidder or potential Bidder; or
4. The Bidder failed to attend a mandatory pre-bid conference, if applicable.

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A Bidder may be deemed not responsible and its Bid rejected if:

a. More than 1 Bid is submitted for the same project from a Bidder under the same or different names;
b. An unsatisfactory performance record exists as shown by past or current Work for the Owner, or for others, as judged from the standpoint of the conduct of the Work, environmental or safety compliance records, workmanship, progress, social equity, Community Workforce Agreement, or equal employment opportunity practices; or termination for cause;
c. The Bidder has failed to settle bills for labor or Materials on past or current contracts;
d. The Bidder has failed to complete a public contract;
e. The Bidder has been convicted of a crime arising from a previous public contract;
f. The Bidder is unable, financially, or otherwise, to perform the Work; or
g. For any other reason deemed proper by the Owner.

The Owner will notify the Bidder by email or other writing if the Bidder is determined to be not responsible under this Section.

SECTION 1-03 AWARD OF CONTRACT

1-03.1 CONSIDERATION OF BIDS

1-03.1(1) BID TABULATION

If a minimum Bid amount has been established for any item and the Bidder's unit or lump sum price is less than the minimum specified amount, the Owner will revise the unit or lump sum price to the minimum specified amount and recalculate the extension and/or the total Bid price.

1-03.1(1)A RECIPROCAL PREFERENCE FOR RESIDENT CONTRACTORS

Per RCW 39.04.380, a Bid which is received from a nonresident Contractor from a state that provides a percentage bidding preference, a comparable percentage disadvantage must be applied to the Bid of that non-resident Contractor. The comparable percentage disadvantage will be per the Contractor's resident state. A non-resident Contractor will be one who, at the time of Bid, does not have an office located in the State of Washington. The resident state is the state in which the Contractor was incorporated or where the Contractor's business entity was formed.

For the purpose of determining the apparent low Bidder, the Owner will multiply the non-resident Contractor's Bid amount by the comparable percentage disadvantage (CPD). The Bid amount is the total of the Base Bid and all selected Alternates, Additives, or Deductives to be awarded. The Owner will add the product of the CPD percentage and the Bid amount to the nonresident Contractor's Bid amount, which determines the nonresident disadvantaged total Bid pertaining to the nonresident Contractor to be used for comparison of competing bids. The nonresident disadvantage total will be compared to the resident Contractor's Bid amount. The calculated lowest total is the lowest Bid.

1-03.1(1)B IDENTICAL BID TOTALS

If two or more responsive Bids are exactly equal, in order to establish the apparent low Bidder, the winning Bid will be determined by random draw among the equal Bids.

1-03.1(2) CLAIM OF ERROR AND RELIEF OF AWARD

A Bidder who wishes to claim error or miscalculation of their Bid and would like to withdraw their Bid after the Bids have been opened, must submit a signed statement, accompanied by copies of the worksheets used in the Bid preparation, requesting to withdraw. The statement must describe the error, or circumstance, and certify that the worksheets are copies of originals used in the preparation of the Bid. The statement and the worksheets must be submitted to: Purchasing and Contracting, City of Seattle, Department of Finance and Administrative Services, 700 Fifth Avenue, Seattle Municipal Tower, Suite 4350 Seattle, WA 98104-5008, or by email to FAS_PW_Admin@Seattle.gov by 5:00 p.m. the next Business Day or as acceptable to the Owner.

The Owner will determine the validity of the claim of error. If the Owner concurs, the Bidder will be relieved of responsibility of Award, the Bid will be withdrawn, and the Bid Guaranty will be returned. Thereafter, at the discretion of the Owner, all Bids may be rejected, or Award made to the responsible Bidder with the next lowest responsive Bid. A low Bidder who claims error is prohibited from bidding on the same project if the project is re-bid.

1-03.1(3) DECLARATION OF THE APPARENT LOW BIDDER

The Owner will evaluate all Bids to determine the apparent low Bidder. The apparent low Bidder is the Bidder meeting the mandatory bidder responsibility criteria and offering the lowest responsive Bid.

The lowest Bid will be determined by the sum of the Base Bid, with Bid Item price extensions corrected where necessary, plus any Alternates, Additives, and/or Deductives that the Owner decides to include in the Contract Price. Alternates, Additives, and/or Deductives may be selected in any order that the Owner determines to be within available funds.

The Owner will determine if the Bidder providing the lowest Bid meets the mandatory responsibility criteria specified in Section 1-02.1

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Once the Owner has determined the apparent low Bidder, all Bidders will be notified through the City's on-line bidding website.

1-03.1(4) PRE AWARD INFORMATION AND RIGHTS OF THE OWNER

The apparent low Bidder must submit the SBRC described in Section 1-02.2 for Owner evaluation. The Owner will also evaluate if the supplemental responsibility criteria in Section 1-02.1 are met. In addition, the apparent low Bidder under consideration for Award may be required to furnish:

1. A complete statement as to the origin, composition, and manufacture of any and all Materials to be used in the project, together with samples which may in turn be subjected to tests to determine their quality and fitness for the Work, as provided for in the Contract.
2. A critical path schedule in the form required by the Engineer showing the order of the Work and the time required on the various phases of the Work.
3. A breakdown of costs assigned to any Bid Item or a schedule of values for lump sum Bids.
4. Any additional information requested by the Owner to understand the Bid price or ascertain the Bidder's general ability to perform the Work.
5. A Social Equity Plan.

In addition to such other rights as may be reserved elsewhere in the Contract, the Owner reserves the right to:

a. Reject any or all Bids at the Owner's discretion;
b. Re-advertise for Bids;
c. Waive informalities or immaterial irregularities in the Bidding and Award processes;
d. Accept the lowest responsive Bid of a responsible Bidder;
e. Correct arithmetical errors in a Bid;
f. Cancel the Work; and
g. Award such Alternate, Additive, or Deductive, as may be set forth in the Bid Form in the order most advantageous to the Owner.

1-03.2 AWARD OF CONTRACT

After the Owner has determined that the apparent low Bidder has met all of the mandatory and supplemental bidder responsibility criteria, the Owner will provide Notice of Intent to Award to all Bidders through the City's official Bid solicitation website.

The Owner will endeavor to Award the Contract within 60 Days after the Bid Opening Date. If the Contract is not awarded within that 60 Day period, a Bidder may withdraw their Bid in writing at any time on or after the 60 Days. All Bids will otherwise continue to be eligible for consideration until the Award of the Contract.

1-03.3 REQUIRED DOCUMENTS TO ESTABLISH THE EXECUTION DATE

Within 10 Business Days of issuing the Notice of Intent to Award, unless extended by mutual agreement, the apparent low Bidder must submit to PC: proof of insurance, fully executed original Payment and Performance Bond, Retainage Bond if applicable, and the original signed Agreement Form. The apparent low Bidder must also submit the Social Equity Plan as specified in Section 1-03.3(4).

1-03.3(1) EVIDENCE OF INSURANCE

The apparent low Bidder must submit to PC the evidence of insurance as required in Section 1-07.18. E-mail delivery is acceptable to FAS_PW_Admin@Seattle.gov.

1-03.3(2) PAYMENT AND PERFORMANCE BOND

The apparent low Bidder must provide to PC an original, executed Payment and Performance Bond for the awarded Contract Price. The Payment and Performance Bond must:

1. Be on a form furnished by the Owner;
2. Be signed by the principal and notarized;
3. Be signed and notarized by an approved Surety or Sureties that:
   a. Is registered with the Washington State Insurance Commissioner;
   b. Appears on the current Authorized Insurance List in the State of Washington published by the Office of the Insurance Commissioner;
   c. Has a current rating of at least A-VII in A.M. Best's Key Rating Guide or is included in the U.S. Department of the Treasury's Listing of Approved Sureties (Circular 570); and
4. Be accompanied by an original power of attorney document with the same date as the notarization by the Surety.

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The Owner may require the Surety or Sureties named on the Payment and Performance Bond to appear and qualify itself. Whenever the Owner determines the security to be inadequate, the Owner may require in writing that the Contractor furnish additional security to cover any remaining Work. No payments will be made until the added security is furnished.

1-03.3(3) AGREEMENT FORM

The apparent low Bidder must submit to PC the original Agreement Form signed by a person authorized to bind the Bidder's business based on the business entity and/or Governing Persons listed on the Washington State Secretary of State website.

After the Owner has countersigned the Agreement Form, establishing the Execution Date of the Contract, the Owner will forward a copy of the fully executed Agreement Form to the successful Bidder (the Contractor.)

No physical work is allowed within the Project Site or within sites furnished by the Owner until the Notice to Proceed has been provided to the Contractor as specified in Section 1-08.4. The Contractor bears all risks for any work begun before the issuance of the Notice to Proceed except for submittal and procurement work as specified in Section 1-08.4.

1-03.3(4) SOCIAL EQUITY PLAN

The apparent low Bidder must submit to PC a completed Social Equity Plan within 3 Business Days of the Owner's issuance of the Notice of Intent to Award. A completed plan must include all sections applicable to the project including the Inclusion Plan Supplement, Apprenticeship, and Workforce Projections when required. The Social Equity Plan must indicate the firms and scopes with estimated dollars for all WMBE subcontractors, and must, if applicable, list all apprentice trade assignments and estimated hours. See Section 1-07.11. The apparent low Bidder should contact PC for help preparing the Plan to ensure completeness. The Social Equity Plan must be approved by PC prior to the Execution Date.

1-03.4 FAILURE TO EXECUTE THE CONTRACT

The Bidder's Bid Guaranty is forfeited if the Bidder to whom the Award was made fails to:

1. Execute the Agreement Form within the required time period; or
2. Furnish satisfactory bonds and insurance within the required time period.

In such case, the Owner may then Award the Contract to the second lowest responsible Bidder. If the second lowest responsible Bidder fails to execute the Agreement Form and furnish satisfactory bonds and insurance within 10 Business Days after Notice of Intent to Award has been made to the second Bidder, or within the time period mutually agreed on by the Owner and second Bidder, the second Bidder's Bid Guaranty will also be forfeited. The Contract may continue in a like manner to the remaining responsible Bidders until the Agreement Form is executed and bonds and insurance furnished by a responsible Bidder or the remaining Bids are rejected.

1-03.5 RETURN OF BID GUARANTY

If the Bid Guaranty submitted by unsuccessful Bidders is in the form of a certified or cashier's check, the funds will be returned after the Execution Date.

The Bid Guaranty of the apparent low Bidder submitted in the form of a check will be returned after the Contract Execution Date. A Bid Guaranty in the form of a bond from the apparent low Bidder must be filed with the Executed Contract.

1-03.6 PROTESTS

A Bidder may protest a determination or action of the Owner. Any protest must be filed in writing by 5:00 p.m. on the second Business Day after notification such as:

1) A Notice of Intent to Award, see Section 1-03.2.
2) A notice that a Bid is non-responsive, see Section 1-02.13.
3) A notice that a Bidder is not responsible, see Section 1-02.1.

All such protests must be in writing and submitted to the Director. The protester accepts all risks of the delivery method they choose. The Owner is not responsible to assure the protest is received by PC within the protest deadlines. If PC does not receive the protest in a timely manner, the protest may be refused.

Submit the protest to: Director, Purchasing and Contracting, Department of Finance and Administrative Services.

Physical Address:
City of Seattle
Seattle Municipal Tower
700 Fifth Ave., Suite 4350
Seattle, WA 98104-5008

By mail, or email:
City of Seattle

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Department of Finance and Administrative Services – Purchasing and Contracting
PO Box 94687
Seattle, WA 98124-4687Email: FAS_PW_Admin@Seattle.gov

To be considered, the protest must comply with these requirements:

1. The protester must have submitted a Bid.
2. The protest must not be on a matter which should have been known to the Bidder before the Bid deadline, including matters specified in Section 1-02.4.
3. The protest must allege:
   a. A matter of bias, discrimination, or conflict of interest;
   b. Errors in responsiveness or responsibility; and/or
   c. Non-compliance with procedures described in the Bidding Documents.
4. All protests must be in writing and state that the Bidder is submitting a formal protest. A notice that a Bidder intends to protest does not reserve the right to protest. The Bidder must file a comprehensive protest within the required deadlines, following the proper format. A casual inquiry, complaint, or protest that does not comply with the form, content, or deadlines herein may not be acted on as a protest. Failure to provide any of the following information may result in refusal of the protest:
   a. Company name, mailing address, phone number, and name of company individual responsible for submission of the protest;
   b. Specify the Public Works Number (PW#) and project name;
   c. State the specific action or decision protested;
   d. Indicate the basis and support for the protest including specific facts and all documentation to support the protest. Additional documentation or information regarding any portion of the bidding or Award process will not be accepted after the protest submittal;
   e. Indicate what relief or corrective action the Bidder believes the Owner should make;
   f. Demonstrate that the Bidder made every reasonable effort within the bidding process to resolve the issue, including asking questions, attending the pre-bid conference, seeking clarification, requesting addenda, and otherwise alerting the Owner to any perceived problems; and
   g. Be signed by an authorized agent of the company.

The Director, or designee, of Purchasing and Contracting will review and decide all such protests. The Director's decision on the protest is final and exhausts all administrative remedies.

SECTION 1-04 SCOPE OF WORK

1-04.1 INTENT OF THE CONTRACT

The intent of the Contract is to prescribe a complete Work. Omissions from the Contract of details of the Work that are necessary to carry out the intent of the Contract do not relieve the Contractor from performing the omitted Work. The Contractor must include all costs of completing the Work in the Bid Item prices. Unless otherwise specified, the Contractor is responsible for the means, methods, techniques, sequences, and procedures of construction within the Contract requirements.

1-04.1(1) BID ITEMS INCLUDED IN THE BID

The Contractor must provide all labor, Materials, tools, equipment, transportation, Supplies, and incidentals required to complete all Work.

1-04.1(2) BID ITEMS NOT INCLUDED IN THE BID

Where the Contract requires Work that is not listed as a Bid Item in a payment section of the Contract, then the costs are incidental and included within the Bid Item prices of the various Bid Items in the Contract. If Work is performed and a Bid Item for that Work is not included in the Bid Form but is found in the payment section of the Contract, then payment will be as specified in Section 1-04.3.

No separate or additional payment will be made for Work which is incidental to other Bid Items specified in the Contract or is an obvious defect or ambiguity in the Contract under Section 1-02.4.

1-04.2 COORDINATION OF CONTRACT DOCUMENTS

All parts of the Contract are essential and complementary. A requirement occurring in 1 is binding as though occurring in all. The Contractor must provide any Work or Materials clearly implied in the Contract even if the Contract does not mention it specifically. The Contractor must notify the Engineer immediately, in writing, if the Contractor finds:

1. A discrepancy between various parts of the Contract;
2. An error or omission in the Drawings; or

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3. A discrepancy in the layouts and instructions provided by the Engineer.

The Contractor must not proceed with any Work affected by such discrepancy, error, or omission until directed to do so by the Engineer.

In the event of any conflicting provisions or requirements between the component parts of the Contract, the component parts of the Contract take precedence in the following order:

a. Change Orders
b. Agreement Form
c. Addenda
d. Special Provisions included in the Project Manual
e. Seattle City Light guidelines, standards, or procedures referenced in the Contract or included in the Appendix of the Project Manual
f. Drawings
g. Standard Plan updates in the appendix of the Project Manual
h. The current version of the Standard Specifications at the time of Bid opening
i. The current version of the Standard Plans at the time of Bid opening
j. Inclusion Plan
k. Supplemental Bidder Responsibility Criteria

This order of precedence does not apply when Work is required by one part of the Contract but omitted from another part or parts of the Contract. The Work required in one part must be furnished even if not mentioned in other parts of the Contract.

Any electronic version of the Standard Specifications and the Standard Plans is for informational purposes only. Should any discrepancy exist between the hard copy version of the Standard Specifications and electronic versions of the Standard Specifications, the hard copy version Standard Specifications take precedence over all other versions.

Written dimensions take precedence over scaled dimensions.

If any part of the Contract requires Work that does not include a description for how the Work is to be performed, the Work must be performed per standard trade practices. For purposes of the Contract, a standard trade practice is one having such regularity of observance in the trade as to justify an expectation that it will be observed by the Contractor in doing the Work.

In case of any ambiguity or dispute over interpretation of the provisions of the Contract, the decision of the Owner is final as specified in Section 1-05.1.

1-04.3 CHANGES

As the Work proceeds, the Engineer may, at any time and without notice to the Surety or Sureties, change the Work. Changes to the Work do not invalidate the Contract or release the Surety. The changes may include:

1. Deleting any part of the Work;
2. Increasing or decreasing quantities;
3. Altering Specifications, designs, or both;
4. Revising the way the Work is to be done;
5. Adding extra Work;
6. Altering facilities, equipment, Materials, services, or sites provided by the Engineer; or
7. Ordering the Contractor to speed up or delay the Work.

If changed Work increases the awarded Contract Price by more than 25 percent or if the Owner specifically requests the Surety's consent, the Contractor must obtain and furnish to the Owner the written consent of the Surety or Sureties in a form acceptable to the Owner.

Changes in the Work will be incorporated into the Contract by Change Order. The exception is that a Change Order is not required for changes noted on field stakes or variations from estimated quantities that are less than 25 percent of the original Bid quantity. Changes noted on field stakes or variations from estimated quantities that are less than 25 percent of the original Bid quantity will be paid at the Bid Item prices that apply. The Contractor must respond immediately to changes shown on field stakes and proceed with the Work without waiting for further notice.

The Contractor accepts all terms and requirements of a Change Order by endorsing the Change Order, writing a separate acceptance, or not disputing a Change Order as provided for in Section 1-04.4.

There may be Change Orders which change the Work or the Contract without resulting in a change in the Contractor's costs or time to do the Work. Such Change Orders are commonly referred to as 'no cost' Change Orders.

If the Engineer determines that a change increased or decreased the Contractor's costs or time to do any of the Work, including unchanged Work, the Engineer will make an equitable adjustment to the Contract. If the Contractor believes that any written directive or change increased or decreased the Contractor's costs or time to do any of the Work, and the Contract has not been equitably adjusted by the Engineer, the Contractor must file a dispute as specified in Section 1-04.4. If the Contractor

believes they have encountered differing Project Site conditions (changed conditions), the Contractor must comply with the process specified in Section 1-04.6. In general, the Engineer will seek the Contractor's agreement on the equitable adjustment; however, if the parties cannot come to an agreement, the Engineer will unilaterally determine the total price of the equitable adjustment as specified in Section 1-09.4 and, if applicable, Section 1-08.8. An equitable adjustment for deleted work will be made as specified in Section 1-09.5. An equitable adjustment for an increase or decrease exceeding 25 percent of the original quantity of any Bid Item, will be made as specified in Section 1-04.5. The Engineer's decision concerning an equitable adjustment of costs and time is final unless the Contractor files a dispute and the dispute or a subsequent claim is upheld as specified in Section 1-04.4.

The Contractor must proceed with the Work upon receiving:

a. A written Change Order approved by the Engineer; or

b. A written directive from the Engineer.

1-04.4 DISPUTE AND CLAIMS RESOLUTION PROCESS

This Section describes dispute and claim resolution processes. The scope of the dispute set forth in the written dispute notice will direct and limit the scope of all subsequent claim, mediation, or litigation on the subject matter, and the Contractor is not allowed to enlarge the scope of any claim beyond that originally presented in the written dispute notice. All subcontract agreements will contain the same provisions as this section in its entirety. All disputes must be resolved prior to final payment.

1-04.4(1) DISPUTE RESOLUTION SEQUENCE

The dispute resolution process sequence is: dispute, claim, mediation, litigation, in that order. The Contractor agrees to follow this sequence, and failure to do so constitutes a waiver of any right to dispute or to claim for additional time or additional payment for the disputed Work.

All disputes must start with the delivery of written notice to the Engineer. The Engineer will evaluate the notice and make a written decision on the matter as specified in Section 1-04.4(2). If the Contractor disagrees with the decision, in whole or in part, the Contractor may file a claim as specified in Section 1-04.4(3). If the Engineer denies the claim, the Owner and Contractor must at the Contractor's request, go to mediation as specified in 1-04.4(4). If the claim is not resolved at mediation, the Contractor may file suit in the King County Superior Court at Seattle, WA as specified in Section 1-04.4(5).

1-04.4(2) DISPUTES

If the Contractor, or Subcontractor, disagrees with a determination by the Owner, or any Change Order, including any written directive by the Engineer, the Contractor must notify the Engineer in writing that it disputes the decision. Notification must be delivered before the close of the third full Working Day following the date the Engineer issued the Change Order or written directive.

In the event that the dispute involves quantities, the written dispute notice must be filed before the placement of the changed quantities and not later than the close of the second full Working Day following the date the Engineer issued the Change Order or written notification. Failure by the Contractor to timely furnish notice of a dispute waives the right to make any further dispute or claim regarding the subject.

The written dispute notice must identify the Change Order, Owner's determination or other Engineer's directive being disputed and a brief explanation of the basis for the dispute.

The Engineer may issue a written decision or may ask in writing for further information.

If the Engineer asks for further information, the Contractor must, within 10 Working Days of the date of that request, furnish a dated, signed written supplemental statement containing:

1. The date of the supplemental written statement;
2. The date of the directive to perform the disputed Work;
3. The nature and circumstances which caused the dispute;
4. The Contract provisions that relate in any way to the dispute;
5. The estimated additional dollar cost, if any, of performing the disputed Work and how that estimate was determined, in detail;
6. An analysis of the accepted critical path schedule in effect at the time the dispute arose, showing the schedule change or disruption, if the Contractor is asserting a schedule change or disruption; and
7. Any additional information the Engineer requests.

The Contractor may request an extension of time to furnish the additional written information. The Engineer will determine if such additional information would be helpful and if the Engineer determines it would be helpful, the Engineer will specify a reasonable extension of time. Any extension must be approved in writing by the Engineer.

Within 10 Working Days from the date the Contractor filed the dispute or the receipt of requested information, the Engineer will issue a written decision regarding the dispute. At the Engineer's sole discretion, the Engineer may furnish written notice to the Contractor extending the time for the decision for a period not to exceed 20 additional Working Days.

If the Engineer rejects any or all of the Contractor's dispute, the Engineer's notice will contain the reasons for the rejection. Payment for approved Work will be made as specified in Section 1-09.4. In the event that the Engineer fails to

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decide the dispute within the 10 Working Days, unless extended by the Engineer, the Contractor may deem the dispute rejected and file a claim as specified in Section 1-04.4(3).

The dispute does not relieve the Contractor from the obligation to promptly proceed with the Work, including the disputed Work. The Contractor must timely perform all Work unless directed in writing by the Engineer to stop work in whole or in part. When performing any disputed Work, the Contractor must keep complete records of actual costs and actual time incurred, identifying extra costs and extra time associated with the disputed Work.

1-04.4(3) CLAIMS

Both the Owner and the Contractor have an interest in the prompt and fair resolution of claims. The purpose of the claims provisions of this Contract is to create a clearly defined process intended to fairly resolve claims at the earliest possible point in time without unnecessary delay or expense, including the expense of administration, mediation, or litigation. The Contractor must only pursue administrative resolution of any claim with the Engineer or Assistant.

In order for the Engineer to accurately evaluate and decide claims, the Contractor is responsible for presenting all relevant information in support of a claim at the claims stage, including the information required in this Section. The Contractor is not permitted to present information known or available to the Contractor (including Subcontractors and Suppliers), schedules or schedule logic, or basis of the dispute, at the mediation or litigation stage, which was not presented to the Engineer at the time the claim was presented.

If the Contractor disagrees with the Engineer's decision as specified in Section 1-04.4(2), the Contractor may file a claim as provided in this Section.

Claims of less than $50,000 must be filed within 10 Working Days of the date of the Engineer's written notice under Section 1-04.4(2).

Claims equal to or greater than $50,000 must be filed within 20 Working Days of the date of the Engineer's written notice.

The Contractor may request an extension for filing a claim. Any extension must be approved in writing by the Engineer. A written request for 10 additional Working Days, or less, will be automatically granted.

The Contractor waives any claim for additional payment if a claim is not filed as provided in this Section.

All claims must be in writing, contain sufficient detail to enable the Engineer to ascertain the basis and amount of the claim, be certified by the Contractor as stated below, and be filed with the Engineer.

No claim will be allowed after the Completion Date.

At a minimum, each claim must include the following information:

1. The date of filing the claim.
2. A detailed factual statement supporting the claim, including all relevant dates, locations, and Bid Items of Work affected by the claim.
3. The name and title of each individual involved in or knowledgeable about the subject of the claim.
4. The specific provisions of the Contract which support the claim and a statement of the reasons why such provisions support the claim.
5. If the claim relates to a decision of the Engineer in which the Contract provides that the Engineer's decision is final, the Contractor must set out in detail all facts supporting its position relating to the decision of the Engineer.
6. A copy of the original, signed notice of dispute, as well as a copy of any supplemental documentation provided to the Engineer and a copy of any written communication from the Engineer regarding the dispute.
7. Copies of all information that relates to the subject of the claim, including diaries, meeting minutes, notes, or field records.
8. Copies of any additional documents that support the claim. Manuals which are standard to the industry governing the Work in which the claim is being made may be included by reference; however, the Contractor must clearly state which part or parts of the industry standard the Contractor is relying upon.
9. If an extension of Contract Time is sought, the following information must also be provided:
    a. The specific Days and dates for which it is sought.
    b. The specific reasons the Contractor believes a time extension should be granted.
    c. The Specifications of Section 1-08.8 under which an extension is sought.
    d. The Contractor's written explanation of the reason for the requested change including the method of analysis used and where appropriate referring to the relevant schedules; supporting documents such as look-ahead, As-Builts, daily records, time sheets, and the basis for the rates of affected tasks that the baseline CPM schedule was founded on, may be required by the Engineer.
10. If additional payment is sought, the Contractor must document the exact dollar amount sought supported by a breakdown of: the dollar amounts as-Bid, and/or as incorporated into the Contract via approved Change Orders, the actual amounts accrued, and the additional payment sought. The basis of any of these amounts may be required by the Engineer. The Contractor must provide the documentation of the amount in the following categories, as applicable:

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a. Direct Labor (hours): This includes regular time rates and overtime rates for all employees and work classifications. These rates must include the basic prevailing wage and fringe benefits, the current rates for Federal Insurance Compensation Act (FICA), Federal Unemployment Tax Act (FUTA) and State Unemployment Tax Act (SUTA), the company's present rates for Medical Aid and Industrial Insurance premiums and the planned payments for travel and per diem payment. This excludes overhead and profit.

b. Direct Material (invoices): The invoice cost for Contractor-supplied Materials. This cost must include freight and handling charges and applicable taxes as shown on the invoices issued by the Supplier. This excludes overhead and profit.

c. Direct Equipment (hours, invoice, and rental agreements as applicable): Separately identify each piece of equipment used and the operation cost for each piece of equipment including all fuel, oil, lubrication, ordinary repairs, maintenance, and all other costs incidental to furnishing and operating the equipment, and the standby rate for each piece of equipment. This excludes overhead and profit. All equipment must have detailed descriptions, including but not limited to year, make, and model.

   1) Where the equipment is Contractor owned through outright ownership or through a long-term lease, the Contractor must document the Contractor's actual internal Bid rates. Bid rates are the equipment rates used by the Contractor or Subcontractors for bidding and project cost tracking; these rates typically exclude labor for operation; if an operator is included in a Bid rate, it must be indicated as such.

   2) Where the equipment is rented and operated by the Contractor, the Contractor must document the actual rental amounts including the actual rates for the equipment, excluding labor for operation.

   3) Where the equipment is rented from a third-party with operator, the Contractor must document the actual rental amounts including the actual rates for the equipment, including labor for operation.

d. Services (invoices/agreements): All invoices and agreements; additional breakdown may be required by the Engineer. This excludes overhead and profit.

e. Overhead and Profit (percentages that apply to direct costs in a, b, c, & d above): Markups for overhead and profit must be provided in detail under the following categories listed below. General company overhead, project overhead, and profit percentages must be provided for each affected Bid Items of Work, the mobilization Bid Item, and for the project as a whole.

   1) General Company Overhead: Costs of the Contractor's home or corporate office necessary to run the business and to support the projects in the field. The Engineer may require that the general company overhead be supported with documentation of company financial information for the past 2 years.

   2) Project Overhead: Indirect costs that cannot be identified with a specific construction activity but support the project as a whole. The Engineer may require documentation of actual costs accrued.

   3) Profit: Net proceeds after expenses. The Engineer may require a detailed justification with supporting documentation of the company's financial information for the past 2 years.

f. Subcontractor Costs: Payments the Contractor makes to Subcontractors at any tier for performing Work are to be included in the claim. This cost must be calculated and itemized in the same manner prescribed for the Contractor.

g. Costs for repair or replacement of defective work or damage to property, of Contractor caused delays, or other inefficiencies resulting from the Contractor operations, including Subcontractors, services, and Suppliers, must not be included in actual or projected costs.

h. Costs must not be included more than once in the claim documentation.

11. Any additional information requested in writing by the Engineer.

12. A notarized statement containing the following language:

STATE OF WASHINGTON

SS.

THE COUNTY OF KING

The undersigned, _____,

(name)

_____, of_____,

(title) (company)

being first duly sworn on oath, deposes and says:

The claim for extra payment and/or time made herein for Work on this Contract is a true statement of the actual costs incurred and/or time sought, and is fully documented and supported as required by the Contract between the parties.

Dated _____ /s/ _____

Subscribed and sworn before me this _____ Day of _____

Notary Public in and for the State of Washington

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residing at _____

My appointment expires

It is the responsibility of the Contractor to keep full and complete records of the actual additional costs and the actual additional time incurred for any alleged claim. The Contractor must retain these records for a period of not less than 3 years after the Completion Date. The Contractor must allow the Engineer complete and unrestricted access to these records and any other records as may be requested by the Engineer to determine the facts or contentions involved in the claim.

Failure to submit information and details as described, to provide access to the records, or as requested in writing by the Engineer for any claim, will result in waiving of the Contractor's claims.

Provided the Contractor has fully complied with all provisions of this Section, the Engineer will respond to the claim by written notice to the Contractor as follows:

a. Within 45 Working Days from the date the claim is filed if the claim amount is less than $50,000;
b. Within 90 Working Days from the date the claim is filed if the claim amount is equal to or greater than $50,000; or
c. If the Engineer determines the above constraints are unreasonable due to the complexity of the claim under consideration, the Engineer will notify the Contractor within 15 Working Days from the date the claim is filed as to the amount of time which will be necessary for the Engineer to prepare its response.

If the Engineer fails to provide written notice within the time periods set forth above, the claim is considered denied and the Contractor may proceed to mediation as specified in Section 1-04.4(4).

1-04.4(4) MEDIATION

If the Engineer denies the claim or the claim is deemed denied as specified in Section 1-04.4(3), the Contractor may request mediation. To request mediation, the Contractor must provide written notice to the Engineer within 30 Days of receiving the Engineer's written notice of denial, or within 30 Days of the date the claim was deemed denied due to the Engineer's failure to respond in the timeframe specified.

The date the Contractor's written notice is received by the Engineer is the date of filing the written notice. Failure to file the written notice within the time period stated above will result in the Engineer's decision regarding the claim being final and binding on the Contractor and all its Subcontractors.

The parties will select a mutually agreed on mediator. If they are unable to agree, the Owner and the Contractor must seek the selection of the mediator by the King County Superior Court at Seattle, WA.

Mediation will occur within 60 Days of the filing of the Contractor's written notice to mediate unless both the Contractor and the Engineer agree to a later date or unless the mediator's schedule requires a later date.

Each party will participate in the mediation process in good faith and may be represented at the mediation by lawyers. The parties will each bear their respective costs incurred in connection with this procedure, except that they must share equally the fees and expenses of the mediator and the costs of the facility for the mediation.

If mediation does not resolve the disputed matter, the Contractor may pursue judicial resolution as specified in Section 1-04.4(5).

1-04.4(5) LITIGATION

If mediation does not resolve the disputed matter, the Contractor may serve and file a lawsuit in King County Superior Court in Seattle, WA. Such lawsuit must be filed within 180 Days of the Physical Completion Date or within 90 Days of the completion of the mediation process specified in Section 1-04.4(4), whichever is later. This requirement cannot be waived except by an explicit waiver signed by the Owner. The failure to file a lawsuit within the 180 Day period will result in the Engineer's decision rendered as specified in Section 1-04.4(3) being final and binding on the Contractor and all its Subcontractors.

Actions by the Contractor against the Owner or between the Contractor and its Subcontractors arising out of a common set of circumstances must, upon demand by the Owner, be submitted in a single forum or the Owner may consolidate such claims or join any party necessary to the complete adjudication of the matter in the same forum.

1-04.4(6) AUDITS

All claims by the Contractor for additional payment are subject to audit as specified in Section 1-09.10. In the event of an audit the Contractor must make available to the Owner all documents the Engineer requests within 7 Days of a written notice from the Engineer. Failure of the Contractor or a Subcontractor of any tier, to maintain or retain sufficient records to allow the Owner to verify all or a portion of the claim or to allow Owner access to the books and records of the Contractor, or Subcontractor of any tier, constitutes a waiver of the portion of the claim that cannot be documented and will bar any recovery for any portion of a claim that cannot be documented.

1-04.5 VARIATION IN ESTIMATED QUANTITIES

The Contractor will be paid for the actual quantities of Work performed and accepted under the Contract. When the accepted quantity of Work performed under a unit item varies from the original Bid quantity, payment will be made using the unit Contract Price unless adjusted as described herein.

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The adjusted final quantity will be determined by starting with the final accepted quantity measured after all Work under an item has been completed. From this amount, subtract any quantities included in Additive Change Orders accepted by both parties. Then, to the resulting amount, add any quantities included in Deductive Change Orders accepted by both parties. The final result of this calculation becomes the adjusted final quantity and the basis for comparison to the original Bid quantity.

Increased Quantities: Either party to the Contract will be entitled to renegotiate the price for that portion of the adjusted final quantity in excess of 125 percent of the original Bid quantity. The price for that excess quantity will be determined as specified in Section 1-09.4.

Decreased Quantities: Either party to the Contract will be entitled to an equitable adjustment if the adjusted final quantity of Work performed is less than 75 percent of the original Bid quantity. The equitable adjustment is based on and limited to 3 factors:

1. Any increase or decrease in unit costs of labor, materials or equipment, used for Work actually performed, resulting solely from the reduction in quantity.
2. Changes in production rates or methods of performing Work actually done to the extent that the nature of the Work actually performed differs from the nature of the Work included in the original Contract.
3. An adjustment for the anticipated contribution to unavoidable fixed cost and overhead from the units representing the difference between the adjusted final quantity and 75 percent of the original Contract quantity.

Adjustment Limits: The following limitations apply to renegotiated prices for increases or equitable adjustments for decreases or both:

a. The equipment rates are actual cost but must not exceed the rates set forth in the AGC/WSDOT Equipment Rental Agreement, referred to in Section 1-09.6, that is in effect at the time the Work is performed.
b. No payment will be made for extended or unabsorbed home office overhead and field overhead expenses to the extent that there is an unbalanced allocation of such expenses among the Contract Bid Items.
c. No payment for consequential damages or loss of anticipated profits will be allowed because of any variance in quantities from those originally specified in the Contract.
d. The total payment including the adjustment amount and unit prices for Work performed for any item that experiences an equitable adjustment for decreased quantity must not exceed 75 percent of the extended amount originally Bid for the item.

If the adjusted final quantity of any item does not vary from the quantity shown on the Bid Form by more than 25 percent, then the Contractor and the Owner agree that all Work under that item will be performed at the original Contract unit price.

When ordered by the Engineer, the Contractor must proceed with the Work pending the determination of the cost or time adjustment for the variation in quantities.

The Contractor and the Owner agree that there will be no cost adjustment for decreases if the Owner has entered the amount for the item in the Bid Form only to provide a common Bid basis for Bidders.

1-04.6 DIFFERING SITE CONDITIONS - "CHANGED CONDITIONS"

The Contractor must provide written notice to the Engineer if the Contractor, or any Subcontractor, encounters:

1. Pre-existing subsurface or latent physical conditions differing from those specified in the Contract and information available to Bidders; or
2. Pre-existing unknown physical conditions at the Project Site of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract and information available to Bidders.

The notice must be submitted promptly upon the discovery, or the next Working Day, before the conditions are disturbed. The Contractor must not proceed with that portion of the Work until ordered to do so.

Upon notification by the Contractor, or when the Engineer suspects a differing site condition, the Engineer will promptly investigate the alleged changed condition and:

a. If the Engineer determines that differing conditions do not exist, the Contractor will be notified in writing. Should the Contractor disagree with such determination, the Contractor may file a written notice of dispute with the Engineer under the requirements of Section 1-04.4; or
b. If the Engineer finds that conditions are materially different and cause an increase or decrease in the Contractor's cost of, or the time required for, performing all or any part of the Work, the Engineer will make an equitable adjustment in the payment for the performance of the Work as specified in Section 1-09.4 or the time for performance as specified in Section 1-08.8.

No equitable adjustment will be allowed unless the Contractor has provided the written notice required in above. The time for providing the written notice may be extended by the Engineer for good cause. The time for giving written notice will not be extended beyond the time the Contractor knew, or should have known, of the existence of the differing condition.

If there is a decrease in the cost or time required to perform the Work, failure of the Contractor to notify the Engineer of the differing condition does not affect the Engineer's right to make an adjustment in cost or time.

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1-04.7 PROGRESS ESTIMATES AND PAYMENTS

Engineer issued progress estimates or payments for any part of the Work must not be used as evidence of performance or quantities. Progress estimates serve only as a basis for making payments. The Engineer may revise progress estimates any time before the Certificate of Completion is issued.

1-04.8 USE OF BUILDINGS OR STRUCTURES

Any building or Structure within the Right of Way that is not to remain during the Work or that may be used by the Contractor will be specified in the Contract.

1-04.9 USE OF MATERIALS FOUND ON THE PROJECT SITE

With written approval of the Engineer, the Contractor may use on the Project Site:

1. Stone, gravel, sand, or other Mineral Aggregates obtained from on-site excavations
2. Timbers removed in the course of the Work

Approval to use these materials will be granted provided the materials satisfy the requirements of the Contract, and are not required for other use by the Contract or for use as selected Materials.

The order of disposal for suitable materials obtained in the course of the Work is as follows unless the Engineer approves otherwise:

a. Used as selected Material, as specified in Section 2-10.2(1);
b. Delivered to the Engineer as salvage as specified in Section 2-02.3(7); or
c. Disposed of as specified in Section 2-01.2.

1-04.10 PROJECT CLEANLINESS AND FINAL CLEANUP

The Contractor must keep the Project Site clean and remove debris, refuse, and discarded materials of any kind resulting from the Work.

Disposal of waste must be as specified in Section 1-07.3 and all applicable provisions of the Contract.

The Contractor must also perform final cleanup as specified in this Section. The Engineer will not establish the Physical Completion Date until final cleanup is completed. The street Right of Way, Material sites, quarry or pit sites, borrow sites, sites used for temporary waste storage, and all other areas the Contractor occupied to do the Work must be left neat, clean, and presentable. The Contractor must not remove warning, regulatory, or guide signs unless approved otherwise in writing by the Engineer. In the event that the Contractor fails to complete clean-up, the Owner, after providing 5 Days notice, may complete the clean-up and deduct the costs thereof from moneys due or to become due to the Contractor.

The Contractor must:

1. Remove and dispose all rubbish, surplus materials not identified as salvage by the Owner, any discarded materials, falsework, piling, camp buildings, temporary structures, equipment, and debris.
2. Remove from the Project Site, all unneeded rock, aggregate, and similar material left from grading, surfacing, or paving unless the Contract specifies otherwise or the Engineer approves otherwise.
3. On all concrete and asphalt pavement Work, clean the pavement and dispose of the wash water and debris per SMC 22.800-22.808, which prohibits such discharges from entering the Storm Drain system.
4. Sweep and clean structure decks and properly dispose of wash water and debris per SMC 22.800-22.808, which prohibits such discharges from entering the Storm Drain system.
5. Clean out from all Culverts and Storm Drains, inlets, catch basins, maintenance holes, and Water Main valve chambers, within the limits of the Project Site, all dirt and debris of any kind that results from Contractor's operations.
6. Level and fine grade all excavated material not used for backfill where the Contract requires.
7. Fine grade all slopes and around all Structure piers, bents, and abutments.
8. Ensure that the final cleanup of clearing and grubbing disposal sites and borrow sites specified in Sections 2-01.2 and 2-10.2(2), and any temporary waste sites created by the Contractor, have been performed per the requirements specified in the Grading Ordinance, permits, property agreements, and the Contract.
9. Upon completion of grading and cleanup operations at any privately owned site for which a written agreement between the Contractor and property owner is required, the Contractor must obtain and furnish to the Engineer a written release from all damages, duly executed by the property owner, stating that the restoration of the property has been satisfactorily completed.
10. Remove all temporary construction stormwater pollution prevention elements within 5 Working Days after final Project Site stabilization, or after they are no longer needed, whichever is later.
11. Before the completion of the Work, amend all new, replaced, and disturbed topsoil as specified in Section 8-01 and Section 8-02.
12. Remove warning, regulatory, or guide signs once removal has been approved in writing by the Engineer.

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13. Clean, remove, and dispose of any debris of any kind that results from Contractor's operations within or outside of the Project Site.

All costs associated with cleanup and disposal are incidental to the Work and must be included in the various Bid Items in the Bid and at no additional cost to the Owner.

SECTION 1-05 CONTROL OF WORK

1-05.1 AUTHORITY OF ENGINEER

All Work must be done as specified in the Contract, to the satisfaction of the Engineer. The Contract gives the Engineer authority over the Work. Whenever it is so provided in this Contract, the decision of the Engineer is final, provided that such decision may be disputed as specified in Section 1-04.4.

The Engineer's decisions are final on all questions including, but not limited to:

1. Quality and acceptability of Materials and Work
2. Substitutions
3. Measurement of Bid Item Work
4. Acceptability of rates of progress on the Work
5. Interpretation of the Contract
6. Determination as to the existence of differing Project Site conditions
7. Fulfillment of the Contract by the Contractor
8. Payments under the Contract including equitable adjustments
9. Suspension of the Work
10. Determination as to Unworkable Days
11. Reviews of submittals
12. Determination of Notice to Proceed Date, Substantial Completion Date, and Physical Completion Date, see Section 1-01.3

If the Contractor fails to respond promptly to the requirements of the Contract or direction from the Engineer:

a. The Engineer may use the Engineer's forces, other Contractors, or other means to accomplish the Work as specified in Section 1-05.8,

b. The Owner is not obligated to pay the Contractor, and will deduct from the Contractor's payments, additional costs when any other means must be used to carry out the Contract requirements or Engineer's direction, as specified in Section 1-09.9(3).

The Engineer may suspend all or part of the Work, as specified in Section 1-08.6, if:

1) The Contractor fails to fulfill Contract terms, to carry out the Engineer's orders, or to correct unsafe conditions of any nature;

2) The Contractor fails to comply with environmental implementation requirements, corrective action, testing, or self-reporting requirements;

3) The weather or other conditions are unsuitable; or

4) It is in the public interest.

Nothing in the Contract requires the Engineer to provide the Contractor with direction or advice on how to do the Work. If the Engineer takes no exception or renders an opinion on any method or manner for doing the Work or producing Materials, it does not:

a) Guarantee that following the method or manner will result in compliance with the Contract;

b) Relieve the Contractor of any risks or obligations under the Contract; or

c) Create any liability for the Owner.

1-05.2 AUTHORITY OF ASSISTANTS AND ELECTRICAL SAFETY OBSERVER

1-05.2(1) AUTHORITY OF ASSISTANTS

The Engineer may appoint Assistants to assist in determining if the Work and Materials comply with the requirements of the Contract. Assistants have the authority to reject defective material and suspend Work that is being done improperly, subject to the final decision of the Engineer. Assistants may exercise such additional authority as may be delegated to them by the Engineer.

Assistants and inspectors are not authorized to accept Work, to accept Materials, to issue instructions, or to provide advice that is contrary to the Contract. Work done or Material furnished which does not comply with the Contract requirements is at the Contractor's risk and is not a basis for a claim even if the inspectors or Assistants purport to change the Contract to provide for such Work or Material, to approve or accept such Work or Material, or issue any instructions contrary to the Contract.

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Although Assistants may advise the Contractor of any faulty Work or Materials or infringements of the terms of the Contract, failure of the Engineer or Assistant to do so does not constitute acceptance or approval.

1-05.2(2) AUTHORITY OF ELECTRICAL SAFETY OBSERVER

The Engineer will assign an Electrical Safety Observer when Work is performed in a substation; in a switchyard; in an energized vault; at other locations containing high voltage lines or equipment; when installing ducts and vaults in the vicinity of energized underground electrical transmission or distribution system; or when any excavation is within 15 feet of an energized electrical transmission or distribution system as indicated by marked for locate as specified in Section 1-07.17(1); or as otherwise deemed necessary by the Engineer. The only exception is when the Contract specifies, and contains a Bid Item, that the Contractor provides a qualified Contractor's Electrical Safety Observer who is approved by SCL.

The Contractor must provide a minimum 7 Working Days advance notice request for an Electrical Safety Observer, see Section 1-07.28 for notification requirements. The Contractor must provide an adequate description of the Work to be performed, equipment to be used, and the Work duration. When the Contractor, or its Subcontractor, does not schedule Work on a specific Day or Days, the Contractor must provide 1 Working Day advance notice unless arranged otherwise with the Electrical Safety Observer. Failure to notify the Electrical Safety Observer at least 1 Working Day in advance will result in the Owner back charging the Contractor for the Electrical Safety Observer's services at the site.

The Electrical Safety Observer's involvement with Project Site safety will be limited to electrical safety, unless the Contract indicates otherwise. The Electrical Safety Observer will notify the Contractor of electrical hazards and may instruct, warn, and if necessary, direct Contractor and Subcontractor personnel to move a safe distance from electrical system components. In addition to all other rights of the Owner and Engineer, the Electrical Safety Observer will have the authority, but not the responsibility, to stop Work if the Electrical Safety Observer judges that there is any hazard that immediately imperils life, health, or property.

The Contractor is solely responsible for safety under the Contract. The presence or absence of an Electrical Safety Observer does not change the Contractor's responsibility for the occupational health and safety of individuals on the Project Site or relieve the Contractor of any of its legal obligations for worker safety.

The Contractor must assign a Contractor's on-site electrical lead and must ensure that each Subcontractor assigns a Subcontractor's on-site electrical lead when Work requires an Electrical Safety Observer. The on-site electrical lead is authorized to resolve safety related issues raised by the Engineer, Assistant, or Electrical Safety Observer. The Contractor must ensure that such on-site electrical lead is physically present at the Project Site requiring an Electrical Safety Observer. Each on-site electrical lead, whether Contractor's or Subcontractor's, must identify themselves to the Electrical Safety Observer at the briefing/tailgate conference.

At the briefing/tailgate conference on each Day when an Electrical Safety Observer is required, the Contractor must notify the Electrical Safety Observer of the work to be performed requiring an Electrical Safety Observer. Each on-site electrical lead, or Contractor's or Subcontractor's on-site supervisory representative, must complete and sign the Safety Watch Checklist and Certification of Training form provided by the Electrical Safety Observer before work starts for which an Electrical Safety Observer is required.

1-05.3 SUBMITTALS

The Contractor must not perform Work or procure Material or start fabrication based on a required submittal until the Engineer has returned the approved submittal. If a submittal is required by the Contract, any related portion of Work performed by the Contractor before the Engineer's return of an approved submittal, or as otherwise specified by the Engineer, is solely at the Contractor's risk and expense.

The City encourages the use of environmentally friendly materials and methods. Unless the Contract or Engineer specifies otherwise, electronic submittals will be used to the maximum extent feasible. When hard copy submittals are required, the Contractor must use recycled and reusable products including recycled content paper.

Section 1-05.3 specifies submittals required by the Engineer. Other documentation required by the Owner will be specified in the applicable Sections.

The electronic submittal received by the Engineer is considered the official and governing document unless a non-electronic submittal is required. The date on which the submittal is received by the Engineer either physically or electronically is considered the date submitted, except that submittals received by the Engineer on a Non-Working Day, or received after 4:00 p.m. on a Working Day, are considered submitted on the following Working Day.

1-05.3(1) GENERAL

1-05.3(1)A ELECTRONIC SUBMITTALS

Electronic submittals must be submitted via email or other means as mutually agreed. Electronic submittals must be in PDF unless otherwise specified in the Contract or on Engineer provided forms. PDF is a digital file format that captures all elements of a printed document as an electronic image such that it can be viewed, navigated, printed, electronically searched and copied, and/or forwarded via email. Whenever practicable, convert text documents to PDF, as opposed to scanning images, to enhance the capability of electronic searching and copying, The PDF file, when printed, must fulfill the page size and format requirements of the applicable specification.

Email addresses will be provided at the preconstruction conference.

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1-05.3(1)B NON-ELECTRONIC SUBMITTALS

Typically, non-electronic submittals are any oversize document or any document that requires an original signature or ink stamp. Non-electronic submittals must be submitted as a hard copy. Examples of submittals required in this format include: formal correspondence, pay estimates, Change Orders, Drawings greater than 11" x 17" in size, and Drawings requiring a Professional Engineer's or Licensed Professional's stamp.

Faxes and other forms of copies are not acceptable as submittals when an original signature or ink stamp are required.

1-05.3(1)C BULK SAMPLE SUBMITTALS

Bulk sample submittals, unless the Engineer agrees otherwise, must include Mineral Aggregate, hot mix asphalt, geotextile, and pipe. Bulk sample submittals received on or after 2:00 p.m. on a Working Day will be considered as received on the following Working Day. Unless directed otherwise, deliver bulk samples to: SPU Materials Laboratory, 707 South Plummer Street, Seattle, WA 98134, (206) 733-9524.

1-05.3(1)D SUBMITTAL NUMBERING

The use of unique identifying numbers for submittals is considered helpful in facilitating Contract-related communications and is therefore encouraged by the Owner. During the preconstruction meeting, the Engineer may propose one or more submittal numbering procedures to be used during the Work. The Contractor must cooperate and comply with all such submittal numbering proposals.

1-05.3(1)E GENERAL SUBMITTAL DISTRIBUTION AND FORMAT SUMMARY

In order to be considered by the Engineer, submittals and items of correspondence must be submitted in the format set forth in the following table. The Engineer's review/approval period runs from the date of receipt of a submittal or item of correspondence delivered in the required format.

This table also provides a general overview of typical format and distribution requirements for various documents and submittals that may be required by the Contract and for correspondence and responses from the Engineer. However, specific submittal requirements are more fully described in the Sections pertaining to them, and to the extent there are conflicts between the table below and the detailed Specification requirements, the detailed Specification requirements govern unless directed otherwise by the Engineer.

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General Submittal Distribution and Format Summary Table			
Submittal/Correspondence Description		**Required Format for Review Period or Formal Action to Start**	**Additional Paper Copies**
From Contractor	All Oversize documents (larger than 11" x 17"), regardless of submittal type	Electronic	3
	As-built Drawings	Electronic	3
	Bulk Samples	Paper Form per Spec, delivered with sample	N/A
	Catalogue Cut Sheets	Electronic	1
	Change Orders	Electronic	0
	Construction Stormwater Pollution Prevention Submittals [1]	Electronic	1
	CPM Schedules	Electronic	3
	Cutting/Patching Proposal	Electronic	1
	E-mails	Electronic	0
	Field Memos	Electronic	0
	Health and Safety Plans	Electronic	1
	Letters, Formal Correspondence	Electronic	0
	Modification Proposal	Electronic	1
	Operations and Maintenance Manuals	Electronic	3
	Progress Estimate	Electronic	0
	Product Data	Electronic	1
	Project Equipment List	Electronic	1
	Project Labor List	Electronic	1
	Reports	Electronic	1
	Request for Information (RFI)	Electronic	1
	Request for Material Source Approvals	Electronic	1
	Schedule of Values	Electronic	0
	Shop Drawings with Professional Engineering Stamp	Electronic	3
	Soil Transfer Forms	Electronic	1
	Subcontractor Approval Requests	Electronic	1
	Submittal Schedule	Electronic	1
	Substitution Requests	Electronic	1
	Test Results	Electronic	1
	Warranties	Electronic	1
	Waste Management Plan	Electronic	1

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General Submittal Distribution and Format Summary Table			
Submittal/Correspondence Description		Required Format for Review Period or Formal Action to Start	Additional Paper Copies
From Engineer	Design Changes	Electronic	
	E-mails	Electronic	
	Field Directive	Electronic	
	Field Memos	Electronic	
	Inspection Reports	Electronic	
	Letters, Formal Correspondence	Electronic	
	Preconstruction Meeting Announcement	Electronic	
	Progress Meeting Minutes	Electronic	
	RFI Responses	Electronic	
	Submittal Review Responses	Electronic	

NOTES:

1. See Section 8-01.3(2) for a listing of the required construction stormwater pollution prevention submittals.

1-05.3(2) SUBMITTAL TRANSMITTAL AND RESPONSE FORM (ST&R FORM)

This form is required by several City departments, and when so required, must be filled out by the Contractor and emailed as part of the complete package along with the submittal in PDF to the Engineer. The form must also be attached to the original hardcopy of the submittal when required and delivered to the Engineer or SPU Materials Laboratory. The Engineer will complete the form and respond electronically.

1-05.3(3) CONTRACTOR SUBMITTAL DELIVERY AND REVIEW TIMELINES

The submittal received date for submittals is specified in Section 1-05.3(1).

Unless otherwise specified in the Contract, the Contractor must allow the Engineer the following submittal review timelines:

1. 20 Working Days for structural Shop Drawings
2. 15 Working Days for other Shop Drawings
3. 10 Working Days for all other submittals

The Contractor must transmit submittals in a timely manner to comply with Contract Time, and must take into consideration the possibility of resubmittal.

Submittals required before or at the preconstruction conference as specified in Section 1-05.3(5) must be provided and will be reviewed as specified in the Contract or as mutually agreed. Unless specified or mutually agreed otherwise, submittals received before the preconstruction conference are considered as received at the preconstruction conference for purposes of determining the start of the Engineer's review cycle.

1-05.3(4) SUBMITTAL CONTROL DOCUMENT

At the preconstruction conference, the Contractor must be prepared to discuss the nature and timelines of all submittals as they relate to the various portions of the Work, to the Bid Items, and to the proposed progress schedule. The Contractor must prepare and submit to the Engineer a Submittal Control Document listing all submittals and when these submittals will be delivered to the Engineer. The Contractor may reference the baseline CPM schedule and show major submittals and review times in the CPM. The initial Submittal Control Document must be submitted with the baseline CPM schedule, see Section 1-08.3(1) for time requirements.

The data in the submittal control document does not relieve the Contractor of the obligation to comply with the requirements regarding Contract Time. Unless all submittals are shown in the CPM schedule, the Contractor must review the Submittal Control Document at least every 30 Days and update or correct the Submittal Control Document as necessary. It is recommended that the Submittal Control Document updates be submitted concurrently with CPM schedule updates. Submittal Control Document updates are incidental to the Bid Items and not required when all pending submittals are shown on the CPM schedule.

At a minimum, the Submittal Control Document and/or CPM schedule must address Material submittals, Shop Drawings, and the standard submittals specified in Section 1-05.3(1).

1-05.3(5) EARLY SUBMITTALS

The following must be submitted before or at the preconstruction conference:

1. Preliminary CPM schedule, see Section 1-08.3

2. Initial Submittal Control Document, see Section 1-05.3(4)
3. Waste Management Plan, see Section 1-07.3
4. Signed "Transfer of Coverage for Construction Stormwater General Permit" form, as applicable, see Section 1-07.15

When applicable, the following must be submitted and approved by the Engineer before mobilization to the Project Site:

a. Construction Stormwater and Erosion Control Plan (CSECP), see Section 8-01
b. Tree, Vegetation, and Soil Protection Plan (TVSPP), see Section 8-01
c. Spill Plan (SP), see Section 1-07.15(1) and Section 8-01
d. Health and Safety Plan, if applicable, see Section 1-07.1(2)
e. SDOT Street Use Permit and approved traffic control plan, see Section 1-07.6 and Section 1-10

1-05.3(6) CONTRACTOR'S REQUEST FOR INFORMATION, SUBSTITUTIONS, AND DEVIATIONS

The Engineer's review of requests for clarification, approved submittal deviations, and/or substitution does not relieve the Contractor from responsibility for the submittal review timeline requirements of the Contract.

1-05.3(6)A REQUEST FOR INFORMATION (RFI)

Information requests must be submitted to the Engineer using the RFI form. The Contractor must comply with the procedures specified in Section 1-05.3(1) and will supplement the form with any other appropriate information. The required notice form titled: Request for Information will be provided in an electronic format by the Engineer upon request.

Each Contractor's RFI must use this form in the format provided, completed in its entirety, supplemented with other appropriate information as may be specified elsewhere, and submitted with attachments necessary for proper review by the Engineer. RFI submittals found to contain errors, or unapproved deviations or variations from the Contract, may be determined by the Engineer to be out of compliance with the Contract. Any costs or delays associated with non-conforming RFIs are the Contractor's sole responsibility and the Engineer has no requirement to extend Contract Time or to make additional payments.

If the Contractor determines any comment by the Engineer on the returned RFI to constitute a change, the Contractor must make such written notice as specified in Section 1-04.3.

1-05.3(6)B SUBMITTAL UPDATE (DEVIATION)

Where the Contractor intends to change, deviate from, or supplement a previously reviewed submittal accepted by the Engineer, the Contractor must resubmit the originally reviewed submittal to the Engineer for additional review indicating the proposed changes or deviations from the originally reviewed submittal and must clearly state reasons, additional calculations, additional details, as necessary to support such need for change or deviation.

1-05.3(6)C CONTRACT DEVIATION REQUEST

Any request for a variation or deviation from the Contract, except substitutions addressed below, must allow the Engineer a minimum 10 Working Days to review and return the request and must clearly state reasons, additional calculations, additional details, as necessary to support such request or deviation from the Contract. The Engineer may deny requests for deviation from the Contract if the request is not in the best interest of the Engineer, or if time or resources are not available for review. The Engineer's decision will be final and the Contractor must Bid accordingly.

1-05.3(6)D SUBSTITUTION

All Materials, equipment or methods proposed by the Contractor as a substitution for a brand name, trademark, patent number, proprietary process, or specified item with an "or equal" allowance must be addressed in the submittal. In making a request for substitution, the Contractor's submittal must demonstrate that the proposed substitution fully meets or exceeds the requirements in Section 1-06.1(1) and the applicable technical Section. Any request to use a substitute for a non-proprietary material, equipment, or process must be proposed through correspondence and must allow the Engineer 10 Working Days to review and return the request and must fully comply with or exceed the requirements in Section 1-06.1 and the applicable technical Section.

1-05.3(7) TECHNICAL SUBMITTAL DESCRIPTIONS

Where a submittal contains information with more than 1 option, such as catalog cut, manufacturer's written instructions, recognized trade association standard, or specified designation, the option applicable to the submittal must be clouded or highlighted.

Include the type of submittal in the description. Examples include: Shop Drawings, product data (catalog cuts, illustrations), samples (bulk of Materials), design data (calculations, mix designs, analyses), test reports (by authorized professional of private testing laboratory or certified individuals), manufacturer's certificate of compliance, manufacturer's written instruction (installation of a product, system, or Material, including special notices and material safety data sheets (MSDS)), operating and maintenance manuals, CPM schedule, as-built Drawings, or others as deemed applicable.

1-05.3(8) SUBMITTAL REVIEW AND POSSIBLE RESPONSE ACTIONS

The Engineer's submittal review is to ensure compliance with the requirements of the Contract. The Engineer's review does not extend to consideration of the Contractor's means, methods, techniques, sequences or procedures of construction or

to safety precautions or programs incident thereto, except where a specific means, method, technique, sequence, or procedure of construction is required or prohibited by the Contract or a regulatory agency. Engineer review of a separate Bid Item does not indicate approval of the assembly in which the Bid Item functions. The Contractor is responsible for confirming and correlating all dimensions; fabrication and construction techniques; coordinating the Contractor's Work with that of all other trades; and the satisfactory performance of the entire Work in strict accordance with the Contract.

The following notations are interpreted as follows:

1. No Exception Taken: Submittals returned and marked No Exception Taken authorize the Contractor to proceed with the portion of the Work, proceed with the fabrication, or to procure Materials or equipment, as contained in the submittal. Where more than 1 submittal is required for a portion of the Work or for a greater portion of Work containing the submittal portion, no portion of Work must proceed until all submittals required of that Work portion are returned by the Engineer without requiring resubmittal. The Contractor must not change in any way, a portion of the Work or fabrication based on submittal returned No Exception Taken. Revisions must only be made as specified in Section 1-05.3(10).
2. Make Corrections Noted: Submittals returned and marked Make Corrections Noted authorize the Contractor to proceed with the portion of Work covered by the submittal as long as the corrections noted are followed. For submittals prepared by a Professional Engineer, the Contractor must provide a return copy showing the noted corrections. The Contractor is responsible for the submittal; if they do not agree with the corrections noted, they must resubmit before proceeding with that portion of the Work.
3. Submit Specified Item: Submittals returned and marked Submit Specified Item indicate an incomplete submittal and does not authorize the Contractor to perform that portion of the Work. The specified item must be resubmitted as specified in Section 1-05.3(10).
4. Rejected or Revise and Resubmit: Submittals returned and marked Rejected or Revise and Resubmit indicate the submittal is incomplete or does not comply with Contract requirements, and must be resubmitted with appropriate changes before proceeding with that portion of the Work, as specified in Section 1-05.3(10).

1-05.3(9) ACTIONS BY CONTRACTOR BEFORE SUBMITTAL RETURN BY ENGINEER

The Contractor bears all risks associated with purchasing any Material or equipment or for starting fabrication or starting any Work requiring a submittal, until the Contractor has received a submittal response from the Engineer that authorizes the Contractor to proceed with the portion of the Work.

1-05.3(10) RESUBMITTALS

Submittals returned to the Contractor marked Rejected, Revise and Resubmit, or Submit Specified Item will include the Engineer's comments. The Contractor must address the Engineer's comments in its resubmittal, with corrections clearly identified in the resubmittal to assist the Engineer's review.

Resubmittal is considered a new submittal; a new submittal review period of the duration specified for the original submittal starts on receipt of the resubmittal by the Engineer. See Section 1-05.3(3) for review timelines. No extension of Contract Time will be allowed for resubmittals.

1-05.3(11) SHOP DRAWINGS

The Contractor must submit supplemental Shop Drawings with calculations as required for the performance of the Work. The Drawings must be on sheets measuring 22 x 34 inches, 11 x 17 inches, or on sheets with dimensions in multiples of 8-1/2 x 11 inches. All Drawings must be to scale. The design calculations must be on sheets measuring 8-1/2 x 11 inches. Shop Drawings must be legible, with all terms identified, and may include computer printouts.

The Drawings and calculations must be provided far enough in advance of actual need to allow for the review process by the Engineer, which may involve rejection, revision, or resubmittal, as specified in Section 1-05.3(8). Shop Drawings must be submitted, and re-submitted if required, by the Contractor in an orderly sequence so that they may be reviewed by the Engineer in the order in which they are received, without creating delay. The Contractor may suggest the sequence in which these Shop Drawing submittals are to be reviewed by the Engineer in order to comply with the critical path scheduling needs.

Shop Drawing and calculation submittals must be prepared by, or under the direction of, a Professional Engineer, licensed under Title 18 RCW, State of Washington, and must carry the Professional Engineer's signature and seal, see Section 1-05.3(12).

If more than the specified number of Working Days are required for the Engineer's review of any individual submittal or resubmitted, an extension of time will be considered as specified in Section 1-08.8.

Before submittal of Shop Drawings, the Contractor must determine and verify all quantities, dimensions, specified performance criteria, installation requirements, Materials, catalog numbers and similar data, and review or coordinate each Shop Drawing with other Shop Drawings and with the requirements of the Contract. Section 1-04.2 specifies the precedence of figured and scaled dimensions. Copies of the Drawings or Standard Plans as substitutes for Shop Drawings will be rejected and will require resubmittal.

1-05.3(11)A SHOP DRAWINGS VARYING FROM CONTRACT REQUIREMENTS

Submittal of a Shop Drawing that varies from the Contract requirements is considered a Contract deviation request and must be as specified in Section 1-05.3(6).

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1-05.3(12) SUBMITTAL PREPARED BY PROFESSIONAL ENGINEER OR OTHER LICENSED PROFESSIONAL

Where the Contract requires a submittal prepared by a Professional Engineer or other licensed professional, such as Surveyor, Landscape Architect or Architect hereafter referred to as Licensed Professional, all Drawings and design calculations must be prepared by, or under the direct supervision of, a Licensed Professional, with current license under Title 18 RCW, State of Washington, who is registered and qualified in the applicable branch of engineering, or a special profession. Any plan details or Drawings requiring design calculations by a Licensed Professional are considered a Shop Drawing.

Each sheet of the Drawings must carry the following:

1. Licensed Professional's original signature, date of signature, original seal, and registration number;
2. The initials and dates of all participating design professionals;
3. Clear notations of all revisions including identification of who authorized the revision, who made the revision, and the date of the revision;
4. The Contract public works number, Contract title, and sequential sheet number. These must also be on all related documents; and
5. Identification of where each drawing sheet will be used by referencing the Contract Drawing sheet number and related item or detail.

Design calculations must carry on the cover page the Licensed Professional's original signature, date of signature, original seal, and registration number. The cover page must also include the Contract PW number, Contract title, and sequential index to calculation page numbers.

A State of Washington Licensed Professional, licensed under Title 18 RCW, State of Washington, and qualified in the applicable branch of engineering or a special profession may be retained to check, review and certify Shop Drawings and calculations of an individual who is licensed in another state, provided the following conditions are satisfied:

a. The Work being reviewed was legally prepared by an individual holding valid registration in another State in the applicable branch of engineering or a special profession.
b. The Washington State Licensed Professional conducts independent calculations and reviews all technical matters contained within the subject Work, Drawings, Specifications, legal requirements, technical standards, and other related documents; and has verified that the design meets all applicable Specifications and is in agreement with the specific Project Site conditions and geometry.
c. All submitted plan sheets must carry the Washington State Licensed Professional's original signature, date of signature, original seal, and registration number.
d. The Washington State Licensed Professional's independent calculations must be submitted for review along with the Drawings. The independent calculations must carry on the cover page the Washington State Licensed Professional's original signature, date of signature, original seal, and registration number. The cover page must also include the following: The Contract PW number, Contract title, and sequential index to calculation page numbers.
e. The Washington State Licensed Professional must keep a signed and sealed copy of the falsework, formwork plans, independent calculations, Specifications, and other related documentation that represents the extent of the review.

1-05.3(13) AS-BUILT RECORDS SUBMITTALS

1-05.3(13)A RED-LINE DRAWINGS, AS-BUILT DRAWINGS AND RECORD DRAWINGS

The Contractor must maintain one set of full-size conformed Drawings for recording Red-Line Drawing mark-ups at the Project Site. The Red-Line Drawings must be updated with clear and accurate mark-ups on a daily basis, and within 2 Business Days after receipt of information a change to the Work has occurred.

Red-Line Drawings must provide the applicable reference for all mark-ups including the date, change order number, the request for information (RFI) number, field directive (FD), design change (DC) or the approved Shop Drawing number. All mark-ups must clearly identify changes utilizing symbols and abbreviations found in the Contract. Mark-ups must be created using a minimum 1/8-inch lettering conforming to the following color code: additions (Red), Deletions (Green), Comments, (Blue) and Dimensions (Graphite).

The Red-Line Drawings must be available for review upon the Engineer's request.

All costs associated with preparing, maintaining, and submitting Red-Line Drawings are considered incidental to the Work.

1-05.3(13)B AS-BUILT DRAWINGS

As-Built Drawings are completed Red-Line Drawings as reviewed and approved by the Engineer. As-Built Drawings must incorporate all deviations from the conformed Drawings and graphically depict all information contained within Addendums, Change Orders, design changes, field memos, requests for information, substitution requests, Contractor notes and all other changes to the Work.

As-Built Drawings must show accurate locations of Storm Drain, Sewer, Water Mains and other piping appurtenances, structures, conduits, light standards, vaults, width of roadways, sidewalks, landscaping areas, building footprints, channelization and pavement markings, pipe invert elevations, top of castings, maintenance holes, inlets, etc.

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Any buried utilities encountered and not shown on the conformed Drawings must be recorded on the As-Built Drawings and be reported to the Engineer.

The Contractor must create and maintain As-Built Drawings within 10 Working Days of completed changes to that portion of the Work. The Contractor must submit to the Engineer As-Built Drawings monthly or when a progress estimate is submitted. Review and acceptance of the As-Built Drawing by the Engineer is a prerequisite for approval of the Contractor's progress estimate. Failure to maintain clear and up to date As-Built Drawings may delay the Contractor's monthly progress payment or the Owner may progressively withhold payment until the As-Built Drawings are properly updated.

The Contractor must submit conformed Drawings and compiled draft As-Built Drawings post Substantial Completion and prior to punch list acceptance. Physical Completion will not be established until the Contractor has submitted and the Engineer has approved final As-Built Drawings.

As-Built Drawing sheets must be stamped "AS-BUILT DRAWING".

All costs associated with preparing, maintaining and submitting As-Built Drawings are considered incidental to the Work.

For Record Drawing requirements, see www.seattle.gov/util/CAD.

1-05.3(14) CONTRACTOR'S FAILURE TO PROVIDE OR COMPLETE SUBMITTALS AND PROGRESS OF THE WORK

All submittals required of the Contractor must be provided by the Contractor. The Contractor acknowledges that its failure to timely provide or complete all submittals will place an extra and unnecessary burden on the Engineer in meeting other obligations and exposes the Owner to increased costs associated with delay in the completion of the Work. The Contractor agrees that failure to provide and complete all submittals is cause for the Engineer to withhold payment in the progress estimate for any and all Bid Items where the Contractor has failed to comply with the specified requirement to provide such submittal. No claim for delay or extension to Contract Time will be allowed for time lost due to Contractor's late submittal or to Contractor's resubmittal.

1-05.4 CONFORMITY WITH AND DEVIATIONS FROM DRAWINGS AND STAKES

Work performed must conform to the lines, grades, cross-sections, data, and dimensions indicated on the Drawings or staked by the Engineer. These stakes and marks will govern the Contractor's Work. The Contractor is solely responsible for detailed dimensions, elevations, and slopes measured from them.

Where specific tolerances are stated in the Contract, the Work must be performed within those stated limits. The Engineer will determine if the Work is in conformity with the lines, grades, cross-sections, and dimensions provided. The Engineer's decision on whether the Work is in conformity is final, as specified in Section 1-05.1.

Before undertaking each part of the Work, the Contractor must carefully study and compare the Contract to existing field conditions by checking and verifying pertinent figures shown in the Contract, and checking and verifying all applicable field measurements. The Contractor must promptly provide written notice to the Engineer of any conflict, error, discrepancy, or omission discovered.

The Contractor must not deviate from the requirements in the Contract except when authorized to do so, in writing, by the Engineer.

1-05.5 CONSTRUCTION STAKES

All Work constituting the practice of engineering or land surveying requires the vertical datum and horizontal datum used to match the current National Geodetic Survey (NGS) Datum. See Standard Plan 001.

Before the Engineer will provide survey control points, the Contractor must first provide a Project Site that has been prepared for safe and orderly installation of such control points as determined by the Engineer.

The Engineer will furnish primary survey control points for Work areas at the Project Site as follows:

1. 2 intervisible horizontal control points for each continuous street between consecutive intersections, and no less than 2 points per 1320 linear feet measured along the centerline of street. T intersections branching off a street with no Work on that branching street will have 1 control point at the T intersection. T intersections branching off a street with Work on that branching street will have horizontal control points per the first sentence of this item 1.
2. 2 vertical control points for each continuous street between intersections within the Project Site. A minimum of 2 points per 1320 feet will be provided.

The Standard Specifications also address additional survey controls provided by the Engineer for specific constructions. See Section 2-09.3(2) and, unless the Contract specifies otherwise, where the Engineer may provide additional staking, Sections 2-04.1(1), 2-09.1, 2-10.3(6), 2-13.3(1)A, 4-04.3(5), 5-04.3(4)C1, 7-18.3(1)A, 8-11.3(3), 8-15.3(1), 8-15.3(5), 8-16.1, and 8-18.3(1).

The Contractor must use the Owner-furnished survey control points for all necessary calculation and survey for the Contractor to complete the Work, and assumes full responsibility for detailed dimensions, elevations, lines, grades, excavation slopes, and as may be required of the Work measured from these Engineer furnished survey control points.

Survey control points provided by the Engineer for the Contractor must be preserved and not be disturbed.

Should any discrepancy in survey control points provided by the Engineer be identified by the Contractor, upon discovery, the Contractor must immediately notify the Engineer of such discrepancy including providing timely follow up with

written notice. In the absence of such immediate notification and follow-up written notice, the Contractor is responsible and liable for any error in alignment or grade at no separate or additional cost to the Owner.

Any claim by the Contractor for extra payment or delay due to error in the Engineer provided survey control points is not allowed unless the original Engineer provided survey control points still exist undisturbed. For straight line and straight grade, the Contractor must provide at least 3 consecutive points to determine variation from a straight line or grade.

The Contractor's surveyor must be, or must work under the direct supervision of, a Land Surveyor licensed under Title 18 RCW in the State of Washington and regularly performing survey work in the State of Washington. The Contractor must keep updated survey field notes in a standard field book and in a format generally accepted in the Land Survey profession. These field notes must include all survey work performed by the Contractor's surveyor in establishing line, grade and slopes for the Work. Provide copies of these field notes upon request.

The Contractor must submit a legible and complete copy of all Contractor surveyor notes and calculations used in the Contractor's survey to the Engineer; these become the property of the Owner.

The Contractor must submit any request for Engineer provided surveying services at least 10 Working Days in advance of the need. The Engineer cannot guarantee that such request can be performed by the Engineer; however, should the Engineer determine he or she can perform such survey or portion thereof, then such additional survey by the Engineer and the Engineer's hourly dollar rates must be agreed to by the Contractor before such survey work starts. The Contractor agrees that all Engineer cost for providing such survey will be charged to the Contractor and deducted from each progress payment as it may come due, see Section 1-07.16(1) regarding responsibilities associated with monumentation.

If the survey work provided by the Contractor does not meet the standards of the Engineer, of WAC 196, or of RCW 18.43, the Contractor must remove the individual or individuals doing the Contractor's survey work upon the Engineer's written notice. Thereafter, the survey work may be completed by the Engineer by such means as the Engineer determines appropriate at the Contractor's sole expense, and all cost for completing the Contractor's survey work by the Engineer will be addressed as specified in Section 1-09.9(3).

All costs for survey work the Contractor is required to perform will be included in the Bid Item prices Bid for the Work.

1-05.6 INSPECTION OF WORK AND MATERIALS

Work performed and Materials furnished will be subject to inspection by the Engineer. The Contractor must provide the Engineer a minimum 1 Working Day advance notice when Work and Materials are ready for inspection, testing, review, approval, or retesting as applicable. The Contractor must provide such facilities as are deemed necessary by the Engineer for sufficient and safe access to the Work or to the Material. Such facilities must include but not be limited to, walkways, railings, ladders, platforms, support systems, safety harnesses, safety lines, and safety nets.

Upon request, the Contractor must furnish, without charge, samples of Materials used, or to be used in the Work, for inspection and testing, to ensure conformance with the Contract. If Materials are tested and approved for the Work, then used for purposes not connected with the Work, the cost of testing and inspection will be deducted from monthly progress estimates for payment to the Contractor. Materials used without inspection may be ordered removed and replaced, and the cost of the Material, including the work associated with the removal and replacement of the Material and any other Material and Work impacted by the removal and replacement, is at the Contractor's sole expense.

If the Contractor fails to furnish Material samples and/or test results as required in the Contract, the Engineer and/or testing agency designated by the Engineer, may sample and/or test the Material at the Contractor's sole expense to verify compliance of the Material with the Contract. Reimbursement for sampling and/or testing performed by the Engineer will be charged to the Contractor at a rate of $85.00 per hour. Reimbursement for sampling and/or testing performed by a testing agency will be by invoice from the designated testing Laboratory, except for Laboratory retest and field revisit charges as specified in Section 1-05.7. These charges will be deducted from moneys due or to become due the Contractor on monthly progress estimates.

Inspections, tests, measurements and other actions taken by the Engineer are for the sole purpose of assisting the Engineer to assess whether or not Work, Materials, rate of progress, and quantities comply with the Contract. These actions by the Engineer do not relieve the Contractor from determining independently that full compliance with the Contract is met at all times, or relieve the Contractor from any responsibility for the Work.

Upon request, the Contractor must remove or uncover any portions of completed Work for inspection by the Engineer. After inspection, the Contractor must make restoration conforming to the standards required by the Contract. The costs associated with uncovering, removing, testing, and retesting as applicable, and restoring exposed Work and Material, including compensating the Engineer for any additional professional services required including retesting and as specified in Section 1-05.7, is at the Contractor's sole expense, if:

1. The exposed Work or Material proves to be unacceptable; or
2. The exposed Work or Material was placed without authority or due notice to the Engineer.

If the exposed Work proves to be acceptable and the Contractor had performed the original Work with the authority of and due notice to the Engineer, payment will be made as extra Work for all costs associated with the uncovering, removing, and restoration and the Contract Time will be adjusted.

Where Work is required to be performed on any facility of a public agency, railroad, or utility, or to the satisfaction of any federal, state, county, or municipal agency, their representatives must be permitted to inspect the Work when the Contractor is

advised by the Engineer to allow them to do so. The Contractor agrees that such inspection does not make such representatives a party to the Contract, and does not constitute an interference with the rights of the Owner or the Contractor.

1-05.7 DEFECTIVE WORK AND UNAUTHORIZED WORK

The Engineer will not pay for unauthorized Work or defective Work. Work and Materials that do not conform to the requirements of the Contract, Work done beyond lines and grades shown on the Drawings or established by the Engineer, or extra Work and Materials furnished without written approval of the Engineer will be considered defective Work or unauthorized Work as applicable. Such Work is at the Contractor's risk and sole expense and may be rejected, even if the Work has been inspected, or a progress estimate is made for payment.

When directed by the Engineer, such Work or Material must immediately be remedied, removed, replaced, or disposed of and all costs, including retesting costs as applicable, associated with such Work is at the Contractor's sole expense. Such Laboratory retesting costs of replaced or reconstructed Work or Material will be charged to the Contractor per the following schedule:

Test Name	Specification Section	Unit	Cost of Unit Retest
Field Soil Density Reading	Section 2-11	Each	$125.00
Concrete Pavement Coring	Section 5-05	Each	$225.00
Asphalt Pavement Coring	5-04.3(9)	Each	$225.00
Soil/Aggregate Sieve Analysis	9-03.13	Each	$175.00
Moisture-Density Curve	Section 2-11	Each	$275.00
L A Abrasion	9-03.13, 9-03.15	Each	$175.00
Soundness	9-03.15	Each	$125.00
Organic Content	9-14.1(5)	Each	$75.00
Epoxy Pull Out Test	6-02.3(24)	Each	$275.00
Asphalt Concrete Sieve Analysis	5-04.3(7)A	Each	$225.00
Asphalt Concrete Binder Content	5-04.3(7)A	Each	$125.00
Asphalt Concrete Air Void Analysis (V_A)	5-04.3(7)A	Each	$225.00
Concrete Compressive Strength	5-05.3(4)B	Each	$75.00

Each field revisit by the Laboratory for the purpose of retesting previously identified unacceptable Work or Material will be charged to the Contractor at the rate of $150.00 each visit. For test methods not shown here, the rate for reimbursement will be charged to the Contractor as the actual cost of the test incurred by the Owner.

These charges will be deducted from moneys due or to become due the Contractor on monthly progress estimates.

Failure on the part of the Engineer or an Assistant to reject defective Work or unauthorized Work does not release the Contractor from the Contractor's contractual obligations, be construed to mean acceptance of such Work or Material by the Owner or, after the Completion Date, bar the Owner from recovering damages or obtaining such other remedies as may be permitted by law.

No adjustment in the Contract Time or payment will be allowed because of delays in the performance of the Work as a result of correcting defective Work or unauthorized Work.

1-05.8 ENGINEER'S RIGHT TO CORRECT AND RECOVER COSTS FOR DEFECTIVE OR UNAUTHORIZED WORK

If the Contractor fails to remedy defective Work and/or unauthorized Work within the time specified in a written notice from the Engineer, or fails to perform any part of the Work required by the Contract, the Engineer may correct and remedy such Work, as may be identified in the written notice, by any means necessary, including the use of Owner forces.

If the Contractor fails to comply with a written notice to remedy what the Engineer determines to be an emergency situation due to defective or unauthorized Work or due to the Contractor failing to perform Work, the Engineer may have the defective Work and unauthorized Work, or both as may apply, corrected immediately, have the rejected Work removed and replaced, or have Work the Contractor fails to perform completed by using in house or other forces. An emergency situation is any situation that, in the opinion of the Engineer, a delay in its remedy could be potentially unsafe, or might cause serious risk of loss or damage to the public.

The Contractor must pay any direct or indirect costs incurred by the Engineer to correct or remedy the Contractor's defective or unauthorized Work, or any damage resulting from the Contractor's refusal or failure to perform any Work. This includes the cost to repair or replace work completed by others damaged due to correcting or removing the Contractor's defective or unauthorized work. Payment will be deducted by the Engineer from any payments due to the Contractor.

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No adjustment in Contract Time, payment, or both will be allowed because of the delay in the performance of the Work attributable to Owner's exercise of the right provided by this Section. Exercise of this right does not diminish the Owner's right to pursue additional remedy or damages with respect to the Contractor's failure to perform the Work as required.

1-05.9 EQUIPMENT AND MACHINERY

Equipment and machinery must be adequate for the purposes used, kept in good working condition, and operated by competent operators. The Contractor is alerted that several Sections have additional specific equipment or machinery requirements. The Contractor is also alerted that several Sections have requirements for the Engineer to have safe and convenient access to facility and Contractor equipment for observation and sampling purposes, and may also require a safe and convenient temporary area for on-site testing purposes, see Sections 1-09.1, 1-09.2, 5-04.3(1), 5-05.3(3), and 6-02.3(4).

Upon request, the Contractor must provide, at no additional cost to the Owner, an operating and maintenance manual for each model or type of mixing, placing, or processing equipment before using it in the Work. The Contractor must also provide test instruments to confirm whether the equipment meets operating requirements, such as vibration rate, revolutions per minute, or any other requirements.

The Contract may require automatically controlled equipment for some operations. If the automatic controls on such equipment fail, the Contractor may operate the equipment manually for the remainder of that Working Day, provided the method of operation produces results otherwise meeting the Specifications. Continued operation of the equipment manually beyond this Working Day will be permitted only by specific authorization of the Engineer.

The Engineer will reject equipment that repeatedly breaks down or fails to produce results within the required tolerances. The Contractor must promptly replace rejected equipment. Rejection and replacement of equipment does not provide the Contractor a right to additional payment or time.

1-05.10 GUARANTEES AND WARRANTIES

The obligations under this Section must survive the Completion Date or termination of this Contract.

1-05.10(1) GENERAL GUARANTY AND WARRANTY

The Contractor must furnish to the Engineer any guaranty or warranty furnished as a normal trade practice in connection with the purchase, by the Contractor or a Subcontractor, of any equipment, Materials, or items incorporated in the Work.

Upon written notice within 1 year after the Physical Completion Date, the Contractor must promptly return and correct defective or unauthorized Work at no additional cost to the Owner. If the Contractor does not promptly comply with the written notice to correct defective and unauthorized Work as may apply, or if an emergency exists, the Engineer may have defective Work and unauthorized Work corrected or removed and replaced as provided by Section 1-05.8.

The Contractor agrees the above 1 year limitation does not exclude or diminish the Owner's rights under any law to obtain damages and recover costs resulting from defective Work and from unauthorized Work discovered after 1 year but before the expiration of the legal time period set forth in RCW 4.16.040 limiting actions on a Contract in writing, or liability expressed or implied arising out of a written agreement.

1-05.10(2) WARRANTY OF TITLE

The Contractor must warrant good title to all Materials, Supplies, and equipment purchased for, or incorporated in, the Work. Nothing contained in this paragraph, however, defeats or impairs the right of persons furnishing Materials or labor, to recover under any bond provided by the Contractor for their protection, or any rights under any law permitting such persons to look to funds due the Contractor in the hands of the Owner.

The provisions of this paragraph must be inserted in all subcontracts and Material Contracts, and notice of its provisions must be provided to all persons furnishing Materials for the Work when no formal Contract is entered into for such Materials.

1-05.11 FINAL INSPECTION

1-05.11(1) SUBSTANTIAL COMPLETION DATE

When the Contractor considers the Work to be substantially complete, the Contractor must notify the Engineer and request the Engineer establish the Substantial Completion Date. To be considered substantially complete the following conditions must be met:

1. The Owner must have full and unrestricted use and benefit of the facilities, both from an operational and safety standpoint.
2. Only minor incidental Work, replacement of temporary substitute facilities, or corrective or repair Work remains to reach Physical Completion of the Work.
3. Operation and Maintenance information, when specified in the Contract in Section 1-05.3 and 1-05.11(3) as required to allow the Owner to have full unrestricted use.

The Contractor's request must list the specific items of Work in Section 1-05.11(1) item 2. that remain to be completed to reach Physical Completion. The Engineer will schedule an inspection of the Work with the Contractor to determine the status of completion.

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If, after inspection, the Engineer concurs with the Contractor that the Work is Substantially Complete, the Engineer will, by written notice to the Contractor, establish the Substantial Completion Date. If, after this inspection, the Engineer does not consider the Work Substantially Complete, the Engineer will, by written notice, notify the Contractor giving the reasons.

Upon receipt of written notice concurring in or denying Substantial Completion, whichever is applicable, the Contractor must pursue vigorously, diligently, and without unauthorized interruption, the Work necessary to reach Substantial and/or Physical Completion. The Contractor must provide the Engineer with a revised critical path schedule indicating when the Contractor expects to reach Substantial and/or Physical completion of the Work.

The above process must be repeated until the Engineer establishes the Substantial Completion Date.

The Engineer may also establish the Substantial Completion Date unilaterally.

1-05.11(2) FINAL INSPECTION AND PHYSICAL COMPLETION DATE

The Engineer will not make the final inspection until the physical Work required of the Contract has been completed. This Work must include: final cleanup as specified in Sections 1-04.10 and 1-07.24; providing the Engineer with all required submittals as specified in Section 1-05.3; completing operational testing and submitting O&M manuals when specified in the Contract, see Sections 1-05.3 and 1-05.11(3); and all extra Work ordered by the Engineer. If the Engineer believes a written release from a private property owner, as specified in Sections 1-04.10 and 1-07.24, is being arbitrarily withheld, the Engineer may at his or her sole discretion accept that portion of the Work involved.

When the Contractor considers the Work physically complete and ready for final inspection, request in writing that the Engineer schedule a final inspection. Within 5 Days, the Engineer will set a date for final inspection. The Engineer and the Contractor will then make a final inspection, and the Engineer will notify the Contractor in writing of all particulars in which the final inspection reveals the Work incomplete or unacceptable. The Contractor must immediately take such corrective measures as are necessary to remedy the listed deficiencies. Corrective Work must be pursued vigorously, diligently, and without interruption until Physical Completion of the listed deficiencies.

If action to correct the listed deficiencies is not initiated within 7 Days after receipt of the written notice listing the deficiencies, the Engineer may, upon written notice to the Contractor, take whatever steps are necessary to correct those deficiencies. Such steps may include the correction of defects using in house forces or by others. In such case, the direct and indirect costs incurred by the Engineer will be deducted from moneys due or becoming due the Contractor. Such indirect or direct costs must include payment for additional professional services required in cost of repair and replacement of the Work of others which is destroyed or damaged by correction, removal, or replacement of the Contractor's deficient Work. The Contractor will not be allowed an extension of Contract Time because of a delay in the performance of the Work attributable to the exercise of the Engineer's right hereunder.

Upon correction of all deficiencies, the Engineer will notify the Contractor and the Owner, in writing, of the date on which the Work was determined physically complete. That date constitutes the Physical Completion Date of the Contract, but does not imply all obligations of the Contractor under the Contract have been fulfilled.

1-05.11(3) OPERATIONAL TESTING, AND OPERATION AND MAINTENANCE (O&M) MANUALS

It is the intent of the Owner to have, at the Substantial Completion Date, a complete draft O&M manual and operable system with all information necessary to operate and maintain the system. Therefore, when the Work involves the installation of machinery or other mechanical equipment; street lighting; electrical distribution and transmission systems; signal systems; irrigation systems, buildings; or other similar Work, it may be desirable for the Engineer to have the Contractor operate and test the Work for a period of time after final inspection but before the Physical Completion Date. Whenever items of Work are listed in the Project Manual for operational testing, they must be fully tested under operating conditions for the time period specified to ensure their acceptability before the Physical Completion Date. During and following the test period, the Contractor must correct any items of workmanship, Materials, or equipment that proves faulty, or are not in first class operating condition. Equipment, electrical controls, meters, or other devices and equipment to be tested during this period must be tested under the observation of the Engineer, so that the Engineer may determine their suitability for the purpose for which they were installed. The Physical Completion Date cannot be established until testing and corrections have been completed to the satisfaction of the Engineer.

Before operational testing or as acceptable to the Engineer, the Contractor must submit 3 sets of O&M manuals for the item being tested. During operational testing, the Contractor must accommodate the Engineer in understanding and applying O&M manual instruction and recommendation. Should inconsistencies between the O&M manual and actual operation or actual maintenance be discovered, the Contractor must provide 3 sets of Supplier provided amendments addressing all correction.

Each O&M manual must include the following:

1. A title indicating its contents permanently labeled on the outside of the binder.
2. A cover sheet identifying equipment with the process or assembly with which it is used, according to:
    a. Location
    b. Section number and title
    c. Engineer’s Drawing (sheet) number
3. A table of contents.

4. A text as prepared by the manufacturer and including the following information or materials, as applicable:
    a. Equipment operating instructions including start-up and shut-down procedures, safety precautions, and instructions on specific controls;
    b. Electrical test reports, including electrical system and motor test reports;
    c. Mechanical test reports, including factory running tests and performance rating tests for motorized equipment;
    d. Shop Drawings;
    e. Assembly Drawings;
    f. Parts list;
    g. Bill of Materials;
    h. Wiring diagrams;
    i. Maintenance instructions to cover any routine operation required to ensure the satisfactory performance and longevity of the equipment, such as lubrication instructions, lists of lubricants, and belt tensioning;
    j. Maintenance summary forms; and
    k. Manufacturer's warranty.

Manuals must be bound in 3-ring or spiral binders with plastic or other stain resistant covering. Manuals must be 8-1/2 x 11 inches in size except for oversize Drawings, which must be bound in fold out fashion or folded and placed inside a bound in envelope. Multiple thinner binders are preferred to extra-large and bulky binders where subdivisions of the contents permit. Equipment operating instructions and test reports must be bound in front of maintenance instructions and other materials.

Unless the Contract specifies otherwise, the costs for power, fuel, labor, Material, Supplies, and everything else needed to complete operational testing, must be included in the various Bid Item prices related to the system being tested, unless specifically set forth otherwise in the Bid Form.

Operational and test periods, when required by the Engineer, do not affect a manufacturer's guaranties or warranties furnished under the terms of the Contract.

1-05.12 COMPLETION AND CONTRACT CLOSE OUT

After the Physical Completion Date is established and after all obligations of the Contract, except retainage release have been completed, the Engineer will submit an acceptance package and supporting documents to PC as specified in Section 1-09.9(4)A.

On behalf of the City, PC will establish the Contract Completion Date, submit the Notification of Completion to the State agencies, and publish notice of the Completion Date as specified in Section 1-09.9(4)B.

After all legal requirements are met, retainage will be released according to the priority and process under RCW 60.28 and as specified in Section 1-09.9(4)C.

1-05.13 SUPERINTENDENTS, LABOR, AND EQUIPMENT

1-05.13(1) GENERAL

The Contractor must keep a copy of the Contract at the Project Site, give the Work the attention required to maintain scheduled progress, and cooperate with the Engineer in the administration of the Work.

The Contractor must be present, in person, or be continuously represented by a duly authorized representative at the Project Site during progress of the Work. The Contractor must assign a project manager or superintendent named in the SBRC or in writing before starting the Work, who is experienced, capable of understanding the Contract, and able to supervise the performance of the Work. The superintendent or project manager must comply with the SBRC specified in Section 1-02.2. The Contractor's superintendent or project manager must have full authority to represent and act for the Contractor. Written notice provided to the project manager or superintendent is as binding as if provided to the Contractor.

The Work must be performed under the continuous supervision of competent personnel experienced in performing the class of Work. Upon written direction of the Engineer, the Contractor must discharge any incompetent, careless, or negligent employees, including supervisors. Upon written direction of the Engineer, the Contractor must immediately remove from the Project Site any superintendent who repeatedly fails to comply with a written order, direction, instruction, or determination from the Engineer. The Contractor must then request the assignment of a new superintendent, in writing to the Engineer. Failure to comply with such direction is sufficient grounds for termination of the Contract.

Machinery and equipment must comply with Section 1-05.9.

1-05.13(2) PERFORMANCE

A Contractor Performance Evaluation is required for all projects with an engineer's estimate of $1,000,000 or more. The Contractor Performance Evaluation process consists of 2 reviews:

1. Mid-point Contractor Performance Evaluation will take place at mid-point of the project as determined by the Engineer.
2. Final Contractor Performance Evaluation will be completed prior to Project's Completion Date.

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The Final Contractor Performance Evaluation will record the permanent evaluation scores for the Contractor's performance. Deficient scores of 59 or below for any individual category may be grounds for a determination of non-responsibility on future City projects. Overall performance evaluation scores deemed deficient with scores of 59 or below from three separate projects may be grounds for Contractor debarment under Section 1-08.10(8) and SMC 20.70.

The Contractor may contest final criteria scores by filing a protest in writing. Protests must be submitted to PC within 5 Business Days after receipt of the Final Contractor Performance Evaluation.

Submit protests to: Director, Purchasing and Contracting, Department of Finance and Administrative Services.

USPS Mailing Address:

City of Seattle

Department of Finance and Administrative Services – Purchasing and Contracting

PO Box 94687

Seattle, WA 98124-4687Email: FAS_PW_Admin@Seattle.gov

Protests must comply with the following requirements:

a. The protest must specifically identify which scoring criteria is contested;

b. The protest must propose a score that reflects the protester's opinion of the Contractor's final performance; and

c. The protest must provide the basis of information and facts that refute the final criteria score and supports a revision to the proposed score.

The PC Director or designee will review and decide on all final criteria score protests. The Director's decision on the protest is final and exhausts all administrative remedies.

1-05.13(3) CONSTRUCTION STORMWATER POLLUTION PREVENTION COORDINATION

The Contractor must assign a Construction Stormwater and Pollution Prevention Coordinator (CSPPC) to the Work and must identify the CSPPC at the preconstruction conference. CSPPC responsibilities must be formally assigned to one or more of the Contractor's supervisors who are actively involved in the planning and management of field Contract activities. Alternates may be identified. The CSPPC is responsible for ensuring the Contractor's compliance with all City of Seattle, other local jurisdictions, county, state, and federal, construction stormwater pollution prevention requirements and must be available on call 24 hours per Day through the duration of the Work. The CSPPC must be listed on the emergency contact list as specified in Section 1-05.13(4).

The CSPPC has overall responsibility for compliance and coordination of the following plans and submittals for the project as specified in Section 8-01, and any other pollution prevention elements on the project:

1. CSECP
2. TVSPP
3. SP
4. TDP
5. Temporary Dewatering Plan

Identify a lead for each plan listed above. The identified leads are responsible for compliance with the requirements specified below. The CSPPC may be the lead on any or all elements. If the Contractor identifies multiple leads, they must clearly identify the responsibilities of each.

1-05.13(3)A CERTIFIED EROSION AND SEDIMENT CONTROL LEAD (CESCL)

The Contractor must assign a Certified Erosion and Sediment Control Lead (CESCL) to the Work and identify the responsible party at the preconstruction conference. The CESCL must be listed on the emergency contact list specified in Section 1-05.13(4).

The CESCL must have authority to act on behalf of the Contractor and must be available, on call, 24 hours per Day throughout the period of construction. The CESCL is responsible for ensuring the Contractor's compliance with all City of Seattle, other local jurisdictions, county, state, and federal erosion and sediment control and water quality requirements.

The CESCL must have, for the life of the Contract, a current certificate of training in Construction Site Erosion and Sediment Control from a course approved by the Washington State Department of Ecology or CPESC certification.

The Washington State Department of Ecology maintains a list of CPESC training and certification providers at: http://www.ecy.wa.gov/programs/wq/stormwater

For additional information on the CPESC certification, go to: http://www.ecy.wa.gov/programs/wq/stormwater/cescl.html

1-05.13(3)B TREE, VEGETATION AND SOIL PROTECTION LEAD

The Contractor must assign a Tree, Vegetation and Soil Protection lead (TVSPL) to the Work and must identify the responsible party at the preconstruction conference. This individual must be listed on the emergency contact list specified in Section 1-05.13(4).

The TVSPL must be given the authority and must be responsible for ensuring compliance with Tree, Vegetation and Soil Protection, as specified in Sections 1-07.16 and Section 8-01.

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1-05.13(3)C SPILL PREVENTION AND RESPONSE LEAD

The Contractor must assign a Spill Prevention and Response lead (SPRL) to the Work and must identify the responsible party at the preconstruction conference. This individual must be listed on the emergency contact list as specified in Section 1-05.13(4).

The SPRL must be given the authority and is responsible for ensuring compliance with Sections 1-07.15(1) and Section 8-01.

1-05.13(3)D TEMPORARY DISCHARGE LEAD

The Contractor must assign a Temporary Discharge lead, when temporary discharge of process water, groundwater, or concentrated and collected stormwater is a component of the Work. The lead must be identified at the preconstruction conference and must be listed on the emergency contact list as specified in Section 1-05.13(4).

The Temporary Discharge lead is responsible for ensuring compliance with applicable permits, requesting permits, and complying with Sections 1-07.6 and Section 8-01, preparing and updating the Temporary Discharge Plan, measuring flow, performing and coordinating water quality testing, preparing reports and record keeping as required by permits.

1-05.13(3)E TEMPORARY DEWATERING LEAD

The Contractor must assign a temporary dewatering lead when dewatering is a component of the Work. The lead must be identified at the preconstruction conference. The lead must be listed on the emergency contact list as specified in Section 1-05.13(4).

The temporary dewatering lead is responsible for dewatering as specified in Section 2-08.

1-05.13(4) EMERGENCY CONTACT LIST

The Contractor must submit an emergency contact list to the Engineer no later than 5 Calendar Days after the date the Contract is executed. The list must include, at a minimum, the Contractor's Project Manager, or equivalent, the Contractor's Project Superintendent, the Traffic Control Supervisor, and the individuals fulfilling the lead requirements as specified in Section 1-05.13(3). The list must identify a representative with delegated authority to act as the emergency contact on behalf of the Contractor and include 1 or more alternates. The emergency contact must be available upon the Engineer's request except during normal working hours. The emergency contact list must include 24-hour telephone numbers for all individuals identified as emergency contacts or alternates.

1-05.14 COOPERATION WITH OTHER CONTRACTORS

The Owner may perform other work at or near the Project Site, including Material sites, with forces other than those of the Contractor. This work may be done with or without a Contract. Should such Work be underway or subsequently undertaken within or adjacent to this project, the Contractor must cooperate with all other Contractors or other forces, and conduct the Work so that the operations of both suffer the least interference and delay. Should there be disagreement between the Contractors, or the Contractor and the Engineer, as to the manner and order of performing Work, such disagreement will be resolved by the Engineer. The Engineer's decision in these matters is final, as provided in Section 1-05.1.

If the Contract provides notice of other work that may affect the Work, or other work is apparent from the Project Site investigation specified in Section 1-02.4, the Contractor must account for coordinating the Work, and any resulting cost must be included in the various Contract Bid Items that make up the Work.

1-05.15 METHODS OF SERVING NOTICES

All notices must be in writing and are considered delivered and service complete when:

1. Delivered by certified or registered mail to the other party at their last provided address; or
2. Delivered in person to the other party; or
3. Delivered to an authorized representative of the other party at the Project Site; or
4. An electronic copy is delivered by electronic mail to the Engineer if sent to the City, and, if sent to the Contractor, to an authorized representative of the Contractor.

1-05.16 WATER AND POWER

The Contractor must make necessary arrangements, and must bear the costs, for power and water necessary for the performance of the Work. See the exception for water in Section 2-12.

1-05.17 ORAL AGREEMENTS

No oral agreement or conversation with any officer, agent, or employee of the Owner, either before or after the Execution Date of the Contract, affects or modify any of the terms or obligations contained in the Contract. Such oral agreement or conversation is considered as unofficial information and in no way binding on the Owner, unless put in writing.

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SECTION 1-06 CONTROL OF MATERIALS

1-06.1 APPROVAL OF MATERIALS BEFORE USE

The City encourages the use of environmentally friendly Materials and recycled material when applicable.

Before use, the Contractor must notify the Engineer of all proposed Materials. The Contractor must use the Request for Acceptance of Material Sources (RAMS) form to identify the source for all Materials proposed for use on the project.

All equipment, Materials, and articles incorporated into the permanent Work:

1. Must be new, unless the Contract allows otherwise;
2. Must comply with the requirements of the Contract and be accepted by the Engineer as specified in Section 1-05.3;
3. May be inspected or tested at any time during their preparation and use;
4. Must not be used in the Work if they become unfit after being previously approved; and
5. Must be verifiable by shipping invoice, certification, load tickets, or other means acceptable to the Engineer.

1-06.1(1) NAMED PRODUCTS

Specified products are occasionally called for by manufacturer or name in the Contract to establish a basis for certain Materials, equipment, or processes. Wherever products are specified by name, the Specification will be treated as if the phrase "or equal" appears after the named product whether “or equal” is indicated or not, unless indicated as without substitution per Section 1-06.1(3). The phrase “or equal” does not imply the availability of such “or equal” products. The terms "or equal" and "or approved equal" are considered synonymous.

When a product is mentioned by name, it includes products that will measure up to the designated standards of the named product mentioned as an equal. The Contractor is responsible for demonstrating that the proposed product is equal. The proposed equal product must comply with the essential requirements of the Contract and items 2. to 5., as specified in Section 1-06.1(2). The Engineer’s review of the proposed product for as equal status will be final.

1-06.1(2) REQUEST FOR SUBSTITUTION OF MATERIAL

If the Contractor prefers to substitute a different Material than what has been specified, the Contractor must obtain the written approval of the Engineer before incorporating the substitute product into the Work. In making a request for substitution of Materials, the Contractor’s submittal must demonstrate the substitution meets the essential requirements of the Contract and:

1. Is equal and shows a cost savings to the Owner, or superior without a cost increase to the Owner;
2. Is equal or superior in all respects to the Material, equipment, or process specified;
3. Is of equal or superior value in the essential and material requirements;
4. Is equal or superior in functionality and at a minimum qualitatively equal or identical; and
5. Has the same or better guarantee or warranty as the item specified.

The Engineer may deny requests for substitution if the substitution is not in the best interest of the Owner, or if time or resources are not available for review. The Engineer’s decision will be final. The Contractor must Bid according to the Material specified in the Contract. See Section 1-05.3 for submittal requirements.

The Contractor will not be granted any time extension for review of substitution proposals. The Contractor is responsible for the performance of substituted Materials. The Engineer may revoke the use of substituted Materials at any time. No time or cost will be granted related to the substitutions.

1-06.1(3) MATERIALS WITHOUT SUBSTITUTION

If a Material, product, equipment, or processes is specified “without substitution” or “no substitution,” there will be no consideration of substitution.

1-06.2 SAMPLES AND TESTS FOR ACCEPTANCE OF MATERIALS

The Contractor must deliver representative samples, from the Contractor, producer, manufacturer, or fabricator, to the Engineer without charge before incorporating Material into the Work. Samples, not already provided for testing as specified in Section 1-03.1(4) item 1, must be provided in sufficient time and quantities to allow testing by the Engineer before use. The Engineer may require samples be submitted at any time. The Contractor, including Subcontractor at any tier, must allow the Engineer full and unrestricted access to its facilities for inspection, observation, sampling and testing purposes. Samples not taken by or in the presence of the Engineer's representative will not be accepted for test, unless so permitted by the Engineer.

Material testing must comply with any specified methods of testing set forth in the Contract, the Washington State Department of Transportation Materials Manual, or applicable designated, recognized standards of national organizations. See Section 1-01.2(1) for the standard acronyms of designated recognized standards organizations used throughout the Contract. This will apply to field tests, as well as to Laboratory tests. The designated, recognized standard in effect on the Day of the Advertisement for Bids for the Work will apply in each case unless the Contract references a standard with a specific publication date differing from the current edition.

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1-06.3 MANUFACTURER'S CERTIFICATE OF COMPLIANCE

The Engineer may accept certain Materials based on a manufacturer's certificate of compliance as an alternative to Material inspection and testing when these Materials are specifically identified in the Contract. Unless the Contractor requests and obtains written authority from the Engineer for an exception to do otherwise, the manufacturer's certificate of compliance must be submitted before use of the Material. No payment will be made for Work incorporating Material without an acceptable manufacturer's certificate of compliance. If, for any reason, the Contractor has not provided an acceptable manufacturer's certificate of compliance for the Materials specified in the Contract by the Completion Date, the Engineer may process the final payment as provided by Section 1-09.9 without paying for the Work performed on such a basis.

Where Materials are specified to conform to industry or technical society reference standards of designated recognized standards organizations, such as ASTM or AASHTO or ACI or AWWA, the manufacturer's certificate of compliance must indicate such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. Instead of the label or listing, the manufacturer's certificate of compliance must contain a statement from a testing laboratory stating that the Material or Material property specified has been tested per the specified organization's test methods and that the item complies with specified organization's reference standard, or that the Material property complies with the specified property of the specified organization's reference test standard, see Section 1-06.5.

The manufacturer's certificate of compliance must identify the manufacturer, the type, and quantity of Material being certified, and compliance with the applicable standards. Where Specifications require additional information be provided, the Contractor must provide the additional information. Include the signature of a responsible corporate official of the manufacturer and supporting mill tests or documents. A manufacturer's certificate of compliance must be furnished with each lot of Material delivered to the Work unless the Contract specifies otherwise. The certified lot must be clearly identified in the manufacturer's certificate of compliance.

All Material used based on a manufacturer's certificate of compliance may be sampled and tested at any time. Any Material not conforming to Contract requirements will be subject to rejection whether in place or not. The Engineer may refuse to accept Material based on its manufacturer's certificate of compliance.

1-06.4 HANDLING AND STORAGE OF MATERIALS

Materials used in the Work must be handled and stored using methods that prevent damage, exposure to elements, mixing with foreign materials, or deterioration from any other cause. The Engineer will not accept or sample for testing, Materials that are improperly handled or stored.

The Contractor must repair, replace, or make good all Owner provided Materials that are damaged or lost due to the Contractor's operation or while in the Contractor's possession, at no additional cost to the Owner.

1-06.5 REQUIREMENTS FOR TESTING AND TEST RESULTS FROM PRIVATE LABORATORIES AND INDIVIDUALS

When testing is required by a private laboratory or individual, whether by Specification or by condition of Street Use Permit, that laboratory or individual must be accredited or certified by an AASHTO or ASTM or A2LA (American Association for Laboratory Accreditation) or other designated recognized standards organization with recognized accreditation authority or certification authority. Such accreditation or certification must be current during such testing or for the life of the Contract, whichever is greater.

Every test must be performed with testing equipment calibrated as recommended by the equipment manufacturer, and at the calibration frequency recommended either by the test equipment manufacturer or the applicable test standard, whichever is most frequent.

Personnel performing tests must be qualified by certification from a designated recognized standards testing organization to perform the required test.

Sample preparation, installation of sample in test equipment or equipment installation in sample or inspection or as may apply, equipment operation, test data acquisition, test data reduction, and test data summary must be performed per the specified test standard unless required otherwise in the Contract.

Unless the Contract specifies otherwise, results of testing must be reviewed, approved, and stamped by a Professional Engineer with current license under RCW 18.43, or by other certifying individual, who is qualified to review and approve such results or perform such testing. The testing must be performed to the satisfaction of the Engineer, per the designated recognized standards organization's test.

The Contractor and the testing laboratory must allow the Engineer to visit the laboratory to observe the Work for the purposes of reviewing and observing the laboratory's quality system, the testing, the technician, the sample preparation, accreditation, personnel certifications and qualifications, test data administration, and as may be required by the Engineer or by the Contract.

All test results submitted to the Engineer by private testing laboratory must be accompanied with the following information:

1. A manufacturer's certificate of compliance by Professional Engineer or certified individual as may apply, listing the test standard used and that the testing was in compliance with the Contract.

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2. The name of the testing laboratory including the accrediting agency, date of accreditation, principal in charge of testing, name of personnel doing testing if different including qualifications, address, phone number, and e-mail address.
3. The results of the test presented in the format required by the designated recognized test standard unless the Contract specifies otherwise.
4. Where and how the sample was obtained, any care provided to the sample, and any care provided in preparing the sample not specified in the test standard, any deviations from the testing standard used in testing.
5. Any other information required by the Contract.

1-06.6 SIEVES FOR TESTING

Sieves for testing must be as specified in Section 9-03.13

SECTION 1-07 LEGAL RELATIONS AND RESPONSIBILITIES TO THE PUBLIC

1-07.1 LAWS TO BE OBSERVED

1-07.1(1) GENERAL

The Contractor is responsible for knowing and complying with all federal, state, tribal, county, and city laws, executive orders, ordinances, rules, and regulations applicable to the Work. All references to laws, executive orders, ordinances, rules, and regulations include all laws, executive orders, ordinances, rules, or regulations as adopted or amended after the Contract Date.

Without usurping the authority of other agencies, the Engineer will cooperate with them in their efforts to enforce legal requirements. Upon awareness of any violation of a legal requirement, the Engineer will notify the Contractor in an effort to achieve compliance. The Engineer may also notify the agency responsible for enforcement if the Engineer determines that action is necessary to achieve compliance with legal requirements. The Engineer may also assist the enforcement agency with Contractor compliance to the extent such assistance is consistent with the provisions of the Contract.

For payment related to changes in law or taxes occurring after the Bid Opening Date, see Section 1-09.4(2).

1-07.1(2) SAFETY RULES AND STANDARDS

The Contractor is solely responsible for:

1. The safety, efficiency, and adequacy of the Contractor's facilities, equipment, Materials and methods;
2. Any damage or injury resulting from the failure, or improper maintenance, use, or operation of the Contractor's facilities, equipment, and methods; and
3. Conditions of the Project Site, including safety of all persons and property during performance of the Work.

These requirements apply continuously and are not limited to normal working hours. The Engineer's review of the Contractor's performance may include review of, but does not determine the adequacy of, the Contractor's safety measures on the Work Site.

The Contractor must establish, maintain, and supervise a safe and healthy working environment, an Acceptable Work Site, an accident prevention program, and training programs to improve the skill and competency of all employees with respect to occupational safety and health.

The Washington State Department of Labor and Industries (L&I) is the sole and paramount administrative agency responsible for the administration of the provisions of the Washington Industrial Safety and Health Act of 1973 (WISHA), as amended.

The Contractor must comply with the Federal Occupational Safety and Health Act of 1970 (OSHA), including all revisions and amendments thereto; the provisions of WISHA, as amended; and as a minimum, the requirements of Title 296 WAC, L&I.

In addition, the Contractor must comply with the requirements of the National Electric Safety Code, when applicable.

In cases of conflict between different safety regulations, the regulation containing the more rigorous safety standard applies.

The Contractor must maintain at the Project Site office or other well-known and readily accessible place at the Project Site, all articles necessary for providing first aid to the injured. The Contractor must establish, publish, and make known to all employees a Health and Safety Plan including procedures for ensuring that employees who may be injured on the Project Site are immediately removed to a hospital or doctor's care. Employees are not permitted to work on the Project Site before the Contractor has established and made known procedures for removal of injured persons to a hospital or a doctor's care.

1-07.1(3) RESERVED

1-07.2 STATE TAXES

1-07.2(1) GENERAL

The Washington State Department of Revenue has issued special rules designed to assist the Contractor in accurately reporting to the Department of Revenue the Contractor's tax liability. Although information may be included in the Contract

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regarding the application of State taxes to a particular Contract, Bid Item or included on the Bid Form, the Contractor is responsible for applying the correct interpretation of the laws and regulations relating to such taxes.

No adjustments will be made to the amount to be paid by the Owner under the Contract because of any misunderstanding by the Contractor as to the Contractor's liability for, or the amount of, any taxes. If in doubt as to the tax procedures in any particular case, the Contractor must consult with the Washington State Department of Revenue.

1-07.2(2) STATE SALES TAX RULE 171

WAC 458-20-171 and its related rules apply to building, repairing, or improving streets and roads, that are owned by a municipal corporation, or political subdivision of the State, or by the United States, and that are used, primarily, for foot or vehicular traffic. For Work performed in such cases, labor and service charges are not subject to the retail sales tax and no such tax on labor and service charges must be included in Bid prices and other Contract amounts. The Contractor is responsible for paying retail sales tax on Materials, equipment, and Supplies used or consumed in doing the Work or used in such projects, and must pay retail sales tax on the purchase of such Materials. The Contractor must include such retail sales taxes on Materials, equipment, and Supplies in the various Bid Item prices and other Contract amounts.

1-07.2(3) STATE SALES TAX RULE 170

WAC 458-20-170, and its related rules, applies to the constructing and repairing of new or existing buildings, or other structures, on Real Property. For Work performed in such cases, the Contractor must collect from the Owner retail sales tax on the full Contract price. The Owner will automatically add this sales tax to each payment to the Contractor. For this reason, the Contractor must not include the retail sales tax in the Bid Item prices, or in any other Contract amount subject to Rule 170, except as provided below.

The Owner will not add in sales tax for a payment the Contractor or a Subcontractor makes on the purchase or rental of tools, machinery, equipment, or consumable Supplies not integrated into the project. Such sales tax must be included in the Bid Item prices or in any other Contract amount.

1-07.2(4) SERVICES

The Contractor must not collect retail sales tax from the Owner on any Contract wholly for professional or other services as defined in State Department of Revenue Rules 138 and 224.

1-07.3 MANAGEMENT AND DISPOSAL OF WASTE

1-07.3(1) GENERAL

All waste generated or encountered under this Contract must be managed per all applicable local, state and federal regulations and law. Unless otherwise specified in the Contract, the Contractor is responsible for arranging and implementing the proper handling, management, segregation, storage, transport, and disposal of all wastes that are not Dangerous Waste(s), including processing and maintaining required documentation. This includes, but is not limited to:

1. Identifying, proposing, and contracting with disposal sites that can legally accept the types of identified or characterized wastes in performing the Work;
2. Identifying, proposing, and contracting with waste transporters qualified and licensed to transport these types of identified or characterized wastes;
3. Obtaining waste clearances or other waste acceptance approvals through Public Health - Seattle & King County (PHSKC) or other agencies as appropriate and as required;
4. Creating and processing all necessary documentation, such as Certificates of Disposal or Recycling, sampling and analysis reports, waste clearance forms, waste acceptance forms, bills of lading, scale tickets, waste receipts, and others as applicable;
5. Providing the Engineer timely notice for reviewing documentation before transporting, see Section 1-05.3; and
6. Providing the Engineer copies of all documentation pertaining to waste generation, recycling and disposal.

Contract-related documents may identify Contaminated Material(s) or Dangerous Waste(s) that the Owner has documented on the Project Site. For all Contaminated Material(s) and Dangerous Waste(s) generated or encountered in connection with the Contract or Project Site, the Contractor must comply with Section 1-07.29.

The Waste Clearance Program Instructions and forms for PHSKC may be provided in the Appendix of the Project Manual or requested from the Engineer. This information is provided for the convenience of the Contractor and the Contractor is solely responsible for verifying that the information is current. Additional copies of the forms or information regarding the forms may be obtained by calling PHSKC at (206) 477-6585.

Private disposal companies and waste sites outside of King County may require other documentation, and Laboratory analysis of waste material may be required to obtain waste clearance or acceptance. Copies of all waste clearance or acceptance forms along with any associated Laboratory data must be provided to the Engineer.

Disposal sites used under the Contract must comply with all applicable rules, ordinances, codes, regulations and laws, and must have all required authorizations for the waste to be disposed.

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Loads of recyclable construction and demolition waste of a single material may be transported directly to a recycling facility. Mixed construction and demolition waste containing materials required to be recycled must be transported to a certified construction and demolition waste processor listed on the City's certified facilities website:

https://www.seattle.gov/utilities/construction-resources/collection-and-disposal/construction-and-demolition/qualified-facilities

per SMC21.36.089. Unrecyclable construction and demolition waste must be transported to disposal facilities per SC 21.36.112.

Waste sites located within the City limits of Seattle are subject to the rules and regulations set forth in Seattle's Stormwater Code and Grading Code, which are SMC Chapters 22.800 – 22.808 and 22.170, respectively, and as otherwise provided in the SMC, and must at minimum require a grading permit issued to the property owner by the Director of the Seattle Department of Construction and Inspections.

Waste sites located outside the City limits of Seattle but within unincorporated King County are subject to the rules and regulations set forth by current King County grading requirements. Sites located outside the City limits of Seattle or unincorporated King County may also be subject to rules and regulations of the local governmental authority having jurisdiction.

Disposal must comply with SMC Chapter 21.36, which provides in part that no wastes of the types identified in SMC 21.36.112 and generated within the City of Seattle must be disposed of at a facility owned or operated by King County, unless specifically agreed by the City and King County.

Options for the disposal of woody debris from clearing and grubbing include on-site grinding for use as mulch or delivery to facilities that compost or recycle woody debris into soil amendment or mulch end products. Any action required to comply with any permit and/or any approval requirements at a Contractor-provided disposal site must be performed by the Contractor at no additional cost to the Owner.

The selection of waste sites and their use is subject to Engineer approval.

1-07.3(2) SUBMITTALS

At or before the preconstruction conference, the Contractor must submit a Waste Management Plan containing a list of proposed disposal and recycle sites that allow the types of wastes and recyclable Materials that can be reasonably expected from examination of the Bid Documents and Project Site including those Materials supplied by the Contractor to perform the Work.

The submittal must:

1. Identify each disposal site and recycle site, and the estimated quantities and type of material to be disposed of or recycled at each site.
2. Identify the proposed transporter to be used for each type of waste or recyclable material and applicable licenses that may be necessary for transporting the identified or characterized waste.
3. Specifically identify any Contaminated Material(s) Not Designated as Dangerous Waste(s) or TSCA Waste(s) that the Contractor proposes to dispose or recycle.
4. Provide a waste management plan for any wastes to be stored on the Project Site before recycling or disposal. The waste management plan must provide procedures to ensure that wastes are stored in a safe, secure manner that does not allow for leakage or other releases of waste.
5. Unless otherwise specified in the Contract, provide adequate details indicating where such waste storage is proposed and the proposed controls at each location including required signs, placards, labels, or other identifying marks. Waste storage areas must be inspected at least daily. See Section 1-07.15 regarding spill prevention and control.
6. Include all documentation that will apply to or must be completed by the Engineer under the Contract, including the following:
    a. Waste acceptance criteria for the facility, including any physical characteristics and maximum allowable chemical parameters.
    b. Waste profile forms.
    c. Waste acceptance or approval documents.
    d. Bills of lading or other shipping documents required to be presented at the receiving facility; and
    e. All other documents required to be completed and submitted by the Engineer for waste review, approval, acceptance, and receipt at the facility.

At the Owner's option, all documentation may be reviewed as specified in Section 1-07.3(1).

For additional or alternate disposal and recycle sites and transporters needed during the Contract Time, the locations and information for each additional site, and qualifications and licenses of transporters, must be submitted to the Engineer for approval at least 10 Working Days before their use.

The Contractor must not dispose or recycle Dangerous Waste(s) or TSCA Waste(s) without prior and specific written approval from the Engineer.

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1-07.3(3) CONTRACTOR FOLLOW-UP DOCUMENTATION REQUIRED FOR THE ENGINEER

The Contractor must submit to the Engineer within 10 Working Days of receipt by the disposal site, 2 copies of each shipment list, also known as bill of lading or transmittal document, listing the waste material shipped from the Project Site and deposited at the waste disposal site. The submitted shipment list must have the waste site operator's confirmation of receipt of the waste, and the name of the waste transporter.

The Contractor must also provide the Engineer with copies of these documents:

1. Documentation of disposal as applicable
2. Waste sampling and analysis reports as applicable
3. Waste clearance or acceptance forms

1-07.3(4) RECYCLABLE MATERIALS

The City requires specific types of construction and demolition waste to be recycled per SMC 21.36.089 and SPU Director's Rule SW-640 (https://www.seattle.gov/utilities/about/policies). Recyclable materials include but are not limited to asphalt and cement concrete, bricks, ferrous and non-ferrous metal, carboard, untreated and unpainted wood, and new construction gypsum scrap.

The Contractor is solely responsible for any revenue obtained or expense incurred for recycling. Materials identified in the Contract as salvage materials are excluded from the provisions of this Section.

1-07.4 SANITATION

The Contractor must provide and maintain in a clean, neat, and sanitary condition, any accommodations for the Contractor and Owner employees that are necessary to comply with the requirements and regulations of the State of Washington Department of Social and Health Services and other agencies. The Contractor must commit no public nuisance and at all times dispose of all waste in accordance with all local, City, State, and federal regulations and requirements.

1-07.5 PREVENTION OF ENVIRONMENTAL POLLUTION AND PRESERVATION OF NATURAL RESOURCES

1-07.5(1) GENERAL

During the life of the Contract, the Contractor must comply with all provisions of federal, state and local statutes, city ordinances and any regulations pertaining to the prevention of environmental pollution and the preservation of public natural resources. Under RCW 39.04.120 such provisions as are reasonably obtainable are set forth below.

1-07.5(2) WATER QUALITY

The Contractor must comply with city ordinances, state, and federal laws and other regulations or rules applicable to water pollution occurring in waters of the State and in interstate waters. The Contractor must:

1. Exercise precautions throughout the life of the Contract to prevent contamination, pollution, erosion, siltation, sedimentation, and pollution of groundwater and surface waters; and to prevent damages to drainage systems, public and private property.
2. Provide for the flow of all watercourses, including but not limited to, streams, ditches, Sewers, and Storm Drains intercepted during the progress of the Work.
3. Completely restore disturbed watercourses to original or better condition, as the Contract may provide.
4. Not obstruct the gutter of any street.
5. Use all proper measures to provide for the free passage of surface water.
6. Remove and properly dispose of all surplus water, mud, silt, slicking, or other run offs pumped from excavations or resulting from sluicing or pavement cleaning or other operations.
7. Make all applicable notifications specified in Section 1-07.28.

The Contractor must comply with the water quality criteria required by the Department of Ecology and regulations of:

a. The Washington State Department of Fish and Wildlife. Comply with RCW Chapter 77.55 and associated rules published in WAC 220-660.
b. Federal statutes on oil spills enacted under the Federal Water Pollution Control Act Amendments of 1972, a copy of which may be obtained from the U.S. EPA.
c. The water quality standards of the State of Washington as set forth in WAC Chapters 173-200 and 173-201A.
d. The City of Seattle Stormwater Code, SMC Chapters 22.800-22.808.
e. Any local statute, regulation, ordinance, or rules that stipulate the various type of discharge prohibited in public Sewer systems, Storm Drains or any drainage ditch in the local jurisdiction.

State statutes on water pollution covering liability of the Contractor, penalty for violation, and liability and damages for injury or death of fish, animals, or vegetation are set forth in RCW Chapter 90.48. As an aid to the Contractor, some of the rules set forth by the various State departments are summarized below. The Contractor is cautioned, however, that each Department of the State may add other restrictions, as they deem necessary, to protect fish and to prevent air or water pollution.

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1-07.5(2)A STATE DEPARTMENT OF FISH AND WILDLIFE

In doing the Work the Contractor must:

1. Not degrade water quality in a way that would harm fish. The Washington State Water Quality Regulations are in addition to other water quality criteria specified in the Contract for the Work.
2. Promptly notify the Engineer if any fish are stranded by the Work.
3. Replant the disturbed area with trees and other vegetation species selected compatible with area conditions as determined by the Engineer, if the Work has disturbed the vegetative cover of any stream bank or shoreline areas.
4. Provide an open water channel at the lowest level of any isolated water location in the channel remaining when the Work is complete.
5. Protect fish by preventing additional siltation build-up on the bed or bottom of any body of water.
6. Allow stream flow to continue for fish passage including use of bypass as the Work may require.
7. Keep all equipment out of any flowing stream or other body of water, except when the Work requires.
8. Not remove gravel or other bottom material from within the high water flow channel bed of any stream nor from the bottom of any other body of water, unless permitted in the Contract.
9. Properly dispose of any debris generated by the Work.

1-07.5(2)B WASHINGTON STATE DEPARTMENT OF ECOLOGY

In doing the Work, the Contractor must:

1. Obtain a waste discharge permit from the Washington State Department of Ecology before washing aggregate and before discharging water into a ground or surface waterway from pit sites or excavations when the water contains turbidity, silt, or foreign materials.
2. Provide the Engineer with a copy of each waste discharge permit before starting the Work.
3. Control drainage and erosion to minimize the pollution of any waterway.
4. Properly dispose of all contaminants including creosote, oil, cement, concrete, and water used to wash equipment in ways that will prevent them from entering State waters.
5. Properly dispose of all debris, overburden, and other waste materials in ways that will prevent them from entering State waters.

The Contractor must perform such temporary work as may be necessary to prevent water pollution, erosion, and related damage within the Project Site and that may be necessary at locations outside the Project Site used in support for the Work.

If Work is suspended for an extended period of time, the Contractor is responsible for controlling erosion, pollution, sedimentation, and runoff during the suspended period.

In addition to other requirements in the Contract, this temporary work includes these water quality considerations:

a. Diversion of Storm Water: Storm water must be diverted around the Project Site to prevent pickup of silt, clay, and other fine particles. This may be accomplished by pumping; improvising ditches; lining channels or by placing metal, plastic or concrete gravity pipe; or constructing ditches, berms, and Culverts to control surface water; or constructing dams, settling basins, or energy dissipaters to control impacts of flow.

b. Surfacing Ground Water: Surfacing ground water must be intercepted and either routed around the areas of Work in-progress or, when impossible, routed through areas of Work in-progress, each with appropriate ESCBMPs to prevent erosion and control sediment.

c. Discharging Ground Water: When ground water is encountered in an excavation, if it meets State Water Quality standards, it may bypass treatment facilities and be routed directly to its normal discharge point. Discharging turbid ground water must comply with the requirements described below in number (i).

d. Turbid Water Treatment Before Discharge: Determination of turbidity is at the discretion of the Engineer. The Contractor is responsible for ensuring any water discharged from the Project Site or from Work performed at the Project Site does not exceed these standards for turbidity, unless otherwise allowed per State Surface Water Quality Standards (WAC 173-201A-200).

e. Discharges to a State waterway caused by aggregate washing, drainage from aggregate pit sites and stockpiles, dewatering of pits and excavations, and other discharges must not increase the existing turbidity of the receiving waters. Turbid water from the Project Site must be treated before being discharged into streams or other State waters.

f. Turbidity is measured in Nephelometric Turbidity Units (NTUs) and measured with a turbidimeter. Turbidity reports must be accompanied by a manufacturer's certificate of compliance indicating laboratory accreditation and turbidimeter calibration as specified in WAC 173-50.

g. Receiving waters with 50 NTU or less as background turbidity must not exceed 5 NTU over background conditions.

h. Receiving waters with more than 50 NTU as background turbidity must not exceed a 10 percent increase in turbidity over background conditions.

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i. Water discharged to a Storm Drain must comply with State Water Quality standards and the Contractor must obtain written permission, including any required permits, from the local jurisdiction, which is SPU when within the City of Seattle.

j. Water discharged to a sanitary or combined Sewer requires the Contractor to obtain written permission, including any required permits, from the local jurisdictions, meeting water quality requirements for both SPU and King County Industrial Waste Division for Work within the City of Seattle.

k. The Contractor is responsible for all testing and monitoring required to ensure the water meets water quality requirements before discharge to the Storm Drain system, or the sanitary or combined Sewer system.

l. Erosion and Sediment Control: General requirements to manage, prevent, and control erosion and to treat sediment are specified in Sections 1-07.15 and Section 8-01.

m. Chlorine Residual: Water containing chlorine residual must be dechlorinated to a concentration of 0.1 ppm or less, or must not be discharged directly into Storm Drains, streams, or State waters. Chlorine water may be discharged into sanitary Sewers or disposed on land for percolation. Chlorine residual may be reduced chemically with a reducing agent such as sodium thiosulphate or vitamin C. Water must be periodically tested for chlorine residual.

n. Vehicle and Equipment Washing: Water used for washing vehicles and equipment must not enter Storm Drains, streams or other State waters. Separation of petroleum products, fresh concrete products or other deleterious material from wash water is required before discharge. Detergent solution may only be discharged into sanitary Sewers, or held on the ground for percolation. A recirculation system for detergent washing is recommended. Steam cleaning units must provide a device for oil separation.

o. Oil and Chemical Storage and Handling: Do not handle or store oil and chemicals adjacent to surface waters. Storage must be in diked tanks and barrels with drip pans provided under the dispensing area. Tanks must have shut off and lock valves. Hoses must have shut off nozzles. Oil and chemicals must only be dispensed during daylight hours unless the dispensing area is properly lighted. Should an oil or chemical spill occur, the Contractor must promptly make the notification specified in Section 1-07.28, item 10), stop the spilling, contain the spill, and then clean up any spilled materials. Fencing is required around oil storage. Locks are required on valves, pumps, and tanks.

p. Sewage: If a pipe carrying sewage is encountered and repair or relocation work is required, the Contractor must provide blocking and sealing of the pipe. Sewage must be pumped out, collected, and conveyed or pumped directly to a sanitary or combined Sewer system maintenance hole for discharge. Existing sewerage must be maintained by the Contractor without interruption of service by the use of temporary Sewer bypasses. In addition, the excavated materials adjacent to and around a rupture of any pipe containing sewage must be removed to a disposal site. Equipment and tools in contact with the above materials must be washed by pressure water lines and the attendant wash water discharged into a sanitary or combined Sewer for transmission to a sewage treatment facility.

q. Sawcutting, Planing, and Grinding By Products: Take special precautions to assure that concrete, asphalt, concrete by products, or asphalt by-products from, or used in, the drilling, sawcutting, grinding, or planing of asphalt cement or cement concrete pavements, sidewalks or curbs do not enter any Storm Drain, surface water, and natural drainage system. In as much as sawcutting by products increase the pH of the wastewater, filtering before discharge is not acceptable. Provide a means for collecting, for on-site temporary storing as necessary, and for properly disposing of these by-products. Surfaces contaminated with these by-products must be power washed and vacuum swept clean at least daily, and more frequently during wet weather.

r. Gutters and other Surface Drainage Channels: Prevent all construction waste and stockpiling, and all byproduct, from entering gutters and other drainage channels inlets, catch basins, and other drainage Structures and features. Material must be removed from drainage channels on a regular basis. Temporary filters or filter materials must be placed and timely maintained by the Contractor in drainage channels to prevent the passage of said material.

1-07.5(3) AIR QUALITY

The Contractor must maintain air quality within the National Emission Standards for Hazardous Air Pollutants. Air pollutants are defined as that part of the atmosphere to which no ambient air quality standard is applicable and which, in the judgment of the Administrator of the Environmental Protection Agency Clean Air Act, may cause or contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness.

1-07.5(4) NOISE POLLUTION

The Work must be performed consistent with the applicable noise control levels: in the City of Seattle, SMC Chapter 25.08 ;outside the City limits and in King County, Chapters 12.86 through 12.100 of the King County Code and the requirements of local jurisdictions; outside King County, the requirements of local jurisdictions. Noise control includes all reasonable measures for the suppression of noise resulting from Work operations including the equipping of engine driven equipment with exhaust and air intake silencers designed to achieve the reasonable degree of silencing determined by Owner.

1-07.5(5) ARCHAEOLOGICAL AND HISTORIC PRESERVATION

Should the Contractor discover, during any construction activity or in any other way, archaeological or historical objects, such as ruins, sites, buildings, fossils, skeletal remains, artifacts, or other objects of antiquity that may have significance from a historic or scientific standpoint (as defined under RCW 27.53.040) at the Project Site, immediately stop construction activity at the discovery site and surrounding area, and promptly notify the Engineer. In the event that human skeletal remains are

encountered, per RCWs 68.50.645, 27.44.055, and 68.60.055, the Contractor must also notify the county coroner and local law enforcement.

If ordered by the Engineer, the Contractor must suspend construction activity that, in the opinion of the Engineer, would be in violation of State Law. Suspension of this construction activity must remain in effect until the Engineer has obtained permission to proceed from the State Historic Preservation Officer or from other authority.

The Contractor and all Subcontractors must comply with regulations regarding archaeological resources including, but not limited to:

1. Archaeological Sites and Resources (RCW 27.53)
2. Indian Graves and Records (RCW 27.44)
3. Archaeological Site Public Disclosure Exemption (RCW 42.56.300)
4. Discovery of Human Remains (RCW 27.44)
5. Archaeological Excavation and Removal Permit (WAC 25-48)
6. Abandoned and Historic Cemeteries and Historic Graves (RCW 68.60)
7. SEPA Environmental and Historic Preservation Polices (SMC 25.05.660-.675)

1-07.5(6) THREATENED AND ENDANGERED SPECIES

The Contractor must prevent the harming of threatened and endangered species, and all critical habitat associated with threatened and endangered species as required by the Federal Endangered Species Act.

1-07.5(7) CONSTRUCTION WITHIN AND ADJACENT TO WATER

In addition to other specifications in Section 1-07.5, the Contractor must comply with the Rivers and Harbors Act, the Clean Water Act, and the Water Resources Development Act.

1-07.5(8) WETLANDS

Wetlands are defined as those areas inundated or saturated by ground or surface water at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

Wetland impacts, including clearing, grading, excavation, and filling, are not allowed without a Clean Water Act Section 404 permit issued by the U.S. Army Corps of Engineers, Clean Water Act Section 401 Water Quality Certification from the Washington State Department of Ecology, and approval by the local agency with authority to regulate impacts to wetlands and wetland buffers as applicable.

1-07.5(9) LIABILITY AND PAYMENT

The Contractor is liable for the payment of all fines and penalties resulting from failure to comply with the federal, state and local pollution control regulations. Except as otherwise provided for in the Contract, costs pertaining to the prevention, containment, or cleanup of environmental pollution and the preservation of public natural resources as outlined in the Contract are considered incidental to the Work and are at the Contractor's sole expense.

1-07.6 PERMITS

The Contractor must comply with all issuing agency requirements and hold the Owner harmless for any Work-related liability incurred under any permit obtained to perform Work under the Contract. If the Contractor finds any ambiguity or conflict between the Contract and the permit, the Contractor must promptly notify the Engineer no later than 2 Working Days from the date of discovery.

Information on Street Use Permits: https://www.seattle.gov/transportation/permits-and-services/permits

1-07.6(1) CONTRACTOR OBTAINED PERMITS

Unless otherwise specified in the Contract, the Contractor must obtain all required permits for the performance of the Work, must provide any notices such permits may require, and must not proceed with any portion of the Work until the requisite permit has been obtained and a copy delivered to the Owner. The costs of permits obtained by the Contractor must be included in the Bid Item prices for the Work.

Information on electrical and side Sewer permits: http://www.seattle.gov/dpd/permits.

1-07.6(2) OWNER OBTAINED PERMITS

Permits obtained by the Owner will be referenced or included in the Contract.

The Contractor may request in writing that the Owner obtain a temporary operating permit in the Owner's name if:

1. A local rule or an agency policy prevents issuing the permit to a private firm;
2. The Contractor takes all actions necessary to support the Owner to obtain the permit;
3. The permit will serve the public interest, including expediency;
4. The permit applies only to Work under the Contract; and

5. The Contractor reimburses the Owner for all fees.

1-07.7 LOAD LIMITS

1-07.7(1) GENERAL

While moving equipment and Materials on any public Right of Way, the Contractor must comply with all laws and regulation affecting motor vehicle traffic and limits loads. The Contract does not exempt the Contractor from such laws nor does it license overloads. Upon request, the Contractor must provide any information needed to determine the weight of equipment on the roadway.

The Contractor is responsible for any damage to any public Right of Way caused by overweight equipment, whether under permit or otherwise.

1-07.7(2) LOAD LIMIT RESTRICTIONS

The following load limits apply to:

1. Structures Designed for Direct Bearing of Live Loads: On these Structures, the gross or maximum load on each individual vehicle axle must not exceed the legal load limit by more than 35 percent. No more than 1 vehicle can operate over any Structure at 1 time.
2. Underpasses and Reinforced Concrete Box Culverts Under Embankments: Over these Structures, maximum loads are 24,000 pounds on a single axle and 16,000 pounds each on tandem axles spaced less than 10 feet apart, provided that:
   a. The embankment has been built as specified in Section 2-10; and
   b. The embankment has reached at least 3 feet above the top of the underpass or Culvert.

   When the embankment has reached 5 feet above the top of the Culvert or underpass, the Contractor may increase axle loads up to 100,000 pounds each if outside wheel spacing is at least 7 feet on centers on the axle.
3. Pipe Culverts and Sewer Pipes: Loads over pipe Culverts and Sewer pipes must not exceed 24,000 pounds on a single axle and 16,000 pounds each on tandem axles spaced less than 10 feet apart. These limits are permitted only if:
   a. The Culvert or pipe has been installed and backfilled to Specifications; and
   b. The embankment has reached at least 2 feet above the top limit of pipe compaction.

   When the embankment has reached 5 feet above the top limit of pipe compaction, the Contractor may increase per-axle loads up to 100,000 pounds if outside wheel spacing is at least 7 feet on centers on the axle centers, except that:
   c. For Class III reinforced concrete pipes, the embankment must have risen above the top limit of compaction at least 6 feet.
   d. For Class II reinforced concrete pipes, the maximum load for each axle is 80,000 pounds if outside wheel spacing is at least 7 feet on axle centers. In this case, the embankment must have risen above the top limit of compaction at least 6 feet.

1-07.8 HIGH-VISIBILITY APPAREL

The Contractor must require all personnel under their control including service providers, Subcontractors, and lower tier Subcontractors that are on foot in the work zone and are exposed to vehicle traffic or construction equipment to wear the high-visibility apparel described in this Section.

The Contractor must ensure that a competent person as identified in the MUTCD selects the appropriate high-visibility apparel suitable for the Job Site conditions.

High-visibility garments must always be the outermost garments.

High-visibility garments must be in a condition compliant with the ANSI 107-2015 (or later version) and must be used per manufacturer recommendations.

1-07.8(1) TRAFFIC CONTROL PERSONNEL

All personnel performing the Work described in Section 1-10 including traffic control supervisors, flaggers, spotters, and others performing traffic control labor of any kind must comply with the following:

1. During daylight hours with clear visibility, workers must wear a high-visibility ANSI/ISEA 107 Type R Class 2 or 3 vest or jacket, and hardhat meeting the high-visibility headwear requirements of WAC 296-155-305.
2. During hours of darkness (1/2 hour before sunset to1/2 hour after sunrise) or other low-visibility conditions such as snow or fog, workers must wear a high-visibility ANSI/ISEA 107 Type R Class 2 or 3 vest or jacket, high-visibility lower garment meeting ANSI/ISEA 107 Class E, and hardhat meeting the high-visibility headwear requirements of WAC 296-155-305.

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1-07.8(2) NON-TRAFFIC CONTROL PERSONNEL

All personnel, except those performing the Work described in Section 1-10 must wear high-visibility apparel meeting the ANSI/ISEA 107-2004 Class 2 or 3 standard.

1-07.9 WAGES

1-07.9(1) PREVAILING WAGE RATES

1-07.9(1)A GENERAL

The Work is subject to the wage requirements of RCW 39.12 (Prevailing Wages on Public Works), RCW 49.28 (Hours of Labor), and to RCW 49.46 (Minimum Wage Act) as amended or supplemented. The Contractor, any Subcontractor, and all individuals and firms required to pay prevailing wages under WAC 296-127-010, must pay all laborers, workers, or mechanics no less than the applicable prevailing hourly wage rate and fringe benefits appropriate to the worker's classification. Higher wages and benefits may be paid at the option of the employer.

The Contractor is responsible for assigning the appropriate classification to all laborers, workers, or mechanics that perform any Work under this Contract, under the scope of work descriptions established by the L&I Industrial Statistician. Laborers, workers, and mechanics must be paid in full at least once each week and in lawful money of the United States. If the Contractor assigns the wrong prevailing wage classification, the Contractor is responsible for and must pay the amount of the corrected prevailing wage. The difference is not subject to an equitable adjustment or Change Order.

The Contractor must ensure that all Subcontractors, and all other individuals and firms as applicable, comply with all prevailing wage requirements including payroll reporting requirements and payment of prevailing wages. The Contractor is responsible for any violations of prevailing wage requirements by Subcontractors, individuals, or firms, and The Owner will take enforcement action against the Contractor to remedy any violations and achieve compliance with prevailing wage requirements

1-07.9(1)B APPLICABILITY OF FEDERAL PREVAILING WAGE RATES

On projects funded in whole or part from federal monies, federal wage laws and rules also apply. If the Work is subject to both the provisions of the State (RCW 39.12) and federal (Davis Bacon and Related Acts, DBRA) prevailing wage requirements, the Contractor and every Subcontractor must pay the higher prevailing wage rate for the classification.

1-07.9(1)C WAGE RATES

Any listing of wages and fringe benefits in the Project Manual for any classification is intended only as a guideline for the Contractor and does not necessarily reflect the most recent classification or prevailing wage rate. Prevailing wage rates will be determined by L&I and published on the first Business Day of February and the first Business Day of August of each year. All prevailing wage rates become effective 30 Days after they are published. Current prevailing wage information may be obtained online:

Washington State Department of Labor and Industries

http://www.lni.wa.gov/TradesLicensing/PrevWage/WageRates/default.asp

For projects funded in whole or part with federal monies, current federal prevailing wage information may be obtained upon request from the:

U.S. Department of Labor

https://www.dol.gov/whd/govcontracts/dbra.htm

By including wage and fringe benefit rates in the Project Manual, the Owner does not imply that the Contractor will find labor available at those rates. The Contractor must calculate any amount above the minimums that have to be paid.

If the Contractor employs labor in a classification not covered by WAC 296-127, the Contractor must request the Industrial Statistician at L&I determine the correct prevailing wage rate for that classification and locality. If the project is federally funded, the Contractor must request the Secretary of the U.S. Department of Labor (US DOL) determine a federal prevailing wage rate for that classification and locality in addition to requesting the State prevailing wage rates. In such case, the Director of L&I's, and if applicable the Secretary of US DOL's, decision regarding the rates is final, conclusive, and binding on all parties. If the state and federal wage rates differ, the Contractor must pay the higher wage rate.

1-07.9(1)D OVERTIME

Pursuant to the provisions of RCW 49.28 and WAC 296-127-022, Work performed on public works contracts will not require the payment of overtime rates for the first 2 hours worked in excess of 8 hours per Day when the employer and employee voluntarily enter into a written agreement wherein the employee will work up to 10 hours per Day in a 4-Day week to accomplish 40 hours of work. Working more than 10 hours on any Calendar Day on a public works project is prohibited except in cases of extraordinary emergency, such as danger to life or property. The Contractor must refer to the Benefits Code Key attached to the Prevailing Wage Schedule for specific overtime rates.

Overtime rates must be paid for all hours worked more than 40 hours per week. This Section provides a minimum public works overtime standard, and does not supersede prevailing overtime wage rates established under RCW 39.12.

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1-07.9(1)D1 WRITTEN OVERTIME AGREEMENT

Recognizing that there may be Days when a full 10 hours of work is not available, the remainder of the forty hours may be made up on another work Day or Days within the same work week. However, work performed on Saturdays, Sundays, and Holidays is subject to the established prevailing overtime provisions for a given trade or occupation, as provided in RCW 39.12.

For the purpose of this Section, an agreement must:

1. Have been authorized by employees who bargained collectively with their employers through representatives of their own choosing; or
2. Be obtained in writing, signed, and dated by both parties;
3. Be entered into individually with each employee;
4. Be entered into separately for each public works project, except that an employer, at its option, may obtain an annual authorization;
5. State the name of the public works project with specificity; and
6. Be entered into voluntarily by the employer and employee.

Each employer must retain copies of individual employee authorization agreements for 3 years from the Completion Date of the Work. Absence of an authorization record for an employee will be deemed per se evidence of lack of that employee's authorization. Such records are payroll records, subject to the requirements of WAC 296-127-320.

For any overtime work performed on a federally funded project per the agreements referenced above, the Contractor, Subcontractor, and all other individuals or firms required to pay prevailing wages must submit a copy of such authorization agreement for each affected employee to PC, either in person or by mail.

Physical address:
City of Seattle
Seattle Municipal Tower
700 Fifth Ave., Suite 4350
Seattle, WA 98104-5008

Mailing address:
City of Seattle
Department of Finance and Administrative Services – Purchasing and Contracting
PO Box 94687
Seattle, WA 98124-4687

1-07.9(2) PAYROLL REPORTS

Payroll reports for the Contractor, every Subcontractor, and all other individuals or firms required to pay prevailing wages for Work performed must be submitted weekly via an online reporting portal: http://www.LCPtracker.net. The Contractor is responsible for approving electronically the payrolls submitted by all Subcontractors. Payroll reports must contain the following information:

1. Name and residence address of each worker
2. Classification of work performed by each worker. The classification must be specific and match the classification categories listed in the applicable wage schedule
3. Total number of hours employed each Day
4. Total number of hours employed during the payroll period.
5. Straight time and overtime hourly rate of wages paid to each worker
6. Total or gross amount earned by each worker.
7. Deductions for medical insurance, FICA, federal withholding tax, and any other deductions taken.
8. Net amount paid each worker
9. Contractor's or Subcontractor's name and address
10. All Days during the pay period
11. Date of final Day of pay period
12. Whether fringe benefits were paid to each worker as part of the hourly wage rate or whether fringe benefits were paid into an approved plan, fund, or program; and the hourly rate of fringe benefits paid, if any.

For federally-funded projects, payroll reports may be submitted on federal payroll form WH 347 or equivalent, which may be obtained by accessing their website: https://www.dol.gov/agencies/whd/government-contracts/construction/payroll-

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certification. The reverse side of the form contains an Affidavit that must be filled out and signed. If the Contractor's payroll reports are computerized, the computerized reports may be submitted along with a Statement of Compliance Affidavit form, which may be photocopied from the sample in the Project Manual.

The first payroll submitted for the Work for both the Contractor and each Subcontractor must be labeled Initial. The last payroll submitted for the Work for both the Contractor and each Subcontractor must be labeled Final. If no work is performed for the week, the Contractor must submit a certified payroll noting that no work has been performed.

1-07.9(3) ENFORCEMENT

The Contractor, every Subcontractor, and all other individuals or firms required to pay prevailing wages for Work performed on this Contract are subject to investigation by PC and L&I in regard to payment of the required prevailing wage to workers, laborers, and mechanics employed on the project.

If the investigations result in a finding that an individual or firm has violated the requirement to pay the prevailing rate of wage, the unpaid wages will constitute a lien against the Contractor's Bond and retainage. The Owner may also withhold payments to the Contractor specified in Section 1-09.9(3). Per RCW 39.12.065 and 39.12.050, the Contractor or Subcontractor may also be subject to civil penalties and may be prohibited from bidding on any public works contract within the State of Washington for the period specified by law. The Owner may consider such violations in preparing performance evaluations specified in Section 1-05.13(2), in determining whether a Contractor or Subcontractor is a responsible Bidder specified in Section 1-02.2, and under debarment proceedings per SMC 20.70.

1-07.9(4) POSTING NOTICES

The Contractor must post in a location acceptable to L&I and in compliance with the requirements of RCW 39.12.020:

1. One copy of the approved Statement of Intent to Pay Prevailing Wages for the Contractor, each Subcontractor regardless of tier, and any other individual or firm required to pay prevailing wages per WAC 296-127-010.
2. A copy of the prevailing wage rates for the project.
3. The address and telephone number of the L&I Industrial Statistician along with notice that complaints or questions about wage rates may be directed there.

1-07.9(5) PREVAILING WAGES FOR APPRENTICES

An apprentice is defined as a laborer, worker, or mechanic employed to perform the Work for whom an apprentice agreement is established through a Training Program that is registered and approved by the Washington State Apprenticeship and Training Council (WSATC). Per RCW 39.12.021 and RCW 49.04, apprentices must be paid the applicable prevailing hourly rate for an apprentice of that trade. If the Contractor or Subcontractor of any tier makes use of an apprentice on work also governed by federal wage rates and regulations, the Contractor must present to the Owner written evidence of registration of such employees in a program approved by the WSATC. On any project that is federally funded and where submission of payroll reports is required, such evidence must be submitted with the first payroll on which the name of the employee appears.

1-07.9(6) PREVAILING WAGE DISPUTES

Prevailing wage disputes are not subject to the dispute resolution process specified in Section 1-04.4. For purposes of prevailing wage disputes the following applies:

If there is a dispute regarding prevailing wages, PC and the Contractor must attempt to resolve the dispute and to receive corrected prevailing wage documents such as amended certified payrolls and other supporting documents as requested. If the Contractor does not make good faith efforts to resolve the dispute within 30 Calendar Days of receiving notification, PC may conduct its own investigation or refer the dispute at any time thereafter to L&I and/ or US DOL as applicable. If PC determines that it will conduct an investigation, PC will provide written notice of the investigation to the Contractor and after its investigation is complete, PC will furnish its written determination to the Contractor including the identification of any or all enforcement actions specified in Section 1-07.9(3). The Contractor may appeal this determination in writing to the Director of PC. The Director will provide a written response to the Contractor regarding the appeal. Nothing in this process precludes other interested parties from filing complaints or disputes with L&I or US DOL or taking other legal action.

In the event that after exhausting the foregoing process, the Contractor disagrees with the Owner’s final determination of a prevailing wage dispute involving a state prevailing wage rate, the matter will be referred to the Director of L&I. In such cases, the Director's decision is final, conclusive, and binding on all parties. If the dispute involves a federal prevailing wage rate, the matter will be referred to the Secretary of U.S. DOL for a decision. In such case, the Secretary's decision is final, conclusive, and binding on all parties.

When the Work is subject to both state and federal prevailing wage requirements, the Contractor and every Subcontractor must pay whichever rate is higher.

1-07.9(7) REQUIRED DOCUMENTS

Before payment is made by the Owner of any sums due under this Contract, the Contractor and each Subcontractor regardless of tier must have a Statement of Intent to Pay Prevailing Wages (form F700 029 000), approved by L&I. Wage rates listed on an approved Statement of Intent to Pay Prevailing Wages may not comply with federal prevailing wage requirements.

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Each progress estimate submitted for payment must include an Owner-provided form listing all Subcontractors and Suppliers, who performed Work on the project during that pay period, including but not limited to, Subcontractor Name, UBI Number, Intent Number and Affidavit Number as applicable, along with a statement completed and signed by an authorized representative of the Contractor certifying the prevailing wages have been paid per RCW 39.12.040.

Upon Physical Completion and before final progress payment and funds retained under RCW Chapter 60.28 can be released to the Contractor, the Contractor and each Subcontractor regardless of tier must have an Affidavit of Wages Paid (form L700 007 000) approved by L&I, see Section 1-09.9.

The Contractor or Subcontractor, as applicable, is responsible for payment of fees for each Statement of Intent to Pay Prevailing Wages and Affidavit of Wages Paid and must submit all forms directly to L&I for approval. The cost of these fees is included in the Bid Item prices that comprise this Contract. Intent and Affidavit forms may be obtained from L&I at the following website: https://lni.wa.gov/licensing-permits/public-works-projects/prevailing-wage-policies

1-07.9(8) AUDITS

Payroll, wage, and cost records must be retained, and may be audited or inspected, as specified in Section 1-09.10.

1-07.10 RESERVED

1-07.11 SOCIAL EQUITY IN CONTRACTING

The City provides assistance to Contractors that desire to Bid on, or have been awarded a City Contract, to comply with equal opportunity, non-discrimination, Affirmative Efforts, and Apprenticeship provisions. Should a Contractor desire assistance or information in recruiting, tutoring, and training or otherwise preparing potential employees and Subcontractors, a Contractor may contact PC at (206) 684-0444. Direct all questions, reports, or other submittals regarding the requirements of this Section to PC. Telephone: (206) 684-0444.

Physical Address:
City of Seattle
Seattle Municipal Tower
700 Fifth Ave., Suite 4350
Seattle, WA 98104-5008

Mailing Address:
City of Seattle
Department of Finance and Administrative Services – Purchasing and Contracting
PO Box 94687
Seattle, WA 98124-4687

1-07.11(1) EQUAL BENEFITS

The Contractor must comply with SMC Ch. 20.45 and the Equal Benefits Program Rules implementing such requirements, under which the Contractor is obligated to provide the same or equivalent benefits (equal benefits) to its employees with domestic partners as the Contractor provides to its employees with spouses. At the Owner's request, the Contractor must provide complete information and verification of compliance with SMC Ch. 20.45.

For further information about SMC Ch. 20.45 and the Equal Benefits Program Rules, call (206) 684-0444 or refer to:

http://www.seattle.gov/purchasing-and-contracting/social-equity/equal-benefits

Evaluation of the Contractor's compliance with the Equal Benefits requirement will be based on these criteria:

1. A domestic partner is a person, either same sex or opposite sex partner, whose domestic partnership is registered either with the employer's internal registry or with a local government entity, per State or local law.
2. Any and all benefits must be provided equally to spouses and domestic partners, including but not limited to health insurance, dental insurance, vision insurance, pension, company discounts, and credit union membership.
3. The conditions for use of benefits including but not limited to bereavement leave, family medical leave, childcare leave, employee assistance programs, and relocation and travel benefits, must be applied equally with respect to spouses and domestic partners.
4. Equal benefits must be offered to all employees at all offices where substantive Work on the Contract with the City of Seattle is being performed.

Reporting Requirements: The apparent low Bidder must submit the Equal Benefits Compliance Declaration to the PC representative within 3 Business Days after request.

Any violation of this Section is a material breach of Contract for which the City may:

a. Require the Contractor to pay actual damages for each Day that the Contractor is in violation of SMC Ch. 20.45 during the term of the Contract;

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b. Terminate the Contract;

c. Debar the Contractor from bidding on or being awarded a City Contract for a period of up to 5 years under SMC 20.70; or

d. Impose such other remedies as specifically provided for in SMC Ch. 20.45 and the Equal Benefits Program Rules promulgated there under.

1-07.11(2) LABOR STANDARDS

As noted in SMC 14.16, 14.17, 14.19, and 14.20, the Owner has adopted a comprehensive set of wage theft prevention and labor harmonization standards to better protect those individuals who conduct business within the City limits. These protections include paid sick and safe time, fair chance employment, and minimum wage and wage theft. Contractors who conduct business inside the City limits, including attending meetings, must comply with SMC 14.16, 14.17, 14.19, and 14.20.

Contractors conducting business outside the City limits, including attending meetings, must comply with RCW 49.46, minimum wage requirements and labor standards, and paid sick and safe time.

1-07.11(3) WOMEN AND MINORITY BUSINESSES AND NON-DISCRIMINATION REQUIREMENTS

The Owner will not enter into contracts with Contractors who do not agree to use Affirmative Efforts to employ or contract with women and minority group members as required under SMC 20.42, who do not agree to ensure an Acceptable Work Site, or who violate any provisions of SMC 20.42, or those requirements set forth below.

In addition, the Contractor must comply with RCW 35.22.650, which provides:

“Contractor agrees that the Contractor shall actively solicit the employment of minority group members. Contractor further agrees that the Contractor shall actively solicit bids for the subcontracting of goods or services from qualified minority businesses. Contractor shall furnish evidence of the Contractor's compliance with these requirements of minority employment and solicitation. Contractor further agrees to consider the grant of subcontracts to said minority bidders on the basis of substantially equal proposals in the light most favorable to said minority businesses. The Contractor shall be required to submit evidence of compliance with this section as part of the bid.”

1-07.11(3)A AFFIRMATIVE EFFORTS

The Contractor must use Affirmative Efforts to solicit and contract with WMBEs on subcontracting and supply opportunities within the project. The Contractor agrees to such efforts, as provided through the submission of the Inclusion Plan, as a material condition of the Contract.

1. Affirmative Efforts must include efforts to achieve the activities specified in the Inclusion Plan the Contractor submitted as specified in Section 1-02.9(4). The Contractor is solely responsible for any efforts made and costs incurred to comply with WMBE Goals.
2. Reporting Requirements:
   a. If applicable, the Contractor must submit an Inclusion Plan as specified in Section 1-02.9(4).
   b. If applicable, the Contractor must submit a Social Equity Plan as specified in Section 1-03.3(4).
   c. The Contractor must submit Subcontractor Payment Reports electronically through B2Gnow: https://seattle.diversitycompliance.com/.
      1) The first Subcontractor Payment Report must be submitted by the 15th Day of the first month after the date specified in the Notice to Proceed.
      2) Subsequent monthly Subcontractor Payment Reports must be submitted by the 15th Day of every month thereafter. When no work is performed during a reporting period, the Contractor must submit monthly reports indicating that no work was performed.
      3) The last Subcontractor Payment Report must be marked as Final and must be submitted no later than 30 Days after the Physical Completion Date. The final report must list the name of and dollar amount paid to each Subcontractor and Supplier used by the Contractor. The Owner will not establish the Completion Date until the completed final Subcontractor Payment Report Form has been received.
      4) A sample of the form may be included in the Appendix section of the Project Manual but this form is submitted through an online reporting website listed above.
      5) Subcontractors and Suppliers must register on the City’s Business Registration website, if not currently registered; this is a one-time registration process for each Subcontractor and Supplier. http://www2.ci.seattle.wa.us/VendorRegistration/.

         Contractors may use this website to look up whether the Subcontractors or Suppliers are registered or not. The Subcontractors and Suppliers must register themselves.
3. Changes to named Subcontractors or Suppliers:
   a. A named Subcontractor or Supplier includes any WMBE firm or business named on the Inclusion Plan or the Social Equity Plan as a WMBE guarantee.
   b. Any named Subcontractor that the Contractor wishes to substitute during the project must request the Engineer’s consent through a Change Order and demonstrated “good cause.” “Good cause” includes:

1) Failure of the Subcontractor to execute a written contract after a reasonable period of time;
2) Bankruptcy of the Subcontractor;
3) Failure of the Subcontractor to provide the required bond;
4) The Subcontractor is unable to perform the Work because they are debarred, not properly licensed, does not comply with the Subcontractor approval criteria, or in some other way is ineligible to work;
5) Failure of the Subcontractor to comply with a requirement of law applicable to subcontracting;
6) The death or disability of the Subcontractor if the Subcontractor is an individual;
7) Dissolution of the Subcontractor if the Subcontractor is a corporation or partnership;
8) If there is a series of failures by the Subcontractor to perform as specified in previous contracts; or
9) Failure or refusal of the Subcontractor to perform the Work.

c. If the Contractor is making a change to a WMBE guarantee, then the Contractor must use good faith efforts to recruit another WMBE Subcontractor to do the Work.

1-07.11(4) EMPLOYMENT NON-DISCRIMINATION REQUIREMENTS

The Contractor must not inquire, collect, or otherwise condition employment based on immigration status. Unless otherwise provided in the Contract, no background checks will be performed as part of the employment process. The City has strict policies regarding the use of background checks, criminal checks, and immigrant status for contract workers. The policies are incorporated into the Contract and are available for viewing on-line at http://www.seattle.gov/city-purchasing-and-contracting/social-equity/background-checks.

The Contractor must not discriminate against any employee or applicant for employment, and will make Affirmative Efforts to solicit and employ women and minorities, and to ensure that applicants are treated during employment without regard to race, color, age, sex, marital status, sexual orientation, gender identity, political ideology, creed, religion, ancestry, national origin; or the presence of any sensory, mental or physical handicap, unless based upon a bona fide occupational qualification. Such Affirmative Efforts include: employment, upgrading, promotion, demotion, or transfer; recruitment or recruitment advertising, layoff or termination, rates of pay, or other forms of payment and selection for training, including apprenticeship.

The Owner may monitor or audit the Contractor's non-discrimination policies and practices, including Affirmative Efforts to employ women or minority employees and Acceptable Work Sites. Monitoring may include proactive observations at the Work Site, interviews of individuals familiar with the Work Site, data that may evidence disparities, investigation of complaints by an individual familiar with the Work Site, or other evidence. The Owner may find unacceptable behavior and may pursue all appropriate contractual remedies.

Equal Employment Opportunity Officer: The Contractor must have a designated Equal Employment Opportunity Officer (EEO Officer).

The Contractor must ensure that all employees, particularly supervisors, are aware of and comply with their obligation to maintain a working environment free from discriminatory conduct, including harassment and intimidation of minorities and women or WMBE businesses. The Contractor must display at each Work Site location, including the Project Site office, the appropriate materials supplied by the Owner regarding Acceptable Work Sites.

1-07.11(4)A ACCEPTABLE WORK SITE

The Contractor must ensure an Acceptable Work Site and must include this Section in all subcontracts.

The intent of the person that appears to violate the Acceptable Work Site is not a measure of whether such behaviors are appropriate; rather the standard is whether a reasonable person should have known that such behavior would cause a worker to be humiliated, intimidated, or otherwise treated in an inappropriate, discriminatory, or differential manner.

Behaviors that violate an Acceptable Work Site include but are not limited to:

1. Persistent conduct that to the reasonable person would be perceived as offensive and unwelcome;
2. Conduct that a reasonable person would perceive to be harassing or bullying in nature;
3. Conduct that a reasonable person would perceive to be hazing;
4. Verbal references that a reasonable person would perceive to be offensive stereotypes or racial/gender slurs;
5. Jokes about race, gender, or sexuality that a reasonable person would perceive to be offensive;
6. Task assignments that stratify, or give a perception of stratification, based on race, gender, or other defining characteristics;
7. Language that a reasonable person would perceive to be offensive based on race, gender, or oriented towards sexuality;
8. Name-calling, cursing, or unnecessary yelling, including from a supervisor, foreman, or other more senior person that a reasonable person would perceive as offensive;
9. Repeating rumors about individuals in the Work Site that a reasonable person would perceive as harassing or harmful to the individual's reputation;

10. Refusal to hire someone based on race, gender, sexuality, or any other protected class; and
11. Reference to or requests for immigration status other than those required by law, religious affiliation, gender affiliation, criminal background, or other related aspects of a worker unless mandated by federal law.

To maintain an Acceptable Work Site, all Work must be assigned in a manner that respects training objectives for apprentices and ensures an equitable distribution of meaningful work, training, and assignments among all workers.

While maintaining and managing an Acceptable Work Site is the Contractor's responsibility, each subcontractor must also have accountability for performance in sustaining and managing their Work Sites. PC will monitor Work Sites and determine whether a risk or circumstance exists that may merit a remedy. Monitoring may include proactive observations of the Work Site, interviews of individuals familiar with the Work Site, collection of data that may evidence disparities, investigation of complaints by an individual familiar with the Work Site, or other evidence. If risks or circumstances that may merit a remedy are discovered, PC will notify and collaborate with the prime Contractor to discuss appropriate remedies and may likewise notify subcontractors and appropriate unions when necessary for the resolution of the situation, except when unusual circumstances require confidentiality. PC may also require other remedies such as those found in Section 1-08.1(3) if PC regards the situation as urgent, of potential harm, or without timely resolution.

This Section is for the benefit of the Owner and its interest in the Project. It does not create any third-party beneficiaries or form the basis of any action against the Owner by a third party.

1-07.11(5) RECORDS

The Contractor must provide evidence of compliance with SMC 20.42, including the Inclusion Plan, to PC, on request and on such form as may be provided. The Contractor must allow access to its records of employment, bidding, and subcontracting, and other pertinent data requested by the City to determine compliance with these requirements. Records must be available at reasonable times and places for inspection by authorized representatives of the Owner.

The Contractor must maintain relevant records and information necessary to document the Contractor's Affirmative Efforts to use WMBEs and other businesses as Subcontractors and Suppliers under the Contract, for at least 24 months after the Completion Date. The Owner has the right to inspect and copy such records. The Contractor must also require of its Subcontractors that the records of the Subcontractors be retained and open to similar inspection and copying for the same period of time.

1-07.11(6) APPRENTICE UTILIZATION

The following Apprenticeship requirements apply to projects with an Engineer's Estimate of $1 Million or more.

1-07.11(6)A GENERAL

The Owner has determined that there is a need for increased training and apprenticeship opportunities in the construction industry and that a diverse and well trained workforce is critical to the economic and social vitality of the region. In establishing requirements for the use of apprentices on the Project, it is the Owner's intent to encourage the training and promotion of apprentices to journey level status.

1-07.11(6)B APPRENTICE UTILIZATION REQUIREMENTS AND GOALS

The Contractor must ensure that 15 percent of the total Contract Labor Hours used on the project are performed by apprentices registered with the WSATC.

Total Contract labor hours include additional hours worked as a result of Change Orders, and exclude hours worked by foremen, superintendents, supervisors, owners, and workers who are not subject to prevailing wage requirements. However, it may be determined that they are subject to prevailing wage requirements under the following criteria of WAC 296-127-015: 2 supervisors (e.g. foreman, general foreman, superintendents) are entitled to receive at least the journey level prevailing rate of wage for performing manual or physical labor:

1. For each hour spent in the performance of manual or physical labor if it is for more than 20 percent but less than 50 percent of their hours worked on a public works project during any given week.
2. For all hours worked in any given week if they perform manual or physical labor for 50 percent or more of their hours worked on a public works project during such week.

The Contractor must include the apprentice utilization requirements of this Section in all subcontracts executed for the Project, and ensure that all Subcontractors working on the project are notified of the apprentice utilization requirements. The Contractor is responsible for meeting the apprentice utilization requirements of the Contract, including overall compliance on all Contract labor hours worked by Subcontractors.

The Contractor must make good faith efforts to:

a. Ensure that apprentice hours worked are equally distributed in each trade/craft and consistent with the apprentice utilization percentage requirement of the Contract.
b. Recruit and hire minority and women apprentices for the Project. Of the total apprentice utilization requirement percentage, the Contractor must pursue a goal of using 21 percent labor hours performed by minority apprentices and 20 percent labor hours performed by women apprentices.

The Contractor must ensure compliance with RCW 49.04, WAC 296-05, and the apprenticeship training standards for each trade/craft classification used on the Project, as set forth by L&I.

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1-07.11(6)C APPRENTICE UTILIZATION PLAN

As specified in Section 1-03.3(4), the Contractor must submit to PC, as part of the Social Equity Plan, a comprehensive plan outlining how the apprentice utilization requirements will be met on the total Contract labor hours. The plan must be submitted on a form provided by the Owner or by accessing http://www.seattle.gov/city-purchasing-and-contracting/social-equity/apprenticeships. An approved plan is required prior to the Execution Date.

PC may provide assistance in directing the Contractor to available resources for hiring apprentices. The Contractor, the Engineer, and PC must meet to discuss and change the plan as appropriate.

1-07.11(6)D CHANGES TO THE APPRENTICE UTILIZATION REQUIREMENT

If the Contractor determines that it will be unable to achieve the apprentice utilization percentage, the Contractor may make a written request to PC to reduce the required apprentice utilization percentage. The request must include documentation of the Contractor's good faith efforts to hire apprentices registered with WSATC approved programs. These documents must demonstrate:

1. That an inadequate number of apprentices are available to comply with the required apprentice utilization percentage or that there is a disproportionately high ratio of material costs to labor hours, which does not make the required minimum levels of apprentice participation possible for this Contract; and
2. That the Contractor has made good faith efforts to comply with the requirement.

PC will evaluate the request and, if appropriate, the Engineer will prepare a Change Order reducing the required utilization percentage. If PC determines that a reduction in the required utilization percentage is not justified, PC will communicate the decision in writing to the Contractor.

1-07.11(6)E APPRENTICE UTILIZATION REPORTING

The Contractor and every Subcontractor must submit a profile for each worker into LCP Tracker through an online portal at http://www.lcptracker.net/ including but not limited to gender, ethnicity, and apprenticeship status of each worker.

The Contractor must submit other information as requested by the Owner to verify compliance with the apprentice utilization requirements of the Contract. The Owner may add, delete, or change the information required by the Contractor, as necessary.

1-07.11(6)F MONITORING

PC will verify the registration of each apprentice used on the project with the WSATC. PC will monitor the apprentice utilization data provided by the Contractor. The Owner will make routine visits to the Project Site for the purpose of confirming the use of apprentices.

1-07.11(7) VIOLATIONS

Any violation of the requirements of this Section or other local, state or federal non-discrimination laws, is a material breach of the Contract for which the Contractor may be subject to damages and sanctions, including but not limited to payment of full payment to employees entitled to receive equal benefits during the term of the Contract who did not receive such benefits, imposition of a civil fine or forfeiture under the Seattle Criminal Code as well as various civil remedies, suspension or termination of the Contract and/or the withholding of any funds due or to become due, or debarment per SMC Ch. 20.70.

The Contractor must immediately report any violation of the requirements of this Section to PC.

1-07.12 RESERVED

1-07.13 CONTRACTOR'S RESPONSIBILITY FOR WORK AND DAMAGE

1-07.13(1) GENERAL

Except as provided for otherwise in the Contract, the Work, including Change Order Work, is at the sole risk of the Contractor until the Completion Date. Except as specifically limited for underground utilities by RCW 19.122.040(3), damage to or destruction of either permanent or temporary portions of the Work, and existing utilities, street improvements, Materials, or equipment and facilities on the Project Site must be promptly rebuilt, restored, repaired, corrected, or replaced by the Contractor, at the Contractor's expense, regardless of the cause of damage.

Exceptions to the above are limited exclusively to the following:

1. Damage to the permanent Work caused by acts of nature, such as earthquake, flood, or other cataclysmic phenomenon of nature.
2. An act of the public enemy or a government authority.
3. A slide occurring on a finished slope after the Physical Completion Date of the Work.
4. Third party damage or vandalism occurring after the Physical Completion Date.

The above exceptions do not apply when damages are due to the Contractor's failure to comply with any contractual responsibilities or to perform sound engineering and construction practices in the conduct of the Work, or to take reasonable precautions under the circumstances.

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If Work is delayed as a result of damage by others not party to the Contract, an extension of time will be evaluated as specified in Section 1-08.8.

Damage qualifying under any of the exceptions listed in Section 1-07.13(1) must be corrected promptly upon request, and payment will be made as specified in Section 1-04.3. Where public safety is affected and an emergency exists, the Engineer may elect to accomplish repair by Owner or other forces as specified by Section 1-05.8. The contents of this Section do not relieve the Contractor of responsibility for, or damage resulting from, the Contractor's, or Subcontractors, operations or negligence, nor is the Contractor relieved from full responsibility for making good any defective Work or unauthorized Work.

The Contractor is solely responsibility for:

a. Damage to property located within or outside the Project Site limits as a result of the Contractor's construction operation, this includes, but is not limited to, damage caused by erosion, situation, or runoff; and

b. Any pollution of a river, stream, ground water, or other water that may occur as a result of the Contractor's construction operation.

1-07.13(2) RELIEF OF RESPONSIBILITY FOR COMPLETED WORK

Upon written approval from the Owner, the Contractor may be relieved of the responsibility of maintaining and protecting certain portions of the Work, as described in this Section that have been completed in all respects as specified in the Contract. Such release will not affect any past, present, or future claims rights of the City. The Contractor is not relieved from damage resulting from any flaw or defect in Materials incorporated into or workmanship of the completed Work or the ongoing operations or negligence of the Contractor or any of its Subcontractors.

Portions of the Work for which the Contractor may be relieved of the responsibility of maintenance and protection as provided in Section 1-07.13(1) include but are not limited to:

1. The completion of at least 2 city blocks, or approximately 1/4 mile, of roadway including the traveled way, shoulders, drainage control facilities, planned roadway protection Work, lighting, and any required traffic control and access facilities.
2. A bridge or other Structure of major importance.
3. A complete unit of a traffic control signal system or street lighting system.
4. A complete unit of permanent street protection Work.
5. A building that is functionally complete and open to the public.
6. Any Contract Bid Item.

1-07.13(3) RELIEF OF RESPONSIBILITY FOR DAMAGE BY PUBLIC TRAFFIC

When it is necessary for traffic to use a roadway facility during construction, the Contractor will be relieved of responsibility for damage to permanent Work caused by traffic under the following circumstances:

1. The Work is as specified in the Contract or approved Drawings;
2. The Work is on a section of roadway required by the Contract to be opened to traffic; and
3. The traffic control is per the approved traffic control plans.

If traffic is relocated to another section of roadway, the Contractor must resume responsibility for the Work until the section of roadway is again open to traffic or the Contractor submits a written request for Work that is completed to a point where relief can be granted as specified in Section 1-07.13(2).

1-07.13(4) REPAIR OF DAMAGE

The Contractor must promptly repair all damage as directed by the Engineer. For damage qualifying for relief under Sections 1-07.13(2) or 1-07.13(3), payment will be made as specified in Section 1-04.3. Payment will be limited only to repair of damaged Work. No payment will be made for delay or disruption to the Work.

The Engineer may elect to accomplish repair by its own forces or other means.

1-07.14 RESERVED

1-07.15 TEMPORARY CONSTRUCTION STORMWATER POLLUTION PREVENTION

During Work, the Contractor must incorporate practices that prevent erosion, or control erosion when erosion is unavoidable, and must make every effort to maintain effective erosion and sediment controls throughout the Work including implementing timely corrective actions as may be necessary. Sediment must be prevented from entering any surface water, drainage facility, and natural drainage system, and must be prevented from transport beyond the Project Site. The Contractor must prepare a project-specific Construction Sediment and Erosion Control Plan (CSECP), or Stormwater Pollution Prevention Plan (SWPPP) if applicable, to be used until the Physical Completion Date. Work must comply with the CSECP and with the current version of the SPU Director Rule DWW-200, SMC Chapters 22.800 through 22.808, and other codes addressing grading, stormwater control, ground water control, and other construction controls. Existing Project Site trees, vegetation, and soil must be protected as specified in Section 1-07.16. See Section 8-01 for Specifications related to the CSECP, TVSPP, and TDP.

The Stormwater Code and Stormwater Manual can be found at:

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http://www.seattle.gov/sdci/codes/codes-we-enforce-(a-z)/stormwater-code

1-07.15(1) SPILL PLAN

The Contractor must prepare a project specific Spill Plan (SP) to be used until the Physical Completion Date. The SP must be submitted to the Engineer before the commencement of any Project Site construction activities as specified in Section 1-05.3(5). Occupational safety and health requirements that may pertain to SP planning are contained in, but not limited to, WAC 296-824 and WAC 296-843. See Section 8-01 for SP requirements.

If potential Contaminated Material(s) or potential Dangerous Waste(s) are discovered during construction, see Section 1-07.29.

1-07.16 PROTECTION AND RESTORATION OF PROPERTY

1-07.16(1) PRIVATE AND PUBLIC PROPERTY

The Contractor must protect Real Property within or adjacent to the Project Site from damage or destruction, including improvements thereto and fixtures found under or upon, and all personal property located within or adjacent to the Project Site that is not designated for repair, replacement or removal. The Contractor must minimize interference with the use of such property.

The Contractor must, at no additional cost to the Owner, restrict access and provide and install safeguards acceptable to the Engineer to protect employees and public and private property, including curb, gutters, and sidewalks. If public or private property is damaged or destroyed or its use interfered with by the Contractor, the Contractor's agents, or the Contractor's employees, such interference must be terminated and damaged or destroyed property repaired and restored immediately to its former condition by the Contractor at the Contractor's expense, unless otherwise directed. Property owners, such as public and private utilities and railroads, that typically repair or maintain their own property, reserve the right to repair all or part of the damage at the Contractor's expense. Should the Contractor refuse or not respond promptly to a written request to restore damaged or destroyed property to its original condition, the Engineer may have such property restored by other means at the Contractor's expense as specified in Section 1-05.8.

The Contractor must be aware that underground electrical transmission and distribution conduit and duct banks are surrounded with cementitious fluidized thermal bedding that must not be disturbed.

The Contractor is alerted to the existence of cast iron Water Main and of thrust block for Water Main within the Right of Way. Cast iron pipe joints have been known to develop leakage when disturbed by shifting earth, excessive vibrations, or adverse impacts of any other construction excavation Work. Thrust blocks, typically placed against Water Main tees, bends, and dead ends, provide resistance to forces within the Water Main to prevent separation or other conditions that may lead to leakage of the Water Main. Thrust blocks typically extend beyond the Water Main and depend both on soil friction and on passive soil resistance. The Contractor must take additional preventative measures both to eliminate adverse impact to cast iron Water Main, and to not disturb existing Water Main thrust block and the soils surrounding the thrust block.

1-07.16(1)A MONUMENT PROTECTION

Do not perform Work under any circumstances that would remove, adjust, destroy, cover, or otherwise make a survey point or monument no longer visible or readily accessible without the Department of Natural Resources (DNR) survey monument permit. The Contractor must not remove or destroy any monument until the monument has been tied out and the Contractor has provided the Engineer with a copy the DNR permit authorizing the removal or destruction of the monument per WAC 332-120. See Section 1-07.28 for contact information.

The Contractor must protect all monument tie out reference points and witness monuments until the monument has been reset and the Contractor has completed the DNR report form, provided the Engineer a copy, and forwarded it to DNR per WAC 332-120.

1-07.16(2) TREE, VEGETATION, AND SOIL PROTECTION

All trees, vegetation, and soil not designated for removal must be left in place and protected from damage in accordance with Standard Plan 132 and Section 8-01.3(2)B until the Substantial Completion Date has been established by the Engineer.

Destroyed or damaged trees and vegetation not designated for removal must be replaced or mitigated by the Contractor at no cost to the Owner. The dollar value of impacted trees and vegetation will be determined by the Engineer in accordance with the current edition of the Guide for Establishing Values of Trees and Other Plants prepared by the Council of Tree and Landscape Appraisers. Unless otherwise required, replacements must be of the same species and size as the tree or vegetation destroyed or damaged by the Contractor during construction. Replacements for trees larger than 4-inch DBH must be provided in a 3-1/2 to 4-inch caliper size. When the replacement tree is smaller in caliper than the tree impacted by construction, the Contractor will be assessed damages equal to the difference in dollar value between the replacement tree and the impacted tree. Where physical limitations prevent the full restoration of destroyed or damaged trees and vegetation, the Contractor will be assessed damages equal to the difference in the dollar value between the trees and vegetation provided and the trees and vegetation impacted. Damages are not to be construed as a penalty and the Owner may deduct these damages from any money due or to become due to the Contractor.

Replacement trees and vegetation must be installed and maintained as specified in Sections 8-02.3(6)A, 8-02.3(6)B, and The Contractor must allow at least 2 Working Days advance notice for inspection and approval of replacement stock by the Engineer.

Soils in areas disturbed by construction, including but not limited to areas impacted by vehicle traffic, materials storage and areas that have been graded, ripped, stripped, or trenched, must be decompacted, amended, and restored as specified in Section 8-02.

1-07.16(3) FENCES, MAILBOXES, AND MISCELLANEOUS ITEMS

The Contractor must enclose the Project Site by installing and maintaining temporary fencing when Work is within easements or abuts private property. The Contractor is liable for all damages arising from noncompliance with this Section.

The Contractor must comply with all requirements of the U.S. Postal Service for maintenance and relocation of postal service, collection, and mail receptacles. Where U.S. Postal Service Structures need to be temporarily relocated, the Contractor must make the notification specified in Section 1-07.28. Information to be provided to the Post Office includes the Location I.D. Number included on the box label or, if no label, the street location; date needed for temporary relocation, and approximate date the area impacted by construction will be completed. All U.S. Postal Service Structure relocation must be done by the Contractor once written permission has been granted by the U.S. Post Office. Do not impair access to existing or temporarily relocated postal Structures. Upon completion of the Work which required the relocation of mail receptacles, the Contractor must notify the U.S. Postal Service in writing that the box has been reinstalled to the original location.

Before any Work limits access to, or disturbs existing mail receptacles or newspaper boxes, the Contractor must make the notifications specified in Section 1-07.28. The temporary location must not impair their accessibility and usefulness. As soon as possible, the receptacles or boxes must be reinstalled at their original location, or at other locations directed by the Engineer. New supports or boxes are not required unless the original boxes or posts were damaged by the Contractor. Replacement or repairs to supports or boxes damaged by the Contractor are at the Contractor's expense. Mailbox height must be per U.S. Postal Service requirements.

Where sprinkler systems are encountered in the planting strip, the Contractor must carefully remove the existing sprinkler system for reinstallation by the Contractor after the Work in the planting strip is complete.

1-07.16(4) SEATTLE MONORAIL

Adjacent to the Seattle Monorail columns, excavation is restricted within the zone measured at street level, 5.5 ft. from the center of each column face, perpendicular to the column face, forming a rectangle around the column and extending outward and downward at 45 degrees. Nearby excavations must be monitored to assure footing stability. Any Work to be performed in or near the restricted area must have prior approval from the Seattle Center director. Excavations in the restricted area may be possible provided a professional engineer designs a site specific support system and the Seattle Center gives written approval.

At or above grade: The piers above ground level must not be moved, nor can any items such as lighting or signage be attached to the piers without prior written consent from the Seattle Center director. Monorail piers must not be painted. Landscaping must not occur adjacent to piers or within 10 feet of a Monorail structure without prior written consent of the Seattle Center Director. Any construction activity in the area of the power rails must comply with OSHA guidelines and must comply with WAC 296.45 for working around high voltage. Construction equipment must remain outside the 14-foot-operational envelope from each side of the beam at all times except for permitted work windows when allowed by the Seattle Monorail facilities.

Contractors must employ spotters and must provide a method to delineate the operational envelope when any construction activity occurs within 25 feet of the beams.

For notification requirements for Work adjacent to Seattle Monorail facilities, see Section 1-07.28, item 5.

1-07.16(5) PAYMENT

All costs for the protection of property and for the repair or restoration of damaged or destroyed property, as specified in Section 1-07.16, will be considered incidental to the Work. These costs will be included in the Bid Item prices for the various Bid Items of Work listed in the Bid Form.

1-07.17 UTILITIES AND SIMILAR FACILITIES

1-07.17(1) GENERAL

Locations and dimensions shown on the Drawings for existing facilities and utilities are per available information obtained without uncovering, measuring, or other verification.

The Contractor must protect private and public utilities, including appurtenances thereto, and other facilities encountered during the Work from damage. Utilities include Sewer and Storm Drain systems; water transmission and distribution systems; electrical transmission and distribution systems; natural gas distribution and transmission systems; telephone, telegraph, telecommunications, and CATV systems; fiber optic systems; fire alarm systems; petroleum pipe lines; steam distribution systems; traffic control systems; power lines; KCM trolley lines and feeders; rail transit infrastructure and appurtenances; pipelines, pipeline systems, transmission pipelines, and underground facilities per RCW 19.122; and other similar facilities and systems.

Cast iron Water Main and some Puget Sound Energy (PSE) gas distribution facilities are known to be sensitive to excessive vibration, possibly resulting in leakage. The Contractor must exercise appropriate care when construction is near such facilities and must cooperate with these facility owners in protecting infrastructure.

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Public and private utilities, or their contractors, will furnish all Work necessary to adjust, relocate, repair, inspect, or construct their facilities unless otherwise provided for in the Contract or as directed by the Engineer. Where it is necessary to remove or relocate utilities and facilities to accommodate the Work, the removal or relocation may be accomplished in advance of construction. If this removal or relocation is performed concurrently with the Work, the Contractor must coordinate the Contract Work with that of the utilities' or facilities' owner or contractor so as to cause the least possible interference with both kinds of work. Where a utility or facility has not been removed or relocated before the Contractor starts the Work at the point affected, the Contractor must note the presence of the facility and immediately notify the Engineer in writing.

Attention is directed to the possible existence of underground utilities and facilities that are not shown on the Contract. The Contractor must comply with all applicable laws and notify all necessary parties, including the one number locator service, upon discovery of any utilities or facilities not shown on the Contract. When the relocation of these utilities or facilities is necessary to accommodate the Work, the Engineer will provide for the relocation of these utilities or facilities by other forces, or the relocation must be performed by the Contractor as extra Work under a Change Order.

The Contractor may encounter side Sewers during Work operations. Side Sewers typically extend from a tee or wye connection on a Sewer or Storm Drain to a property. Beyond the property line, the side Sewer may be a single pipe or may branch into multiple pipes. Up to date plats of as-built side Sewer constructions are maintained by the SPU geographic information systems (GIS) staff. GIS mapping is available online at https://www.seattle.gov/utilities/construction-resources/water-and-sewer-map, http://web1.seattle.gov/dpd/sidesewercardsv2/ or by e-mail request: sidesewerinfo@seattle.gov. It is the Contractor's responsibility to locate and protect these existing side Sewers.

The Contractor is also alerted to the existence of RCW 19.122, an act relating to governing exposure of underground utilities facilities and prescribing penalties for non-compliance. Section 1-07.28 prescribes certain notification to be made by the Contractor; however, does not include all notification that may be necessary. Any cost or scheduling impact incurred by the Contractor by reason of Contractor's required compliance with these statutory and contractual provisions is borne by the Contractor. Excavation must not start until all known utilities and facilities near the excavation area have been located and marked, and the Contractor has complied with all applicable provisions of RCW 19.122.

The right is reserved to the Engineer and the owner of utilities and facilities, or their authorized agents, to enter on the Right of Way for the purpose of making changes, connections, inspections, or repairs to their facilities, and to monitor construction on or near their utility or facility. The Contractor must cooperate with forces engaged in this work and must avoid any unnecessary delay or hindrance to work or monitoring being performed by other forces. It is the Contractor's responsibility to make all notifications and applications needed to effectively coordinate utility and Contractor Work.

Should the Contractor desire to have an adjustment in line or grade made on a utility or other improvement for the Contractor's convenience and the rearrangement is in addition to, or different from, that specified in the Contract, the Contractor must make all necessary notifications and applications with the owner of the utility or other improvement for such rearrangement and bear all expenses in connection with that work, as specified in Section 1-05.3(6).

The Contractor may encounter private water service utilities during Work operations. The public portion of the water service typically extends from the tap on a Water Main to the water meter and then to the union. Beyond the union, these private water-service utilities may be either a single water-service utility from the water meter or a multiple water-service utility from the water meter. Records of these utilities are not maintained by the Engineer and therefore do not appear on the Drawings and will not be field located by Seattle Public Utilities. The locations of these private utilities can usually be ascertained by relative meter location, residence location, or through discussion with various private property owners. It is the Contractor's responsibility to locate and protect these private water services from damage.

The Contractor is responsible for providing, as necessary, temporary water supply connections to mitigate conflict with private water services during construction, at no additional cost to the Owner.

In all cases, the Contractor must repair private water service lines it damages, at the Contractor's expense. The Contractor must notify the Engineer immediately of any such damage and must start repairs immediately and work continuously until water service is restored. Repair of damaged private water service lines will be inspected by Seattle Public Utilities or applicable water utility before backfilling.

Except as otherwise provided in the Contract, all costs incurred by the Contractor in complying with Specifications of this Section are included in the Bid Item prices for the various Bid Items of Work listed in the Bid Form. If others delay or otherwise adversely affect the Work through late or improper removal or relocation or inspection of any utility or similar facility, the Contractor's loss of time or increased cost, or both, may be adjusted as specified in Section 1-08.8.

1-07.17(2) UTILITY CLEARANCES

1-07.17(2)A WATER MAIN CLEARANCES

All utilities, both public and private, passing over, under, or parallel to existing Water Main within clearances specified in Section 1-07.17(2)A must be coordinated with Water Operations at least 15 Working Days in advance of construction for approval of, and coordination with, the Engineer. See Section 1-07.28, item 8) for required notifications. Provide a minimum of 5 feet separation horizontally from a ductile iron Water Main and 18 inches separation vertically under an existing Water Main.

Notifications regarding shutdowns of Water Mains or obstructions of hydrants and valves or not meeting clearance requirements must be as specified in Section 1-07.28, item 8).

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Except for gas utilities, specified in Section 1-07.17(2)D, and cast iron Water Main facilities, specified in Section 1-07.17(2)A3, if a separation less than any specified clearance is unavoidable, the space between the Water Main and the other non-gas utilities must be filled with polyethylene plastic foam material, as specified in Section 9-05.10, before backfilling.

1-07.17(2)A1 WATER MAIN WITH SEWER, SIDE SEWER, STORM DRAIN, AND COMBINED SEWER

Where possible, Sewer and Storm Drain must be laid at a lower invert elevation than Water Main. See Standard Plans. 286a and 286b.

All Water Main must be spaced apart horizontally from Sewer and Storm Drain a minimum of 10 feet, measured center to center, except the spacing may be reduced to the following nearest point measurements:

1. Five feet horizontal when the Water Main is a ductile iron Water Main;
2. Less than 5 feet horizontal when the Water Main is ductile iron; and:
   a. The Sewer is constructed of materials and with joints that are equivalent to Water Main standards, including pressure testing requirements for a 5-foot distance clear of Water Main.
   b. The bottom of the Water Main is at least 18 inches above the top of the Sewer.

New Water Main crossing over Sewer and Storm Drain must be constructed of ductile iron and must be spaced to provide a minimum vertical separation of 18 inches between the bottom of the Water Main and the top of the Sewer and Storm Drain. In addition to the above requirements, protect Water Mains passing under Sewer and Storm Drain by providing:

a) A minimum vertical spacing of 18 inches between the bottom of the Sewer / Storm Drain, and the top of the Water Main.

b) Adequate support for the Sewer and Storm Drain to prevent excessive deflection of joints and settling on the Water Main.

c) The point of crossing centered between 2 successive joints of the Water Main pipe.

When the Water Main is existing and new side Sewer is being installed or reconnected, the following requirements of SMC Chapter 21.16 apply:

1) Use ductile or cast iron pipe for all side Sewer crossing over Water Mains, for a perpendicular distance of at least 5 feet clear from the center of the Water Main.

2) Side Sewer laid below Water Main must be laid at least 18 inches below and 5 feet horizontal, from all Water Main and water service line as measured from the nearest points, unless ductile or cast iron pipe is used for the side Sewer to at least 5 feet clear from the centerline of the Water Main.

1-07.17(2)A2 NEW WATER MAIN CLEARANCE WITH GAS MAIN

New Water Main to be installed crossing over or under existing gas facilities must comply with the minimum vertical clearance specified in Sections 1-07.17(2)D or 1-07.17(2)A, whichever is greater. New Water Main installed within the vertical clearance specified in Section 1-07.17(2)D must have a protective wrap and extend for the entire distance of all specified clearances.

New Water Main to be installed parallel to existing gas facilities must be at least 5 horizontal feet clear of the gas facility. If the minimum horizontal clearance is less than 5 feet but greater than 3 feet as specified in Section 1-07.17(2)D, provide a protective wrap on the Water Main.

The protective wrap must consist of either a split PVC pipe or PVC wrapping of at least 0.04 inches thickness, applied to all Water Main for a distance at least 5 feet clear of the gas facility.

1-07.17(2)A3 CAST IRON WATER MAIN

Cast iron Water Main in Seattle's Right of Way must be protected as specified in Section 1-07.16(1).

Horizontal separation from cast iron Water Main must be at least 10 feet.

The clearances specified in Section 1-07.17(2)A1 also apply to all existing cast iron Water Main, water services, hydrants and hydrant connections, vaults, and chambers. Thrust blocks supporting cast iron water pipe typically at tees, bends, and dead ends. Standard thrust block applications are shown on Standard Plans 300a, 300b, 300c, 330a, 330b, 331a, 331b, 340a and 340b.

When smaller separations or clearances are unavoidable, the use of polyethylene plastic foam is not allowed, and the Contractor must notify the Engineer as specified in Section 1-07.28 item 8).

Where cast iron water distribution and transmission pipe line exists and any excavation approved by the Engineer is within the clearances specified in Section 1-07.17(2)A1, the Contractor's protective system must be a support system as specified in Section 2-07. Shield systems are not allowed.

1-07.17(2)B CLEARANCES AMONG SEWER AND/OR STORM DRAIN

Whenever a new Sewer or Storm Drain clears an existing or new Sewer or Storm Drain by 6 inches or less, polyethylene plastic foam, as specified in Section 9-05.10, must be placed between the pipes as a cushion before backfilling.

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1-07.17(2)C CLEARANCES WITH ELECTRICAL DISTRIBUTION AND TRANSMISSION SYSTEMS

Whenever a proposed excavation is within 15 feet of an underground electrical distribution or transmission facility of any kind, the Contractor must make the notification specified in Section 1-07.28.

See Section 1-05.2(2) for information regarding the Contractor's obligations for Project Site safety and cooperation with SCL's Electrical Safety Observer when excavation is near an underground electrical facility.

Proposals for tree planting, trimming, or removal near electrical distribution and transmission systems require the Contractor to make the applicable advance notification specified in Section 1-07.28, as follows:

1. Within 10 feet of overhead electrical lines less than 50Kv or within 16.5 feet of overhead power lines 50Kv or higher, .
2. Within 10 feet of KCM trolley wire, Streetcar overhead wires, or Sound Transit Link Light Rail wires.
3. Within 10 feet or more feet of varying voltage electrical transmission lines.
4. Within 20 feet of Seattle Monorail guideway.

Do not disturb the cementitious fluidized thermal backfill that surrounds underground electrical conduits and duct banks.

1-07.17(2)D GAS MAIN CLEARANCES WITH HEAT GENERATING UTILITIES AND NON-HEAT GENERATING UTILITIES

Heat generating facilities must include electrical distribution and transmission including grounds, steam facilities, and other heat generating sources.

Non-heat generating utilities clearance requirements:

1. For high-pressure gas main and service lateral, and for gas transmission line:
   a. If a utility is parallel to the gas facility, then horizontal clearance must be at least 3 feet.
   b. If a utility crosses over or under the gas facility, then vertical clearance must be at least 3 feet.
2. For non-high pressure gas main and service lateral except gas transmission line:
   a. If a utility is parallel to the gas facility, then horizontal clearance must be at least 1 foot.
   b. If a utility crosses over or under the gas facility, then vertical clearance must be at least 6 inches.

A utility must never make contact of any kind with a gas facility.

Heat generating utilities clearance requirements: For installing heat generating utilities within any gas facility clearance specified in this Section, the Contractor must make the notification specified in Section 1-07.28 and must come to agreement with the gas facility owner on protection to be provided before this construction starts.

The gas facility owner may require a protective split sleeve to surround the gas facility to a distance beyond specified clearances, and the Contractor must provide such protection.

1-07.17(2)E TREE CLEARANCES

Planting of new trees must comply with the tree clearance requirements shown on Standard Plan 030.

1-07.17(2)F STANDARD LOCATION FOR UTILITIES – RESIDENTIAL STREET

Utilities located on residential streets must comply with the location standards and clearances shown on Standard Plan 030.

1-07.18 INSURANCE

1-07.18(1) MINIMUM INSURANCE COVERAGE, LIMITS AND OTHER REQUIREMENTS

Insurance must provide the minimum coverages and limits of liability and comply with all other requirements in this Section. Providing evidence of coverage for these stated minimum limits of liability does not relieve the Contractor, any Subcontractor of any tier, or their respective insurers from liability for claims in excess of such stated minimum limits of liability.

If Work is subcontracted, applicable minimum coverages and limits of liability may be evidenced by any Subcontractor as specified in Section 1-07.18(5) provided that such insurance fully meets the applicable requirements set forth herein and includes the City of Seattle as an Additional Insured as specified in Section 1-07.18(2).

1-07.18(1)A COMMERCIAL GENERAL LIABILITY (CGL) INSURANCE

CGL insurance must include coverage for:

1. Premises/Operations
2. Products/Completed Operations
3. Personal/Advertising Injury
4. Contractual
5. Independent Contractors
6. Stop Gap, unless insured as Employers Liability under Part B. of a Workers Compensation Insurance Policy
7. Per project aggregate per ISO CG 25 03 (Aggregate Limits of Insurance per project) or Equivalent

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8. Blasting, if explosives are used in the performance of the Work

Such insurance must provide a minimum limit of liability of $1 Million each Occurrence Combined Single Limit Bodily Injury and Property Damage (CSL) except $1 Million each Offense Personal/Advertising Injury and $1 Million each Accident/ Disease - Policy Limit/ Disease - each Employee Stop Gap or Employers Liability.

1-07.18(1)B AUTOMOBILE LIABILITY INSURANCE

Automobile Liability for owned, non-owned, hired, and leased vehicles, as applicable, with a minimum limit of liability of $1 million CSL. If pollutants are to be transported, MCS 90 and CA 99 48 endorsements are required on the Automobile Liability insurance policy unless the transportation pollution risk is covered under the Contractor's Pollution Liability insurance policy.

1-07.18(1)C STATE OF WASHINGTON STATUTORY WORKERS' COMPENSATION INSURANCE

The Contractor must comply with Workers' Compensation coverage per Title 51 RCW.

1-07.18(1)D RESERVED

1-07.18(1)E RESERVED

1-07.18(1)F RESERVED

1-07.18(1)G RESERVED

1-07.18(1)H RESERVED

1-07.18(1)I RESERVED

1-07.18(1)J RESERVED

1-07.18(1)K RESERVED

1-07.18(1)L RESERVED

1-07.18(1)M RESERVED

1-07.18(1)N RESERVED

1-07.18(1)O RESERVED

1-07.18(1)P RESERVED

1-07.18(2) GENERAL REQUIREMENTS (DO NOT APPLY TO STATE OF WASHINGTON STATUTORY WORKERS' COMPENSATION INSURANCE)

No Work is to begin until documentation of insurance has been delivered to and approved by the Owner. The Contractor must keep required insurance in force at all times during the term of the Contract. The term insurance includes but is not limited to self-insurance, alternative risk transfer techniques, capital market solutions, or any other form of risk financing.

Each insurer must either be authorized to do business in the State of Washington and maintain A.M. Best's ratings of A-: VII or higher, or procured as surplus lines per RCW Chapter 48.15 , except as otherwise approved by the Owner.

The City of Seattle must be included as an Additional Insured for primary and non-contributory basis with respect to insurance coverages specified in Sections 1-07.18(1)A, 1-07.18(1)B, and if required, 1-07.18(1)G. For CGL insurance, Automobile Liability, and Contractor's Pollution Liability Insurance, if required, such additional insured status must:

1. Be evidenced by an ISO endorsement form CG 20 10 or equivalent designated or blanket additional insured endorsement or policy language;
2. Be primary and non-contributory as respects the Owner's insurance; and
3. Contain a separation of insureds provision.

ISO endorsement form CG 20 12 or equivalent endorsement or blanket additional insured language limiting additional insured status to governmental permitting does not satisfy the requirements of this paragraph. For Automobile Liability insurance, such additional insured status must be evidenced by ISO endorsement form CA 20 48 or equivalent designated or blanket additional insured endorsement or policy language, must be primary and non-contributory for the Owner's insurance, and must contain a separation of insureds provision.

Written notice of cancellation must be delivered or mailed to the Owner not less than 30 Days before the effective date of any cancellation except for cancellation for non-payment of premium, which cannot be less than 10 Days before such date, unless a longer period of written notice is required under RCW 48.18.290 for cancellation by insurer.

Notice under this paragraph must be issued to:

City of Seattle

Department of Finance and Administrative Services – Purchasing and Contracting

PO Box 94687

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Seattle, WA 98124-4687

If emailed, send as a PDF or XLS format attachment to FAS_PW_Admin@Seattle.gov.

Failure on the part of the Contractor to maintain the insurance as required constitutes a material breach of Contract, on which the Owner may, after giving 5 Business Days notice to the Contractor to correct the breach, may immediately terminate the Contract or, at its discretion, procure or renew such insurance and pay any and all premiums in connection therewith, with any sums so expended to be repaid to the Owner on demand, or at the sole discretion of the Owner, offset against funds due the Contractor from the Owner.

Any self-insured retention (S.I.R.) in excess of $25,000 that is not fronted by an insurer must be disclosed and is subject to the Owner's approval. Upon request by the Owner, the Contractor must furnish financial information that the Owner may reasonably require to assess the Contractor's risk bearing capacity, and must provide a written statement that the Contractor will defend and indemnify the Owner against any claim within the Contractor's S.I.R. at least to the same extent that coverage would be afforded to the Owner under the relevant insurance policy meeting the requirements stated herein. The Contractor is responsible for the cost of any payments for defense and indemnity falling within the S.I.R.

The Contractor and/or any Subcontractor of any tier must comply with all of a railroad's risk management requirements including purchasing Railroad Protective Liability Insurance before performing construction services work adjacent to or on a railway's Right of Way and/or property.

All costs for insurance are incidental to and included in the unit or lump sum Bid Item prices of the Contract and no additional payment will be made.

1-07.18(3) SUBCONTRACTOR INSURANCE

The Contractor must contractually require that each Subcontractor of every tier maintain at a minimum the insurance coverages specified in Sections 1-07.18(1)A and 1-07.18(1)B for a value commensurate with their subcontract value, and include the City of Seattle as an Additional Insured for primary and non-contributory limits of liability.

1-07.18(4) NO LIMITATION OF LIABILITY; ADDITIONAL INSURED

The limits of liability specified herein are minimum limits only. Such minimum limits of liability requirements are not construed to limit the liability of the Contractor, that of any Subcontractor of any tier or of any of their respective insurers. Any provision in any Contractor or Subcontractor insurance policy that limits available limits of liability to those specified in a written agreement or contract does not apply and all insurance policies, with the exception of Professional Liability and Workers Compensation, must include the City of Seattle as an additional insured for primary and non-contributory limits of liability for the full valid and collectible limits of liability maintained by the Contractor or Subcontractor, whether such limits are primary, excess, contingent or otherwise. This provision applies regardless of whether limits maintained by the Contractor are greater than those required by this Contract, and regardless of whether the certification of insurance provided by a Subcontractor of any tier under Section 1-07.18(3) specifies lower minimum limits than those specified for or maintained by the Contractor.

1-07.18(5) EVIDENCE OF INSURANCE (DOES NOT APPLY TO STATE OF WASHINGTON STATUTORY WORKERS' COMPENSATION)

The Contractor must provide the Owner documentation of insurance meeting these requirements before the Execution Date is established. The documentation must include the following:

1. An ACORD certificate or equivalent form fully disclosing all coverages and limits of liability maintained.
2. A copy of the additional insured endorsement or blanket additional insured language to the Commercial General Liability, Automobile Liability, and, if required, Pollution Liability insurance documenting that the City of Seattle is an additional insured for primary and non-contributory limits of liability and, if required, Products and Completed Operations Additional Insured; a statement of additional insured status on an ACORD or other form of certificate of insurance will not satisfy this requirement.
3. A copy of each policy's Declarations page with the verifications of the limits of liability and schedule of forms and endorsements.
4. Any other policy language or endorsements that documents compliance with these requirements, including CA 99 48 and MCS 90 endorsements, if required.
5. An All Named Insured Endorsement is required if the Contractor's name on the ACORD certificate, Declaration Page(s), or Schedule of Forms is different from the legal name of the Contractor on the Bid Form.

Should any insurance policy neither be issued nor delivered to the named insured Contractor at the time it delivers the signed Contract for the Work, the Contractor must deliver and maintain on file with the City, binders of insurance evidencing compliance with the requirements. As soon as practicable after delivery of the policy, the Contractor must deliver the insurance certification specified above.

At any time upon the Owner's request, the Contractor must forward to the Owner a true and certified copy of any insurance policy.

Certification of insurance must be issued to:

City of Seattle

Department of Finance and Administrative Services – Purchasing and Contracting

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PO Box 94687
Seattle, WA 98124-4687
If emailed, send as a PDF or XLS format attachment to FAS_PW_Admin@Seattle.gov.

1-07.18(6) INDEMNIFICATION

The Contractor must defend, indemnify, and hold harmless the Owner and its officials, officers, employees, and agents from every claim, risk, loss, damage, demand, suit, action, judgment, and attorney's fee, and any other kind of expense:

1. On account of injury to or death of any and all persons, or on account of property damage of any kind, whether tangible or intangible, or loss of use resulting there from, arising out of or in any manner connected with the Work performed or to be performed under this Contract; or
2. Caused or occasioned by the presence of the Contractor's materials, equipment, vehicles, or other personal property on or in proximity to the property of the Owner, or an official, officer, employee, or agent of the Contractor, a Subcontractor, or a Supplier on or in proximity to the property of the Owner, at any time before the Completion Date; or
3. Caused or occasioned by the Contractor's violation of any applicable law, regulation, or permit, or by the Contractor's breach of this Contract.

If the claim, suit, or action for injuries, death, or damage is caused by or results from the concurrent negligence of the Contractor or its officers, agents, or employees and the Owner or its officials, officers, agents or employees, the indemnity provisions are valid and enforceable only to the extent of the Contractor's negligence.

The Contractor must also defend, indemnify, and hold harmless any state, county, city, or district and the officials, officers, and employees of the state, county, city, or district connected with the Work within the limits of which county, city or district the Work is being performed, all in the same manner and to the same extent as provided above for the protection of the Owner and the Owner's officials, officers, employees, and agents, provided that no retention of money due to the Contractor will be paid by the Owner except as provided in RCW 60.28, pending disposition of suits or claims for damages brought against the state, county, city, or district.

The Contractor assumes all risk of damage to its property, or injury to its officers, directors, agents, Suppliers, Subcontractors, or invitees, in or about the project from any cause, and waives all claims against the Owner. The Contractor further waives, with respect to the Owner only, its immunity under Title 51 RCW Industrial Insurance, or any other worker's compensation law.

The Contractor and the Owner acknowledge that the provisions of this Indemnification Section have been negotiated by them, that the Contractor considered these obligations of this Indemnification Section in preparing their Bid, and that the Contract Price reflects this negotiation.

Neither the requirement that the Contractor maintain insurance, nor the type or amount of any insurance maintained by the Contractor, are construed as waiving or limiting the Contractor's liability under this Indemnification Section.

1-07.18(7) WORKER'S BENEFITS

The Contractor must make all payments required for unemployment payment under Title 50 RCW and for industrial insurance and medical aid required under Title 51 RCW. If any payment required by Title 50 or Title 51 is not made when due, including payments due from Subcontractors, the Owner may retain such payments from any money due the Contractor and pay the same into the appropriate fund.

For Work on or adjacent to water, the Contractor is responsible for ensuring workers are covered under the Longshoremen's and Harbor Worker's Compensation Act administered by the U.S. Department of Labor, or the State Industrial Insurance coverage administered by the Washington State Department of Labor and Industries, or both coverages.

The Contractor must include in the Bid, all costs for payment of unemployment payment and for providing either or both of the insurance coverages. The Contractor is not entitled to any additional payment for failure to include such costs, or for determinations made by US DOL or L&I regarding the insurance coverage.

The Public Works Contract Division of L&I will provide the Contractor with applicable industrial insurance and medical aid classification and premium rates. The L&I Request for Release form also serves the purpose of obtaining a release with respect to the payments of industrial insurance and medical aid premiums.

1-07.19 GRATUITIES AND ETHICS

The Contractor must not extend any loan, gratuity, or gift of money in any form whatsoever to any employee or officer of the Owner; or to the consultant or employee of consultant under Contract with the Owner for services related to the Work. The Contractor must not rent or purchase any equipment or Materials from any employee or officer of the Owner or the consultant or employee of the consultant.

The Contractor must comply with all applicable Sections of the State Ethics law, RCW 42.52, which regulates gifts to Owner's officers and employees. Under that statute, any Owner officer or employee who has or will participate with the Contractor regarding any aspect of this Contract is prohibited from seeking or accepting any gift, gratuity, favor or anything of economic value from the Contractor. Accordingly, neither the Contractor nor any agent or representative may offer anything of economic value as a gift, gratuity, or favor directly or indirectly to any such officer or employee.

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The Contractor must comply with the City of Seattle's Code of Ethics in SMC 4.16 and all other applicable City codes and ordinances regulating gratuities and ethics.

1-07.20 PATENTED DEVICES, MATERIALS, AND PROCESSES

The Contractor assumes all costs arising from the use of patented devices, Materials, or processes used on or incorporated in the Work, and agrees to indemnify, defend, and save harmless the Owner, and its duly authorized agents and employees from all actions of any nature for, or on account of the use of any patented devices, Materials, or processes.

1-07.21 ROCK DRILLING SAFETY REQUIREMENTS

The Contractor is responsible for maintaining safe working conditions during rock drilling, by keeping dust concentration below the threshold limit value or by providing those protective devices that may be required by L&I, or both.

1-07.22 USE OF EXPLOSIVES

Do not use explosives without written authority of the Engineer; and then only under such restrictions as may be required by the proper authorities. When the use of explosives is necessary, the Contractor's insurance must contain a special clause covering the blasting. Explosives must be handled, marked, stored, and used in strict compliance with Chapter 296 52 WAC and all applicable local laws, rules, and regulations. The stricter provisions apply. For Work within The City of Seattle, the Seattle Fire Code, Article 77, also applies and the individual in charge of blasting must be certified by the Seattle Fire Department. In all cases, the individual in charge of blasting must have a current Washington State Blaster Users License.

The Contractor must obtain, comply with, and pay for such permits and costs as may be necessary in conjunction with blasting operations. Copies of the permits must be furnished to the Engineer. For Work within the city limits of Seattle, a permit must be obtained from the Seattle Fire Department.

The Contractor must use the utmost care not to endanger life or property, cause slides, or disturb the materials outside the neat lines of the cross-section. Blasting near proposed Structures must be completed before construction on such Structures is undertaken. Do not leave explosives unprotected along or adjacent to any existing public place.

The Contractor must provide advance written notice of the location, date, time, and approximate duration of blasting to public and private utilities having facilities near the blast site and any other property owner in the vicinity who may be affected by blasting operations. Notification must be sufficiently in advance that affected entities can take steps to protect their property from damage.

1-07.23 PUBLIC CONVENIENCE AND SAFETY

1-07.23(1) CONSTRUCTION UNDER TRAFFIC

The Contractor must make the applicable notification specified in Section 1-07.28, and must:

1. Conduct all operations with the least possible obstruction and inconvenience to the public.
2. Have under construction no greater length or quantity of Work than can be continuously and vigorously prosecuted properly with due regards to the rights of the public.
3. To the extent possible, complete each section before starting Work on the next.
4. Minimize the disruption of traffic by:
    a. Permitting traffic to pass through the Work with the least possible inconvenience or delay except in those areas where safety and lack of space requires detouring the traffic elsewhere.
    b. Maintaining existing roads, streets, sidewalks, bikeways, and paths that lie adjacent to or inside the Project Site limits by keeping them open and in good, clean, and safe condition at all times. Deficiencies caused by the Contractor's operation must be repaired at the Contractor's expense. Deficiencies not caused by the Contractor's operations will be repaired by Owner forces at the Owner's expense. The Contractor must also maintain roads, streets, sidewalks, bikeways, and paths adjacent to the Project Site when they are affected by the Contractor's operations.
    c. Removing or repairing any condition resulting from the Work or Contractor's operations that might impede traffic or create a hazard including the removal of deposits and debris that accumulates on the roadway surface, see Section 1-04.10.
    d. If the Contractor fails or refuses to clean the streets, trucks, or equipment as required by the Engineer, the Engineer may direct the Work suspended at the Contractor's risk until compliance with the Contractor's obligation is assured. The Engineer may also direct the streets in question cleaned by others and such costs incurred by the Owner in achieving compliance with these Contract requirements, including cleaning of the streets, will be deducted from any progress payment due to the Contractor. The Contractor has no claim for delay or additional costs if the Engineer chooses to suspend the Contractor's Work until compliance is achieved.
    e. Maintaining existing, permanent signs and not relocating or removing traffic control and street name signs that interfere with construction until absolutely necessary; and installing and maintaining temporary pavement markings and striping on the roadway using temporary pressure sensitive tape when necessary. The Contractor is responsible for scheduling when to renew striping and pavement marking, subject to the Engineer's approval.

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f. Providing access at all times to emergency traffic such as police, fire, and disaster units. The Contractor is liable for any damage to property or persons, resulting from failure to comply.

g. Coordinating construction operations with all disposal firms and transit bus service that may be operating within the Project Site. If KCM operates in the area of Work, the Contractor must maintain the Project Site in such a manner that transit bus service, including access to bus zones, is safe and convenient. Whenever it is necessary to change KCM Transit Bus or Trolley Service such as closure or temporary relocation of a bus stop or on-street bus staging area, removal of a bus shelter, closure of or detour of a bus route, construction in a roadway where bus transit is granted access and transit must be made aware of, or requesting a temporary weekend-only diesel bus for an electric trolley, the Contractor must make the notification as specified in Section 1-07.28, item 4).

h. Keeping existing traffic signal and lighting systems in operation as the Work proceeds. The Owner will continue the routine maintenance on such systems.

5. Protect the rights of abutting property owners by:

a. Planning and conducting construction operations so that the least inconvenience possible is caused to abutting property owners.

b. Making the required notification when it is impractical to carry on the construction and maintain traffic simultaneously, or maintain ready and convenient pedestrian and vehicular access to driveways, houses, and buildings along the line of Work.

c. Posting signs and barricades advising street closure at the nearest intersections away from the closed portion of the street and on all cross streets. Street closings must not exceed 2 blocks in length at any one time unless approved otherwise by the Engineer.

d. Making the required notification when street closure is required in the preparation of the roadway for placement of asphalt pavement, concrete pavement, Sewer excavation, or other construction that prohibits safe vehicular traffic notifying abutting property owners and tenants of any restrictions that might affect access to their property.

e. Providing temporary approaches to crossing or intersecting roads and keeping those approaches in good condition.

f. Providing another access before closing an existing one whenever the Contract calls for removing and replacing an abutting owner's access. Do not close the existing access until the replacement access facility is available.

6. When traffic must pass through grading areas, the Contractor must:

a. Make cuts and fills that provide a smooth, even roadbed.

b. Place, in advance of other grading Work, enough fill at all Culverts and bridges to allow traffic to cross.

c. Make roadway cuts and fills, if ordered by the Engineer, in partial width lifts, alternating lifts from side to side to allow traffic to pass on the side opposite the Work.

d. Install Culverts on half the width of the traveled way, keeping the other half open to traffic and unobstructed until the first half is ready for use.

7. After rough grading or placing any subsequent layers:

a. Prepare the final roadbed to a smooth, even surface free of humps and dips suitable for use by traffic.

b. Settle dust with water, or other dust palliative, as directed.

8. If grading Work is on or adjacent to a roadway in use, the Contractor must complete the grade immediately after rough grading and place surfacing Materials as the Work proceeds.

9. Conduct all operations to minimize any drop offs, defined as abrupt changes in roadway elevation, left exposed to traffic during Non-Working hours. Unless otherwise directed in the traffic control plan, the Contractor must also protect drop offs left exposed to traffic during Non-Working hours as follows:

a. Drop offs up to 0.20 feet may remain exposed with appropriate warning signs alerting motorists of the condition.

b. Drop offs more than 0.20 feet that are in the traveled way are not allowed unless motorists are notified about the danger of a drop off immediately ahead of them with appropriate warning signs and protection is provided as specified in the immediately following subparagraphs c.1) or c. 2).

c. Drop offs with depths more than 0.20 foot, but no more than 0.50 foot, that are not within the traveled way are not allowed unless motorists are notified about the danger of a drop off immediately ahead of them with appropriate warning signs and further protected by having 1 of the following:

1) Channeling devices such as Type I barricades, plastic safety drums, or other devices 36 inches or more in height placed along the traffic side of the drop off and a new edge of pavement stripes placed a minimum of 3 feet from the drop off on the traffic side. The number in feet of maximum spacing between the devices is the posted speed number in miles per hour. Signs, warning of pavement drop off, must be placed in advance of and throughout the drop off treatment.

2) Temporary concrete barrier or other approved barrier installed on the traffic side of the drop off with 1 foot between the drop off and the drop off side of the barrier, and a new edge of pavement stripe a minimum of 2 feet from the face of the traffic side of the barrier. An approved terminal, flare, or impact attenuator will be

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required at the starting of the barrier facing oncoming traffic. For night use, the barrier must have standard delineation such as paint, reflective tape, lane markers, or warning lights.

d. Drop offs more than 0.50 feet not within the traveled way must be marked with appropriate warning signs and further protected as specified in the immediately preceding subparagraphs c. 1) or c. 2) if all following conditions are met
   1) The drop off is less than 2 feet;
   2) The total length throughout the project is less than 1 mile;
   3) The drop off does not remain for more than 3 Working Days;
   4) The drop off is not present on any of the Holidays listed in Section 1-01.3; and
   5) The drop off is only on 1 side of the roadway.

e. Drop offs more than 0.50 feet that are not within the traveled way and are not otherwise covered by the immediately preceding subparagraph d above must be both protected with appropriate warning signs and with protections as specified in item c. 2) this Section.

10. Open trenches within the traveled way must have a steel plate cover placed and anchored over them. Place a wedge of suitable material, if required, for a smooth transition between the existing surface and the steel plate, see Section 2-02.3(8). Use warning signs to alert motorists of the presence of the steel plates.
11. Castings that are exposed and are not in the plane of adjacent surface due to construction involving the surrounding surface, must have temporary transition tapers on all sides of the exposed casting consisting of temporary pavement patch material or other suitable material to prevent nuisance to traffic.
12. Whatever other specific Work the Contract indicates is to be furnished or performed by the Owner or Engineer.

1-07.23(2) PEDESTRIAN CONTROL AND PROTECTION

When the Work area encroaches on a sidewalk, walkway, or crosswalk area, give special consideration to pedestrian safety. Make maximum effort to separate pedestrians from the Work area.

Protective barricades, fencing, and bridges, together with warning and guidance devices and signs, must be used so that the passageway for pedestrians is safe and well defined. Whenever pedestrian walkways are provided across excavations, they must be provided with suitable handrails. Footbridges must be safe, strong, free of bounce and sway, have a slip resistant coating, and be free of cracks, holes, and irregularities that could cause tripping. Ramps must be provided at the entrance and exit of all raised footbridges to prevent tripping. Adequate illumination and reflectorization must be provided during hours of darkness. All walkways must be maintained at least 4 feet clear width except in areas of unusually heavy pedestrian traffic such as business districts, where the minimum clear width is 8 feet.

Where sidewalks are required to be closed by construction, an alternate walkway must be provided, and to the extent reasonably feasible, the walkway must be ADA compliant including curb ramps and detectable warnings.

Where it is necessary to divert pedestrians into the roadway, barricading or channeling devices must be provided to separate the pedestrian walkway from the adjacent vehicular traffic lane. Do not divert pedestrians into a portion of a street used concurrently by moving vehicular traffic.

At locations where adjacent alternate walkways cannot be provided, appropriate signs must be posted at the limits of construction site, and in advance of the closure at the nearest crosswalk or intersection, to divert pedestrians to an alternate walkway.

Physical barricades, per the current version of the City of Seattle Traffic Control Manual and 2009 MUTCD, must be installed to prevent people with visual impairments from inadvertently entering a Work area or closed construction area. Pedestrian access must be maintained to all properties adjacent to the Work area.

1-07.23(3) SPEED AND PARKING CONTROL

See Section 1-10.3(3)N for alteration of the legal or posted speed limit or parking control.

1-07.24 REAL PROPERTY RIGHTS

Restrictions to access such as Right of Way margins, parcel boundaries, limits of easements and other Real Property rights, and limits of construction permits obtained by the Owner, will be specified in the Contract, but may not always be shown on the Drawings. The Contractor's construction activities are not allowed beyond these restrictions. An exception may be allowed if such exception is the use of private property, and such use of private property is not in violation of a condition in the Contract, arrangements for such use of private property are made before commencement of construction, and the Engineer is informed of such arrangement before use of said property.

The Owner will obtain, before the Bid Opening Date, all Real Property rights, both permanent and temporary, necessary for carrying out the Work.

Whenever any of the Work is accomplished on or through property except public street Right of Way, the Contractor must comply with and fulfill all covenants and stipulations of any Real Property agreement obtained by the Engineer from the owner of the private property. Copies of the Real Property rights documents will be included in the Project Manual or made available to the Contractor as soon as practical after they have been obtained by the Engineer.

The Contractor must not proceed with any portion of the Work on private property where Real Property rights have not been secured. If the Contractor is delayed due to acts of omission on the part of the Owner in obtaining Real Property rights, the Contractor will be entitled to an extension of time. The Contractor agrees that such delay is not a breach of Contract.

Each property owner must be notified in advance of the Contractor's entry onto that owner's property under Section 1-07.28. This includes entry onto private property where private improvements must be adjusted.

The Contractor is responsible for providing, without expense or liability to the Owner, any additional land and access thereto that the Contractor may desire for temporary construction facilities, storage of Materials, or other Contractor needs. Before using any private property, whether adjoining the Work or not, the Contractor must file a written statement with the Engineer granting permission by the property owner for such property use. Upon vacating the private property, the Contractor must file a written release with the Engineer from the property owner. Each property disturbed or otherwise interfered with by the Contractor for reasons of construction pursued under this Contract requires a written permission and written release. The written permission and written release must be signed by the private property owner, or proper authority acting for the owner of the property affected, stating that permission has been granted to use the property and all necessary permits have been obtained or, in the case of a release, that the restoration of the property including cleanup as required in Section 1-04.10 has been satisfactorily accomplished. The written permission and written release must include the parcel number, address, and date of signature. Written releases must be filed with the Engineer before the Physical Completion Date can be established, as specified in Section 1-05.11(2).

1-07.25 OPENING OF SECTIONS TO TRAFFIC

The Owner may use and open any portion of the Work before the Physical Completion Date without constituting acceptance of any of the Work. This action will not cause the Owner to incur any liability to the Contractor except as otherwise provided in the Contract.

If the Engineer opens any portion of the Work before the Physical Completion Date because early opening is specified in the Contract, or the Contractor has failed to prosecute the Work continuously and efficiently, then any Work remaining after that portion of the project is open to traffic will be performed at Bid Item prices for Bid Items of Work involved. No additional payment will be made for costs incurred by the Contractor because of:

1. Inconvenience, additional length of travel to conform to established traffic patterns, or planned access features.
2. Compliance with statutes governing traffic regulations and limitations of loads.
3. Additional flagging costs necessary to protect the Work and the traveling public.

The Contractor must take all costs due to traffic using portions of the Work into account when submitting the Bid, and the unit Contract prices for the various items of Work involved must include these costs.

1-07.26 NO WAIVER OF OWNER'S LEGAL RIGHTS; ASSIGNMENT OF CLAIMS FOR DAMAGES FOR ANTI TRUST LAW VIOLATIONS

The Owner is not precluded or estopped by any measurement, estimate, certificate, or payment made, whether before or after the Completion Date, from showing the true amount and character of the Work performed and Materials furnished by the Contractor, or from showing that any such measurement, estimate, payment, or certificate is untrue or incorrectly made, or that the Work or Materials do not conform in fact to the Contract. The Owner is not precluded or estopped notwithstanding any such measurement, estimate, or certificate, and payment from recovering from the Contractor and the Contractor's Sureties such damages as the Owner may have sustained by reason of the Contractor's or Sureties' failure to comply with the terms of the Contract and bond. Neither the establishment of the Completion Date by the Owner, nor any payment for the whole or any part of the Work, nor any extension of time, nor any possession taken by the Owner is considered a waiver of any portion of the Work, or of any power herein reserved to the Owner, or any right to damages herein or otherwise provided or bar recovery by the Owner of any money wrongfully or erroneously paid to the Contractor. A waiver by the Owner of any breach of the Contract is not held to be a waiver of any other or subsequent breach.

The Contractor and the Owner recognize that the impact of any overcharge to the Owner by the Contractor resulting from an anti-trust law violation by any Materialperson or Subcontractor of the Owner adversely affects the Owner rather than the Contractor. Therefore, the Contractor assigns to the Owner any and all claims for such overcharges.

1-07.27 RESERVED

1-07.28 NOTIFICATIONS RELATIVE TO CONTRACTOR'S ACTIVITIES

The Contractor must plan and schedule Work activities to allow time for notifications, approvals, reviews, and other conditions of the Contract.

The Engineer will initially notify public and private entities having facilities within the Project Site:

a. The approximate time the Work will start
b. The project scope of Work
c. Utilities in the street Right of Way that require relocation per the project design

Thereafter the Contractor must make the following notifications regarding Work performed within the Project Site and other areas affected by the Contractors operations in performance of the Work, as applicable. Notification must provide information germane to the type of Work to be performed. The information must include the time of commencement and

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completion of the Work, Work hours, location of the Work, names of streets affected by the Work, schedule of operation, routes of detours, and closures.

1. For Work Outside the Seattle City Limits:

   Notifications must be provided per permit and other requirements of the agency having jurisdiction. The Contractor must be familiar with those requirements before starting Work.

   a. For Work on roads and highways outside the Seattle City limits but within King County, notifications must be made as indicated below, as otherwise specified in the permit, or by the requirements of the agency having jurisdiction over those roads and highways. Construction permits in the King County Right of Way may be obtained by calling (206) 296-7456. In unincorporated areas of King County, the following must be notified at least 2 Working Days in advance:

      1) King County Roads Division: (206) 296-8100

      2) King County Fire Marshall's Office (206) 296-6675

      3) King County Police: 1-800-344-4080 or (206) 296-3311

   b. For all other areas within the Project Site and other areas affected by the Contractors operations in performance of the Work notifications must be made as specified in the Contract, as otherwise specified in permit, or by the requirements of the agency having jurisdiction.

2. For Work That Partially or Completely Restricts Any Seattle Arterial, Street, Sidewalk, or Alley:

   After receiving approval of the traffic control plan, see Section 1-10.2(5), the Contractor must provide notice to SDOT at (206) 684-7623 Monday to Friday by 2:00 p.m. at least 1 Working Day before the start of Work within the street Right of Way. The Contractor must also provide SDOT notification upon completion of Work within the street Right of Way no later than 9:00 a.m. the first Working Day following completion. This notification requirement includes partial or full lane closures, parking restrictions, sidewalk closures, detours, complete or partial street closures, shoulder work, and pedestrian rerouting, as well as the placing of building Materials or equipment on city streets, sidewalks, or alleys.

   a. Complete or partial closure of any street: In addition to notifying SDOT, provide 24 hours advance notification to the following:

      1) Within Seattle City Limits:

         a) Seattle Fire Department (206) 386-1494

         b) Seattle Police Department, Parking Enforcement, and Traffic Section of the Seattle Police Department (206) 684-5101 FAX (written notification only)

   b. Complete closure of any arterial within the Seattle City Limits: Provide 3 Working Days advance notice to SDOT (206) 684-7623 Monday to Friday 8:00 a.m. to 5:00 p.m.

   c. Complete closure of any local access street, alley, or sidewalk within the Seattle City Limits: Provide notice to SDOT at (206) 684-7623 Monday to Friday 8:00 a.m. to 5:00 p.m. by 2:00 p.m. at least 1 Working Day in advance.

   d. To restrict parking on any street within the Seattle City Limits: Provide 2 Working Days advance notification to SDOT (206) 684-7623 Monday to Friday 8:00 a.m. to 5:00 p.m. To arrange for inspection of No Parking easels and other parking related signs by a parking enforcement officer or uniformed peace officer, contact (206) 386-9012 after placing the easels and 24 hours in advance of the effective date of enforcement on the easels, see Section 1-10.2(5)C, item 4.).

   e. When signs are Owner furnished, signs will be provided by SDOT. To order signs, or to coordinate SDOT's installation of signs, the Contractor must provide at least 30 Working Days and no more than 40 Working Days advance notification to the Engineer and must verify signs and locations per the Contract for signs to be installed by the Contractor, and/or provide notification of signs to be installed by SDOT. The Contractor must provide a list of locations and specify the number and type of signs needed and include contract information for the coordination of work to be performed by SDOT crews. The Engineer will notify the Contractor of when the signs are ready for pickup. The Contractor must pick up the signs at the SDOT sign shop at 4200 Airport Way South on Business Days between the hours of 8:00 a.m. to 3:00 p.m.

3. City of Seattle - Signage, Parking Pay Stations, Parking Meters:

   a. Parking Meters, Parking Pay Stations, and sidewalk containing parking or loading signs, posts, and numbered base plates: 10 Working Days advance notice is required for the following:

      1) To request covering of parking meters and placing no parking markers on numbered base plates where parking pay stations exist, contact (206) 684-5086. Also see Section 1-10.3(3)N.

      2) To request removal of parking meters, parking pay stations, and sidewalk containing parking or loading signs, posts, and numbered base plate, contact 206-684-8175. Also see Section 2-02.3(3)F.

      3) After completion and acceptance of newly constructed sidewalk, to request installation of parking pay station, parking or loading signage, and numbered base plates, contact 206-684-8175.

      4) The Contractor must reimburse SDOT for lost parking revenue unless this is an SDOT Project.

b. Traffic Signs and Street Designation Signs: see Section 8-21.3(1)A.

c. To coordinate the installation of the bus zone signs, numbered base plates and signs associated with parking pay stations, contact SDOT Traffic at (206) 684-5092 at least 10 Business Days before completion of new sidewalk work or scheduled mounting of signs on existing infrastructure.

d. To coordinate and/or to verify location of the installation of the traffic sign, street designation signs, and street name, contact SDOT at (206) 684-5370 at least 10 Business Days before completion of new sidewalk work or scheduled mounting of signs on existing infrastructure.

4. Disruptions to, or service modification requests for KCM Transit, Streetcar service and facilities, or Sound Transit Link Light Rail service and facilities:

a. Contact the Construction Information Center (CIC) at (206) 684-2732 or (206) 477-1140 for non-trolley requests and (206) 477-1150 for trolley requests, email construction.coord@kingcounty.gov for non-trolley requests and trolley.impacts@kingcounty.gov for trolley requests, or see the website at http://www.kingcounty.gov/transportation/kcdot/MetroTransit/Construction.aspx for the following:

1) For work resulting in temporary closure/relocation of a bus stop or for work within an area of a bus stop that will limit full access to it by coaches and pedestrians/passengers, 5 Business Days advance notification is required.

2) For work resulting in KCM removing any transit facility structure including, but not limited to shelters, boards/kiosks, and bus stop signs, 10 Business Days advance notification is required.

3) For work resulting in road closure on which buses operate that will require rerouting, 10 Business Days advance notification is required.

4) For work resulting in a full or partial road closure on which a streetcar operates that does not require overhead line deactivation or a shutdown to its track operation, a 5 Business Days advance notification is required.

5) The request for assignment of diesel coaches or battery-electric trolley busses for electric coaches on electric trolley routes on non-Business Days must be made no later than 15 Business Days before the weekend requested, which is COB Wednesday 3 weeks prior. KCM will not grant diesel coach or battery-electric trolley busses substitutions on Business Days. If line deactivation is required see b) below.

b. Contact KCM at (206) 263-1800 for overhead power wire requests as follows:

1) Overhead power line modification or outage requests for an electric bus require 10 Business Days advance notification, which is COB Monday 2 weeks prior. Request forms must be submitted to Construction Information Center (email above). Trolley bus overhead deactivation is limited to weekends only (4:30 a.m. Saturday morning until 2:00 a.m. Monday morning).

2) Overhead power line modification or outage requests for a streetcar require 10 Business Days advance notification, which is COB 10 Days prior. Request forms must be submitted to Construction Information Center. Streetcar deactivations are limited to non-operational hours during periods when Streetcar staff are not testing cars or training new operators.

3) When working within 10 feet of any electric bus or streetcar overhead power, 10 Business Days advance notification is required. It is the responsibility of the Contractor to comply with Washington Administrative Code requirements in regard to working within the vicinity of high voltage lines.

4) Requests for overhead power line modification or outage may have an associated cost payable by the Contractor. In addition, outage requests for non-SDOT projects may be subject to a recently-legislated King County Trolley Ordinance Fee. The Contractor must consult with KCM to determine costs and include such costs within the Bid. Requests may require additional information. Approval is dependent on KCM Transit Power Distribution's ability to perform requests; some overhead power line modification requests may require more than 10 Business Days advance notification.

c. For Sound Transit Link Light Rail Right of Way and power outage requests, call (206) 903-7696. If work affects both rail and busses, the Construction Information Center listed above under a. also needs to be notified.

5. Seattle Monorail: When Work is within 20 feet of any portion of the monorail Structure above or below ground the Contractor must contact Seattle Monorail at (206) 396-5490 at least 10 Working Days in advance of construction.

6. Property access restrictions: Provide abutting property owners and tenants of impending access restrictions. Advance notification must be 24 hours for residential property and 2 Business Days for commercial property.

7. Emergency Work for City of Seattle Pavement or Sidewalk Problems: Provide immediate notification to: SDOT (206) 684-7623 Monday to Friday 8:00 a.m. to 5:00 p.m., all other times (206) 386-1218.

8. Water Mains, Hydrants, Water Services, and Related Appurtenances:

a. Shutdowns and Obstructions: For all shutdowns involving facilities owned by Seattle Public Utilities, for any Work involving water service and/or water service connections, and for any hydrant access restrictions, the Contractor must coordinate scheduling and notification with the Seattle Public Utilities Water Operations Division via the Engineer. The same applies to Work that will obstruct normal access to any fire hydrant or water utility valve. The Contractor must not operate, or restrict access to, any water valve owned by the Seattle Public Utilities. Notifications must be as follows:

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1) Within SPU Water Service Franchise Area: Seattle Public Utilities Water Operations (206) 386-1800. Water Main shutdown notifications and advisories regarding fire hydrant status will be provided to fire agencies by SPU Water Operations.
   a) All Work impacting Water Mains, water service or water service connection requires a minimum of 3 Working Days advance notice to the Engineer. The Engineer will plan and coordinate the shutdown with Water Operations.
   b) All Work requiring a shutdown of a Water Main, interruption of water service or restricting access to hydrants or valves requires a minimum of 5 Working Days advance notice to the Engineer. The Engineer will plan and coordinate the shutdown with Water Operations.
   c) All Work requiring Water Main shutdowns in commercial, industrial and critical service areas and in areas where over 5 percent of the population consists of a specific language group except English requires a minimum of 7 Working Days advance notice to the Engineer. The Engineer will plan and coordinate the shutdown with Water Operations.
   d) All Work on pavement impacting castings and Structures connected to the water distribution or water transmission system requires a minimum of 5 Working Days advance notice to the Engineer. The Engineer will plan and coordinate with Water Operations.
2) Within King County: Seattle-King County Department of Public Health (206) 296-4722. At least 2 Working Days advance notice is required.
3) Outside SPU Water Service Franchise Area and outside King County: The Contractor must notify the water service franchise as specified in the Contract, as otherwise specified in permits, or the agency having jurisdiction.

b. Application for New and Temporary Water Service within SPU Water Service Franchise Area: Contact SPU Customer Service at (206) 684-3333.

c. Water Mains and Clearance with other Utilities within SPU Water Service Franchise Area:
1) When proposed underground utilities are within the clearance limits of water pipe except cast iron, see Section 1-07.17(2)A2, any required Contractor notification will be addressed in the Contract.
2) When excavation is proposed near a cast iron water pipe, see Section 1-07.17(2)A3, Contractor required notification will be addressed at the preconstruction conference specified in Section 1-08.1(2)A.

d. Backflow Prevention Assembly (BPA) Inspection within SPU Water Service Franchise Area: When a backflow prevention assembly is required in any temporary or permanent connection with a Water Main, the Contractor must request inspection by making the following notification at least 2 Working Days in advance of making the connection to the Water Main, see Section 2-12, Section 8-03.3(1), Section 8-03.3(8), and Section 9-30.13:
1) Denny Way and north (206) 233-2635
2) South of Denny Way (206) 684-3456

e. Hydrant permit for temporary withdrawal of water within SPU Water Service Franchise Area, see Section 2-12.3(2).

9. Electrical Safety and Service within SCL Service Area:

a. Electrical Safety Observer: To schedule an Electrical Safety Observer, notify Seattle City Light at least 7 Working Days in advance of the need to enter a Seattle City Light vault, or to work on or within any other Seattle City Light electrical Structure or facility, or to work on or near any Seattle City Light electrical transmission or distribution system (206) 684-4911, see Section 1-05.2(2).

b. Electrical Service Connection and Inspection: To schedule an electrical service connection or inspection except street lighting and signals, see Section 8-30.1(1) and except irrigation, see Section 8-03.3(1), contact (206) 684-3000 at least 30 Days in advance.

c. Excavation at or near Underground Electrical Distribution and Transmission System: When proposed excavation is within the vicinity of underground electrical distribution and transmission facilities as specified in Section 1-07.17(2)C, the Contractor must notify Seattle City Light at least 10 Working Days in advance of the excavation as follows:
1) At and North of Denny Way: (206) 615-0600
2) South of Denny Way: (206) 386-4200

d. Streetlight System Inspections: To schedule an inspection for streetlight systems, contact SCL at least 10 Days in advance.

10. Sanitary Sewer Spills: In the event of a sanitary Sewer spill immediately notify:

a. Public Health – Seattle & King County (206) 296-4632 within King County

b. KCM (206) 263-3801 within King County

c. Seattle Public Utilities (206) 386-1800 within SPU service area

d. The Sewer service as specified in the Contract, as otherwise specified in permits, or the agency having jurisdiction

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11. Chemical, Oil, Hazardous Substance, or other Contaminant Spill or Discharge or Release: When the Contractor first becomes aware of an environmental spill, discharge or release of: chemicals, oil, hazardous substances, Contaminated Material(s), Dangerous Waste(s), or TSCA Waste(s) the Contractor must immediately notify:
    a. The Engineer
    b. If into Storm Drains, sanitary Sewers, combined Sewers, or side Sewers within the SPU service area; any rivers, streams, or lakes within Seattle; or Seattle watersheds, call (206) 386-1800
    c. If into Lake Union, Ship Canal, Lake Washington, or Puget Sound:
        1) U.S. Coast Guard via the National Response Center, Washington, D.C. 1-800-424- 8802 (operated 24 hours a Day);
        2) Washington Department of Fish and Wildlife (360) 902-2530; and
        3) Seattle Harbor Patrol (206) 684-4071.
    d. If into any side Sewer, sanitary Sewer or combined Sewer if within King County:
        1) King County Industrial Waste (206) 477-5300 Monday to Friday 8:00 a.m. to 5:00 p.m.; or
        2) West Point Treatment Plant (206) 263-3801 at all other times.
    e. If into Storm Drain, sanitary Sewer, combined Sewer, side Sewer, rivers, streams, lakes:
        1) Washington State Department of Ecology (425) 649-7000; and
        2) If outside of Seattle, the Sewer service as specified in the Contract, as otherwise specified in permits, or the agency having jurisdiction.
    f. For flammable or hazardous materials: Seattle Fire Department 911.
12. Overhead Electrical Power Lines and Trees: When tree trimming or tree removal is within 10 feet of overhead power lines less than 50kV or within 16-1/2 feet of overhead power lines 50kV or higher, if within SCL service area contact Seattle City Light at least 7 Working Days in advance at (206) 386-1663, else contact as specified in the Contract, as otherwise specified in permits, or the agency having jurisdiction, see Sections 1-07.16(2) and 1-07.17(2)C.
13. Underground Utility Locator: The Contractor must call the Utilities Underground Location Center at 811 (or 1-800-424-5555) not less than 2 or more than 10 Working Days before the scheduled date for commencement of any excavation that might affect underground facilities. Alternate notification time periods limits may be substituted if mutually agreed to, in writing, by the Contractor and utility involved. If a utility is known to have, or suspected of having, underground facilities within the area of any proposed excavation, and that utility is not a subscriber to the Underground Utilities Location Center, notice by the Contractor must be provided individually to the utility, see Section 1-07.17(1).
14. Entry onto Private Property: Each property owner must be provided 2 Business Days advance written notice before entry by the Contractor, see Section 1-07.24.
15. U.S. Postal Service Collection Boxes, Mail Receptacles, and other structures: the Contractor must receive written permission from the local U.S. Post Office to relocate a Collection Box, Mail Receptacle or structure. The U.S. Postal Service recommends contacting them at least 7 Calendar Days in advance for approval for the Contractor to relocate a Collection Box, Mail Receptacle or other U.S. Postal structure. See Section 1-07.16(3).
16. Signalized Intersections, Traffic Signals, and Loop Detection Systems: Where pedestrian and/or vehicular signals, or a loop detector system, or a signalized intersection are impacted, or will be impacted by construction, see Sections 1-07.17(1) and 8-31.1(1), within the City of Seattle the Contractor must provide at least 10 Working Days advance notice to (206) 386-1206 for coordinating temporary signal wire disconnect and temporary signal timing requirements, or else provide notification as specified in the Contract, as otherwise specified in permits, or the agency having jurisdiction.
17. Survey Monumentation: When proposed construction, changes to proposed construction, or other activity requires removal or destruction of a survey monument, at least 2 Working Days prior to this work, the Contractor must provide the Engineer with a copy of the Department of Natural Resources (DNR) permit authorizing the removal or destruction of the survey monument per WAC 332-120. Removal or destruction is defined to mean the physical disturbance or covering of a survey monument such that the survey point is no longer visible or readily accessible. Before Physical Completion, the Contractor must provide the Engineer a copy of the DNR final report form with evidence that each survey monument has been replaced or restored to its pre-construction position. For permitting information see http://www.dnr.wa.gov/publications/eng_plso_remove_destroy_monument.zip or call DNR at (360) 902-1230. At the time the permits are provided to the Engineer, the Contractor must forward a copy of this initial DNR permit with authorizing signatures and final report form to the Land Survey Manager, Seattle Public Utilities, physical address: Seattle Municipal Tower, 700 Fifth Avenue, or mailing address: PO Box 34018, Seattle, WA 98124-4018.
18. Gas Main, Transmission line, and Service Lateral: Before removals over underground gas facilities or before excavation or new facility construction, which are within the clearances of gas infrastructure as specified in Section 1-07.17(2)D, the Contractor must contact PSE at 1-888-Call-PSE (1-888-225-5773) at least 3 Working Days in advance of removal or excavation, or as otherwise specified in the Contract, in permits, or by the agency having jurisdiction.
19. Salvage; Brick, Cobblestone, and Granite Curb within Seattle: When brick, cobblestone, or granite curb is to be salvaged, the Contractor must coordinate the loading operations with the SDOT Pavement Supervisor by giving at least 2 Working Day advance notice of the impending removal operations. Where removal takes place south of

Denny Way, the Contractor must call (206) 386-1223. Where removal takes place north of Denny Way, the Contractor must call (206) 684-4660.

20. Replacement Casting and Covers: For Seattle City Light (SCL) replacement of casting and covers pick-up or delivery coordination and notification of adjustment the Contractor must call the SCL utility castings electrical reviewer at phone number (206) 684-4911 at least 10 Working Days in advance of the scheduled work.

    For Seattle Public Utilities (SPU) Sewer and Drainage replacement or adjustment of casting and covers, notify the Engineer at least 10 Working Days before the scheduled work to coordinate adjustment notification and pick-up or delivery of castings and covers by SPU forces.

    For Seattle Public Utilities (SPU) Water replacement of casting and covers pick-up or delivery coordination and notification of adjustment the Contractor must call the SPU Field Crew Scheduling at phone number (206) 386-1835 at least 10 Working Days in advance of the scheduled work.

    For PSE replacement of casting and covers pick-up or delivery coordination and notification of adjustment the Contractor must call PSE utility castings at phone number (888) 321-7779 at least 5 Working Days in advance of the scheduled work.

    For all other replacement of casting and covers pick-up or delivery coordination and notification of adjustment the Contractor must call or as specified in the Contract, as otherwise specified in permits, or the agency having jurisdiction in advance of the scheduled work.

21. For Coordination Contacts Not Specifically Specified Above: The Contractor must notify the service or franchise as specified in the Contract, as otherwise specified in permits, or the agency having jurisdiction.

1-07.29 DISCOVERIES OF CONTAMINATED MATERIAL(S), DANGEROUS WASTE(S) AND TSCA WASTE(S)

1-07.29(1) GENERAL

Section 1-07.29 addresses Work related to responding to potential pre-existing Contaminated Materials, Dangerous Wastes, and TSCA Wastes encountered during construction or in connection with the Contract or Project Site but not otherwise identified in Contract-related documents.

1-07.29(2) PRESENT SITE CHARACTERIZATION

Contract-related documents may identify Contaminated Material(s), Dangerous Waste(s), or TSCA Waste(s) that the Owner has documented on the Project Site. The Owner may not have confirmed the presence or absence of contaminants in all areas of the Project Site. Therefore, the potential exists for encountering Contaminated Material(s), Dangerous Waste(s), or TSCA Waste(s) at the Project Site.

1-07.29(3) DISCOVERIES

During the performance of the Work, the Contractor must respond to each discovery of potential Contaminated Material(s), potential Dangerous Waste(s), or potential TSCA Waste(s) on the Project Site using due diligence.

Potential Contaminated Material(s), potential Dangerous Waste(s), and potential TSCA Waste(s) at a Project Site may include soils or debris containing petroleum, metals or other contaminants, and vactor wastes (street, Storm Drain, and Sewer cleanings). Indicators of the presence of Contaminated Material(s), Dangerous Waste(s), or TSCA Waste(s) may include, but are not limited to, the presence of:

1. Visibly stained and/or discolored soil and other areas presumed to contain petroleum, oil, and lubricants;
2. Suspect areas based on historical use or the presence of an aboveground or underground feature such as drums or other similar containers, a tank or conveyance piping or dry wells under drains in floor slabs or in maintenance holes and conveyance piping with visible staining;
3. Other areas based on staining and odor, or field screening instrument readings;
4. Exposed or buried debris; or
5. Suspect building materials based on age, appearance, or historical use.

Upon discovery by Contractor or any other entity of potential Contaminated Material(s), potential Dangerous Waste(s), or potential TSCA Waste(s) not otherwise identified in Contract-related documents the Contractor must:

a. Immediately suspend Work activities only in the vicinity of the area of concern.
b. Immediately notify the Engineer of the discovery.
c. Secure the area of concern as needed to protect the general public and other personnel from entering the area of concern.
d. If authorized by the Engineer, secure all potential Contaminated Material(s), potential Dangerous Waste(s), and potential TSCA Waste(s) as that prevents their release to the environment, to the extent the Contractor can do so in compliance with all applicable law.

Work in the area of concern must not resume until the Engineer releases the Contractor to resume Work. This release does not relieve the Contractor from the requirements to maintain a safe workplace.

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If potential or confirmed Contaminated Material(s), Dangerous Waste(s), or TSCA Waste(s) not otherwise identified in Contract-related documents are generated or encountered, the Contractor must immediately submit to the Engineer both oral and written notice of all available information regarding the materials and waste. The Contractor must not take further action with respect to the characterization, disposal, or recycling of the materials unless directed to do so by the Engineer in writing.

If the Engineer subsequently informs the Contractor in writing to proceed regarding the materials or waste, the Contractor must arrange for and implement the proper and legal handling, storage, transport, and/or disposal of the materials or waste in compliance with the Contract and any direction from the Engineer.

The Contractor must comply with applicable regulations and law at all times using trained and qualified personnel.

1-07.29(4) TESTING

Testing will be performed by the Owner or as specified in writing by the Engineer before testing.

The Contractor must provide reasonable assistance to the Engineer. Such assistance may include collecting samples. Any Work performed by the Contractor must be done consistent with applicable law which may include:

1. Code of Federal Regulations: 29 CFR 1910 Occupational Safety and Health Standards
2. Washington Administrative Code: WAC 296-155 Safety Standards for Construction Work, WAC 173-303 Dangerous Waste Regulations, and WAC 296-800 Safety and Health Core Rules

The Owner will provide the Contractor 1 copy of all constituent test reports conducted on materials discovered at the Project Site.

1-07.29(5) PAYMENT

No separate measurement and payment will be made for Work required under this Section before the notification to the Engineer of a discovery, and after the Engineer's order to resume Work. All costs in connection with suspended work activities and work directed by the Engineer must be as specified in Section 1-04.3. Work not directed by the Engineer will not be measured for payment except to the extent necessary to meet the obligations specified in Sections 1-07.29(3) and 1-07.29(4).

Costs for the Work to prevent, contain, remove, and dispose of contaminated materials created or introduced by the Contractor's means and methods of construction must be included in the various Bid Items in the Bid Form, and no separate payment will be made under this Section. See Section 8-01.3(2)C.

SECTION 1-08 PROSECUTION AND PROGRESS

1-08.1 PRELIMINARY AND ON-GOING MATTERS

1-08.1(1) COPIES OF CONTRACT

The Engineer will issue to the Contractor, without charge, the following:

1. Full size Drawings (22" x 34"), 1 Set
2. Reduced Drawings (11" x 17"), 1 Set
3. Project Manual, 1 Set

1-08.1(2) CONTRACT CONFERENCES AND MEETINGS

1-08.1(2)A PRECONSTRUCTION CONFERENCE

After the Contract has been Executed, but before the Contractor starts Work, a preconstruction conference will be held for the Contractor, the Engineer and such other interested parties as may be invited.

The purpose of the preconstruction conference will be:

1. To review the preliminary critical path schedule indicating major work activities including the order and duration of work activities, milestones and time frames required in the Contract, and the critical path.
2. To establish a working understanding among the various parties affected by the Work.
3. To establish and review procedures for items including but not limited to progress estimates and cut-off Dates, notifications, approvals, reviews, and submittal delivery methods.
4. To establish normal working hours for the Work.
5. To review safety standards, traffic control, and maintaining cleanliness.
6. To review the Construction Stormwater Pollution Prevention Submittal requirements and leads specified in Sections 1-05.13, 1-07.5, 1-07.15, and Section 8-01 and related permits, as applicable.
7. To review Material sources as may be applicable.
8. To discuss such other related items as may be pertinent to the work.

See Section 1-05.3(5) for submittals due at the preconstruction conference.

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1-08.1(2)B PREOPERATIONAL CONFERENCES

The Contractor must also meet with the Engineer for preoperational conferences as required before starting any new phase of Work to more thoroughly establish effective working understandings when more detail is required than was provided at the preconstruction conference. In addition to representatives of the City, attendees will include each Subcontractor, Supplier, or other entity, or their representative concerned with current operations.

1-08.1(2)C WEEKLY PROGRESS MEETINGS

Weekly progress meetings will be held at a mutually agreed location, at regular weekly intervals or as otherwise mutually agreed. In addition to representatives of the City, attendees will include the Contractor, each Subcontractor, Supplier, or other entity, or their representative concerned with current progress or involved in planning, coordination, or performance of future activities. These meetings will be used to coordinate work and review progress and to review the project CPM schedule as specified in Section 1-08.3.

1-08.1(3) SUBCONTRACTING

Work done by the Contractor's own organization must account for at least 30 percent of the awarded Contract Price. The Contract may specifically designate any Work that may be excluded from the calculation of the 30 percent of the awarded Contract Price. If it does, then the Contractor must subtract the cost of any excluded Work from the awarded Contract Price before computing this percentage.

Work must not be subcontracted, regardless of tier, without written consent of the Engineer. A request to subcontract must be made on the Subcontractor Approval Application Form provided by the Engineer. If the Owner requests, the Contractor must provide documentation that the Subcontractor meets the supplemental bidder responsibility criteria. Each subcontract must contain a provision that requires the Subcontractor to comply with Chapter 39.12 RCW and furnish to the Contractor all certificates, statements, and submittals that the Contractor is required by the Contract to furnish to the Owner. The Contractor is responsible for verifying that the Subcontractors, of every tier, meet the Responsible Bidder requirements of Sections 1-02.1 and 1-02.2.

Along with the request to subcontract, the Contractor must submit the names of any contracting firms a Subcontractor proposes to use of any tier. Collectively, these second and lower tier Subcontractors must not do an amount of work that exceeds 25 percent of the total amount subcontracted to the first tier Subcontractor. When a Subcontractor is responsible for construction of a specific Structure or Structures, the following Work may be performed by second and lower tier Subcontractors without being subject to the 25 percent limitation:

1. Furnishing and driving of piling; and
2. Furnishing and installing concrete reinforcing and post tensioning steel.

Except for the 25 percent limit, second and lower tier Subcontractors must comply with the same requirements as first tier Subcontractors.

Consent to subcontract will not be provided unless the Engineer is satisfied with the proposed Subcontractor’s prior performance, equipment, experience, and ability to perform the Work. Approval to subcontract does not:

a. Relieve the Contractor of any responsibility to carry out the Contract;
b. Relieve the Contractor of any obligation or liability under the Contract and the Contractor’s bond;
c. Create any Contract between the Owner and the Subcontractor; or
d. Convey to the Subcontractor any right against the Owner.

The Owner will not consider as subcontracting:

1) The purchase of sand, gravel, crushed stone, crushed slag, batch concrete aggregates, ready mixed concrete, off-site fabricated structural steel, other off-site fabricated items, and any other materials supplied by established and recognized commercial facilities;
2) Delivery of any of the materials identified in item 1) immediately above to the Project Site in any vehicle owned or operated by the Materialperson of such material or by a recognized independent or commercial hauling company. Such purchase is considered as being purchased from Materialpersons.

The Washington State Department of Labor and Industries may determine that Chapter 39.12 RCW applies to the employees of any Materialperson identified in items 1) or 2) immediately above per Chapter 296-127 WAC. If this should occur, the provisions of Section 1-07.9, as modified or supplemented, applies.

When a portion of the Work that has been subcontracted by the Contractor is not being prosecuted as satisfactory to the Engineer, the Subcontractor must be removed and replaced immediately upon the Engineer's written order, and must not again be employed on the Work unless the Contractor makes protest and the Contractor's protest is upheld by the Owner.

If the Engineer determines that any Subcontractor is performing any services in an unsatisfactory manner or is not completing the Work as specified in the Contract or is otherwise undesirable or unacceptable, the Engineer will so advise the Contractor by written notice. The Contractor must then take immediate steps to terminate such Subcontractor. Further subcontracting by Subcontractors will be subject to the same Owner’s rights and Subcontractors’ obligations. The Contractor and each of its Subcontractors must ensure that such Owner’s right is included in each subcontract and sub subcontract for any portion of the Work.

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The Contractor's cost records pertaining to any subcontracting of this Contract must be open to inspection, subject to retainage periods, and as specified in Section 1-09.10.

The Contractor must report on Subcontractors as specified in Section 1-07.11(3)A.

1-08.1(3)A SUBCONTRACTOR COMMUNICATIONS

The Contractor may not impede, restrict, or prohibit Subcontractors, Suppliers, and vendors from communicating directly with the Engineer for any of the following reasons:

1. Responding to City-initiated communications
2. Inquiring, seeking assistance on, or reporting a violation of Acceptable Work Site provisions of Section 1-07.11(4)
3. Inquiring or seeking assistance on weekly payroll issues involving LPCtracker per Section 1-07.9(2)
4. Inquiring or seeking assistance on issues related to equal opportunity, non-discrimination, Affirmative Efforts and Apprenticeship provisions of Sections 1-07.11, 1-07.11(3), 1-07.11(4), 1-07.11(6)B, and 1-07.11(6)E
5. Inquiring or seeking assistance related to progress payments and prompt pay requirements per Section 1-09.11(2); or
6. Inquiring or seeking assistance related to Subcontractor retainage per 1-09.11(4)A.

The Owner is not obligated to respond to any direct communication from a Subcontractor, vendor or Supplier allowed by this Section, and this Section does not create a contractual relationship between the Owner and any Subcontractor, vendor or Supplier, or bestow the status of a third-party beneficiary on any of those entities for any purpose. This Section does not alter or waive any notice requirement under the Contract or otherwise.

1-08.1(4) HOURS OF WORK

The normal hours of Work must be between 7:00 a.m. and 7:00 p.m. on any Working Day and consists of 8 hours, exclusive of a lunch period of not more than 1 hour. On City Holidays, Work must not begin before 9:00 a.m. See SMC Chapter 25.08.425 for additional information. The normal work week must not exceed 40 hours of Work. The normal hours of Work are established at the preconstruction conference or before the Contractor starts the Work and must not be changed or extended without approval of the Engineer.

The Engineer, in their sole discretion, may grant permission to work beyond the normal daily hours, normal work week, or Working Days subject to certain conditions.

Permission to work outside normal hours of Work may be withdrawn at any time. The Contractor has no claim for damages or delay should such permission be withdrawn.

Any request to perform Work outside of normal hours of Work or on Non-Working Days must be submitted to the Engineer before noon on the Working Day before the Day that the Contractor is requesting permission to work.

1-08.1(5) REIMBURSEMENT FOR OVERTIME WORK OF EMPLOYEES OF OWNER

If the Contractor requests permission to work on a Saturday, Sunday or Holiday, or in excess of the established normal hours of Work described in Section 1-08.1(4) and the Engineer approves, then such work is considered overtime work. On all such overtime work, the Contractor must reimburse the Owner for each of the Owner's employees required to work overtime hours to support Contractor requested overtime on any project related construction activity. The number of Owner employees, and the duration of their participation in supporting the Contractor's overtime Work is at the sole discretion of the Engineer.

The Contractor must reimburse the Owner according to a table of overtime charges contained in the Project Manual. If no table of overtime charges is included in the Project Manual, the Contractor must reimburse the Owner $100 per hour for each Owner employee supporting the Contractor's overtime Work.

The Contractor hereby authorizes the Engineer to deduct the reimbursement required in the paragraph immediately above from any amount that might then be or thereafter become due or payable by the Owner to the Contractor under or by virtue of the Contract until such reimbursement has been recouped by the Owner.

1-08.2 ASSIGNMENT

The performance of the Work or any part of it must not be assigned without written consent of the Owner. Consent will not be provided to a proposed assignment that would relieve the Contractor or the Contractor's Surety of their responsibilities under the Contract.

The Contractor may assign moneys due or to become due to the Contractor under the Contract. This assignment will be recognized by the Owner, if provided notarized written notice, to the extent permitted by law. Assignment of monies is subject to all set offs, withholdings, and deductions provided by law and under the Contract.

1-08.3 CRITICAL PATH SCHEDULE AND SCHEDULE CONSTRAINTS

1-08.3(1) CRITICAL PATH SCHEDULE

1-08.3(1)A GENERAL REQUIREMENTS

The Contractor is responsible for scheduling the Work. The construction of this project will be planned and tracked by use of a conventional Critical Path Method (CPM) schedule.

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The Engineer's review and acceptance of any critical path schedule does not transfer any of the Contractor's responsibilities to the Owner or to the Engineer. Acceptance implies only that the Engineer has determined that the Critical Path Schedule submittal with any noted exceptions is within reasonable conformity to the requirements of the Contract. Acceptance of any schedule does not relieve the Contractor of its responsibility to complete the Work within the required Contract Time.

All schedules must comply with these general requirements.

The critical path is the series of sequentially-linked activities in a project schedule that will take the longest total amount of time to complete. Therefore, at any point in time, the critical path will be the path with the least amount of total float. The critical path does not have to follow the same logic path from start to finish and does not have to have zero total float. A critical task is a discrete work activity within a critical path. Total Float is the number of Days that a scheduled activity can be delayed without affecting a given intermediate milestone or Physical Completion Date. A milestone is a zero-duration task marking the completion of a significant body of work or important date/event associated with the Contract.

The baseline CPM Schedule and each Critical Path Schedule update must conform to the following guidelines:

1. Schedules must be prepared, viewed, and printed using standard Gantt-chart format.
2. Show all activities necessary to complete the Work.
3. Each task must have a descriptor sufficiently detailed to understand the scope of work encompassed by that task. Overly-broad descriptors such as grading, electrical, or plumbing may be rejected by the Engineer, especially when in conjunction with long durations.
4. Activities must be assigned durations consistent with the activity's scope of work, assuming that work will be done continuously over the entire task duration. Float time is not represented as a part of the task duration. Except for the Preliminary CPM Schedule, the maximum duration for any 1 activity is 10 Working Days unless otherwise accepted by the Engineer.
5. Sequential work activities must be linked logically by precedent/successor activities.
6. Display the Critical Path as a red-colored sequence within the project schedule. Multiple parallel critical paths are not allowed unless the Contractor can demonstrate that each of the parallel paths has minimal total float time.
7. Comply with all order of Work requirements included in the Contract.
8. Show durations in Working Days.
9. Show Contract milestones including the following:
    a. Notice to Proceed Date
    b. Substantial Completion Date
    c. Physical Completion Date
    d. Any milestones defined in the Special Provisions of this Contract
    e. Other milestones at the option of the Contractor
10. Show required submittals for significant activities. Establish discrete work activities for provision and review of submittals, ensuring durations conform to the time allowed by the Contract.
11. Identify special labor or equipment needs that may constrain or limit the Contractor's ability to perform project tasks simultaneously. These may be shown as Resources within the CPM schedule, or described separately in narrative format.
12. Show procurement, manufacture, and delivery activities for significant Material items of Work that affect the schedule.
13. Show significant Owner activities and/or delivery of Owner-supplied Materials that may impact the schedule.
14. Show significant elements of the Construction Stormwater and Pollution Prevention Plans. These elements may include but are not limited to the installation and removal of erosion/sedimentation controls, and stormwater control.
15. Include project close-out items such as punch-list items, provision of O&M manuals and as-built Drawings.

Unless otherwise specified in the Contract, the Contractor must allow the Engineer a reasonable amount of time to perform the Owner's activities. Reasonable will be defined as customary or normal for the type of work involved.

Float available in the CPM Schedule, at any time, must not be considered for the exclusive use of either the Contractor or the Engineer. However, any float used by the Owner that is later needed by the Contractor and results in delay to the critical path will be considered an excusable non-compensable delay.

If the CPM Schedule is not within reasonable conformity to these Specifications, it will be returned to the Contractor for correction and re-submittal.

The Contractor, or its Subcontractors, must not deviate from the projected start and completion times for major phases of the Work shown on the accepted CPM Schedule without providing at least 14 Days advance notice to the Engineer. Failure to notify the Engineer of a deviation from projected start and completion times for a major phase of the Work shown on the schedule may impact costs to the Owner, including the cost of additional community outreach to communicate changes in schedule to the public. The Contractor is responsible for resulting costs due to this failure to notify. The Owner will deduct these costs from any payment due or to become due to the Contractor.

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1-08.3(1)B SCHEDULE TYPES

1-08.3(1)B1 PRELIMINARY CPM SCHEDULE

The Contractor must prepare and submit a preliminary critical path schedule at the preconstruction conference. The preliminary schedule must show the first 30 Days of Work in reasonable conformity to these Specifications. The remaining schedule must show the critical path schedule using broad Work activities, and major milestones and durations for the purpose of review and discussion at the preconstruction conference.

1-08.3(1)B2 BASELINE CPM SCHEDULE

The Contractor must submit for Engineer's review and acceptance a baseline CPM Schedule no later than 7 Days after receipt of the Notice to Proceed. The baseline schedule will not be accepted unless it satisfies Section 1-08.3(1)A General Requirements.

Within 7 Days of the Engineer receiving the submittal, the Engineer and the Contractor must meet for joint review, correction, and adjustment of the initial baseline CPM schedule. Within 7 Days, the baseline schedule must be resubmitted to the Engineer showing the agreed on adjustments. Adjusted baseline CPM schedules submitted by the Contractor will be reviewed by the Engineer and returned to the Contractor within 7 Days of the Engineer's receiving the submittal. If necessary, the joint review and adjusted schedule submittal process must be repeated. However, the schedule must be finalized within 30 Days after Notice to Proceed.

1-08.3(1)B3 CPM SCHEDULE UPDATE

The Contractor must submit monthly Critical Path Schedule updates and whenever changes occur that have potential to delay Substantial or Physical Completion by 5 or more working Days. When required, include with the updates a written narrative describing the project schedule status, the critical path, and any revisions to the schedule.

1. At the discretion of the Engineer, progress meetings may be held monthly for the purpose of updating the critical path schedule. Progress will be reviewed to verify actual start and finish Dates, remaining duration and percent complete of uncompleted activities, and any proposed revisions to the schedule. It is the Contractor's responsibility to provide the Engineer with the status of activities at this progress meeting and prepare schedule updates based on this information once it has been verified and agreed upon. If the Work conforms to the last accepted critical path schedule, the Engineer may waive the monthly update or the final as-built CPM schedule.
2. The updated critical path schedule must contain the agreed on revisions or be resubmitted.

The Contractor must submit a supplemental Critical Path Schedule update within 7 Days of a request by the Engineer and of Substantial Completion. The CPM Schedule updates must conform to the following additional requirements:

a. Schedule updates must be presented in a Tracking Gantt format, showing 2 sets of Gantt-style progress bars consisting of 1) the latest accepted baseline CPM schedule versus 2) a combination of the actual start/finish progress of completed tasks and projected start/finish Dates of uncompleted tasks.
b. Include columns showing actual or projected start and finish Dates of all activities. Identify changes to activity precedents, successors, and/or constraints that have altered the critical path.
c. Highlight any new activities or additional activities resulting from the restructuring/splitting of existing baseline activities.
d. Identify the current critical path, which could vary from the baseline critical path due to actual Work progress, additional work, or changed conditions.

Unresolved issues or disputes with asserted time effects may be reflected in a schedule update by comparing the baseline critical path to the revised critical path shown on an updated schedule. If Work cannot be completed within the Contract Time, the updated schedule must reflect the earliest Completion Date practicable, and a narrative must be provided by the Contractor addressing the reason behind the delay. Acceptance of late completion schedules will be at the discretion of the Engineer and does not relieve the Contractor from Liquidated Damages.

1-08.3(1)B4 LOOK-AHEAD SCHEDULE

At each weekly progress meetings, the Contractor must submit a look-ahead schedule showing the Contractor's, and all Subcontractors' proposed Work activities and any Owner activities or supplied Materials for the next 3 weeks. Include the description, duration and sequence of Work, and highlight any deviations between planned and regular hours of Work. The 3 week look-ahead may be reduced to a 2 week look-ahead with the approval of the Engineer. Unless otherwise specified in the Contract, the Contractor must notify the Engineer at least 2 Working Days in advance of changing Work as shown on the look-ahead schedule; an updated look-ahead schedule must be submitted with the notification.

1-08.3(1)C SUBMITTALS

The Contractor must submit 1 copy of the CPM schedule in Gantt chart format, with columns displayed to show predecessors and successors of each activity, and narrative, and 1 full electronic copy in selected CPM software format. Unless approved otherwise by the Engineer, the CPM Schedule must be printed on 24" x 36" paper or larger. The CPM Schedule and any narrative must also be submitted in PDF format.

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The Gantt chart format is a standard method of presenting schedule information. The following standard requirements apply:

1. The schedule must include a horizontal time scale consistent with the project calendar.
2. Each activity/task/milestone must be listed in order of start date in a tabular grid to the left of the time scale. The tabular grid must include the task number, description, start date, completion date, predecessors, successors, and float. Baseline schedules must show the baseline-planned start and finish Dates. Updated schedules must show the actual/projected start and finish Dates.
3. Each activity must be provided with a corresponding task bar in the horizontal time scale, with a plotted length conforming to its duration and Dates.
4. Linked activities must be indicated by logic arrows in the timescale portion of the Gantt chart, as needed to clearly show the sequence and interdependence of all activities required for complete performance of all items of Work under the Contract.
5. Activities on the critical path must be highlighted using red task bars.

The electronic copy of the Critical Path Schedule must be compatible with Microsoft project or other Engineer approved software. The Contractor must submit a functional and complete CPM schedule electronically via email, on compact disk, or other medium accepted by the Engineer.

1-08.3(1)D EARLY COMPLETION

The Engineer allocates resources to a Contract based on the Contract Time. The Engineer will review and accept a Critical Path Schedule indicating an early Physical Completion Date but cannot guarantee Owner resources will be available to comply with the accelerated schedule. No additional payment or time will be allowed if the Contractor is not able to comply with its accelerated schedule due to the unavailability of Owner resources or for other reasons beyond the Engineer's control.

1-08.3(1)E PAYMENT

Payment for the cost necessary to complete the Work described in this Section is considered incidental to and included in all Bid Items of Work. No separate payment will be made for the Work required in this Section.

1-08.3(2) SCHEDULE CONSTRAINTS

The Contractor's CPM schedule must reflect constraints imposed by applicable laws and regulations, and those specified in the Contract. Constraints include but are not limited to the following:

1. Submittal requirements and review durations, see Section 1-05.3
2. Traffic Control restrictions, see Section 1-10.2(5)
3. Environmental restrictions, see Sections 1-07.5, 1-07.15 and permits
4. Safety restrictions, see regulations and permits
5. Holiday Construction Moratorium, see Section 1-10.2(5)C

1-08.4 NOTICE TO PROCEED AND PROSECUTION OF THE WORK

After the Execution Date of the Contract is established, the Contractor may proceed on submittals and procurement of Materials critical to project completion within Contract Time. The Contractor bears all risks for any Work begun before the Contract Execution Date. The Contractor must not start any other Work until the Notice to Proceed has been provided by the Engineer. The Engineer may provide a limited Notice to Proceed and authorize only a portion of the Work to commence. Notice to Proceed will be provided after the Contract has been Executed and the Payment and Performance Bond and evidence of insurance have been approved and filed by the Owner.

The Contractor bears all risks for any Work begun before the Notice to Proceed except for submittals and procurement after Execution of the Contract. Contract Time starts on the Notice to Proceed Date.

The Contractor must diligently pursue the Work to the Physical Completion Date within the time specified in the Contract. The Contractor must not voluntarily shut down or slow Work operations without requesting and obtaining prior approval of the Engineer. Such approval does not relieve the Contractor from the contractual obligation to complete the Work within the Contract Time.

1-08.5 TIME FOR COMPLETION

The Work must be physically complete within the time specified in the Contract or as changed by the Engineer.

Unless the Contract specifies otherwise, the Contract Time will be stated in Working Days, starts on the Notice to Proceed Date, and ends on the Physical Completion Date.

Each successive Working Day, starting with the Notice to Proceed Date and ending with the Physical Completion Date, must be charged to the Contract Time as it occurs except a Day or part of a Day that is designated a Non-Working Day or an Engineer determined Unworkable Day.

The Engineer will furnish Contractor with a weekly report showing:

1. The number of Working Days charged against the Contract Time for the preceding week

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2. The Contract Time in Working Days
3. The number of Working Days remaining in the Contract Time
4. The revised Physical Completion Date as applicable
5. The number of Non-Working Days
6. Any whole Days during the immediately preceding week that the Engineer declared to be an Unworkable Day.

If the Contractor elects to work 10 hours a Day and 4 Days a week and the fifth Day of the week in which a 4-10 shift is worked would ordinarily be charged as a Working Day then the fifth Day of that week will be charged as a Working Day whether or not the Contractor works on that Day.

The Contractor will be allowed 10 Days after the date of each report in which to file a written notice of protest of an alleged discrepancy in the Contract Time as reported. Otherwise, the report will be deemed to have been accepted by the Contractor as correct.

Unworkable Days may be granted for unsuitable weather and such other conditions beyond the control of the Contractor that prevent satisfactory and timely performance of the Work, see Section 1-08.6.

1-08.6 SUSPENSION OF WORK

The Contractor must immediately suspend the Work or resume suspended Work only when ordered or authorized in writing to do so by the Engineer. The Engineer may suspend all or part of the Work and for such periods of time as the Engineer may deem proper if:

1. Unsuitable weather and such other conditions beyond the control of the Contractor occur that prevent satisfactory and timely performance of the Work; or
2. The Contractor does not comply with the Contract or the Engineer's orders.

When ordered by the Engineer to suspend or resume Work, the Contractor must do so immediately.

If the Work is suspended for reason 1. above, the period of Work stoppage will be counted as Unworkable Days. The Engineer will set the number of Unworkable Days or parts of Days by deciding how long the suspension delayed the entire project.

In order to be granted an Unworkable Day, the Contractor must demonstrate vigorous work on the affected work and this work must be on the critical path as shown on the Contractor's latest CPM schedule. The Contractor may be granted 1 Unworkable Day when weather or other conditions beyond the control of the Contractor prevent work for a period greater than 1/2 of a Working Day.

If the Work is suspended for reason 2. above, the period of Work stoppage will be counted as Working Days. The lost Work time, however, does not relieve the Contractor from any Contract responsibility.

If the Contractor believes that the performance of the Work is suspended, delayed, or interrupted for an unreasonable period of time and such suspension, delay, or interruption is the responsibility of the Owner, the Contractor must immediately submit a written notice of dispute to the Engineer as specified in Section 1-04.4. No adjustment will be allowed for any costs incurred more than 10 Calendar Days before the date the Engineer receives the Contractor's written notice of protest.

The Engineer will determine if an equitable adjustment in cost or time is due as specified in this Section. The equitable adjustment for increase in costs, if due, is subject to the limitations specified in Section 1-09.4, provided that no profit of any kind will be allowed on any increase in cost necessarily caused by the suspension, delay, or interruption.

Request for extensions of time will be evaluated as specified in Section 1-08.8.

The Engineer's determination as to whether an adjustment should be made will be final as specified in Section 1-05.1.

No claim by the Contractor under this clause is allowed unless the Contractor has followed the procedures specified in Section 1-04.4.

1-08.7 MAINTENANCE DURING SUSPENSION

In preparing for or during suspensions of the Work as specified in Section 1-08.6, the Contractor must do whatever is necessary to prevent damage to or deterioration of the Work. The Contractor's safety and maintenance responsibilities remain unchanged except for those assumed by the Engineer under the conditions set forth in this Section.

At no additional expense to the Owner, the Contractor must maintain a safe, smooth, and unobstructed roadway, sidewalks, paths, temporary roads, or detours for public use through the construction area during suspension of the Work as specified in Section 1-07.23.

If the Engineer determines that the Contractor failed to pursue the Work vigorously, diligently, and without unauthorized interruption before the suspension, or failed to comply with the Contract or the Engineer's orders, the Contractor must maintain the temporary roadway, detour, sidewalks, or paths in use during suspension. In this case, the Contractor bears the maintenance costs. If the Contractor fails to maintain the temporary roadway, detour, sidewalks, or paths, the Owner will do the maintenance work and deduct all resulting costs from payments due to the Contractor specified in Section 1-05.8.

If the Engineer determines that the Contractor has pursued the Work vigorously, diligently, and without unauthorized interruption before the suspension, the Owner will do the routine maintenance work and bear its cost. The maintenance performed by the Owner will include only routine maintenance of:

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1. The traveled way and shoulders, sidewalks, paths, and detour surface.
2. Roadway drainage along and under the traveled roadway or detour.
3. All barricades, signs, and lights needed for directing traffic through the temporary roadway or detour in the construction area.

The Contractor must protect, maintain, and bear the costs of completing all other portions of the Work in areas not used for traffic.

After a suspension, during which the Owner has done the routine maintenance, the Contractor must accept the traveled roadway or detour as is, when the Work resumes. The Contractor must make no claim against the Owner for the condition of the roadway or detour.

After any suspension, the Contractor retains responsibility for repairing or restoring the roadway, its slopes, and its drainage system to the requirements of the Contract.

1-08.8 TIME EXTENSIONS AND DELAYS ENTITLEMENT AND COMPENSATION

1-08.8(1) GENERAL

The Engineer determines the Contract Time sufficient to complete the Work. For this reason the Engineer will not grant a time extension for any reason except those specified in Section 1-08.8(3)A.

The Contract will be extended for a period equivalent to the actual time the Work is suspended or delayed for an excusable reason. Entitlement, length of time extension, and applicable payment will be determined by the Engineer.

If the Work is suspended or delayed and the Contractor believes the reason for the suspension or delay is excusable or compensable, the Contractor must submit to the Engineer a written notice requesting an adjustment in the Contract Time, in the costs, or both. To be considered, the request must be submitted to the Engineer no later than 10 Days after the claimed suspension or delay occurs. The request must state the reasons why the adjustment should be granted. Upon receipt, the Engineer will evaluate the Contractor's request and determine if the:

1. The portion of the Work that was delayed:
   a. Is on the critical path of the critical path schedule in effect at the time as specified in this Section below; or
   b. Has increased in cost, time, or both as a result of such suspension or delay.
2. Delay was caused by one or more conditions beyond the control of, and were not the fault of, the Contractor or any of the Contractor’s Materialperson or Subcontractor at any approved tier;
3. The suspension was not on an Unworkable Day;
4. Performance was not suspended or delayed by any other cause; and
5. Adjustment is provided for or specifically excluded, under any other term or condition of this Contract.

If the Engineer agrees that an adjustment is warranted considering all evaluation criteria stated in items 1. through 5. immediately above, the Engineer will make an adjustment in Contract Time, cost, or both (excluding profit) and change the Contract accordingly. No adjustment will be allowed for any cost that was incurred by the Contractor more than 10 Working Days before the date the Engineer received the Contractor's written notice requesting an adjustment. The reasons for and times of extensions are determined by the Engineer and such determination is final under Section 1-05.1. Any disagreement with the Engineer's determination must be pursued as specified in Section 1-04.4.

The Contractor’s accepted critical path schedule in effect at the start of the claimed delay will be used to evaluate the extent of the delay and the claimed delay’s impact on the Contract Time. The Contractor is responsible for showing on this critical path schedule that the change or event:

a. Had a specific impact on the critical path, and except in cases of concurrent delay, was the sole cause of such impact; and
b. Could not have been avoided by resequencing of the Work or other reasonable alternative.

Failure of the Contractor to efficiently use all available time after the Notice to Proceed Date will be considered in evaluating requests for extensions of time.

The granting of a time extension or granting payment of additional payment or granting of both will be made by Change Order, except that time extensions and/or payment of additional payment for suspensions of the Work on Days determined by the Engineer to have been Unworkable Days will be as specified in Section 1-08.8.

1-08.8(2) NON-EXCUSABLE DELAYS

Non excusable delays are those delays caused by factors within the Contractor’s control that could have been foreseen or avoided had the Contractor exercised due care, prudence, foresight, or diligence and pursued the Work vigorously and without unauthorized interruption. Non-excusable delays do not entitle the Contractor to an extension of time and are not compensable.

Non excusable delays include, but are not limited to:

1. Delays caused by or resulting from the Contractor’s own Subcontractors or Materialpersons.
2. The Contractor’s lack of sufficient working capital.

3. The default of the Contractor.
4. The Contractor's act or failure to act.
5. The Contractor's failure to procure Materials or to provide labor or to perform the Work according to the Contract.
6. Changes, protests, increased quantities, or changed conditions that do not delay the completion of the Contract or prove to be an invalid or inappropriate time extension request.
7. Delays caused by Contractor submittal as specified in Section 1-05.3.
8. Rejection of faulty or inappropriate equipment as specified in Section 1-05.9.

The Contract may be terminated for a non-excusable delay.

1-08.8(3) EXCUSABLE DELAYS

1-08.8(3)A GENERAL

Excusable delays are those delays caused by one or more factors beyond the control and without fault or negligence of the Contractor.

Excusable delays may be compensable and will entitle the Contractor to an extension of time if the activities that are subject to the delay are on the critical path of the accepted critical path schedule in effect at that time, and the Contractor has submitted a request for an extension of time within the prescribed time limits.

Excusable delays include:

1. Acts of nature;
2. Acts of the public enemy;
3. Acts of a government in its sovereign capacity;
4. Acts or omissions or defaults of the Owner, or any of its officers and employees, including the Engineer, or of another Contractor employed by the Owner;
5. Unforeseeable conditions not the fault of the Contractor;
6. Fires or floods due to nature or other casualty for which the Contractor is not responsible;
7. Epidemics;
8. Quarantine restrictions;
9. Unusual transportation delays such as freight embargoes;
10. Strikes or combined actions of labor;
11. Unusually severe weather as defined in this Section, provided that:
    a. The Engineer has not already allowed it as an Unworkable Day as specified in Section 1-08.5;
    b. The Contractor timely filed a written notice of protest (per Section 1-08.5) asserting that time the Engineer charged as a Working Day should have been allowed as an Unworkable Day or portion thereof; and
    c. The Engineer responded to the Contractor's written notice of protest of item k. 2) above with a written notice approving that time as an Unworkable Day or portion thereof.
12. Any other conditions for which the Contract permits time extensions including but not limited to:
    a. Section 1-04.3 if a change increases the time to do any of the Work including unchanged Work;
    b. Section 1-04.4 if the increased time is part of a dispute that is found to be valid;
    c. If a dispute or claim also involves a delay in completing the Contract and the dispute or claim proves to be valid;
    d. Section 1-04.5 if increases in the quantities of any Bid Item of Work exceed 25 percent and these increases caused a delay in completing the Contract;
    e. Section 1-04.6 if a changed condition is determined to exist that caused a delay in completing the Contract;
    f. Section 1-05.3 if the Engineer does not approve properly prepared and acceptable Shop Drawings within the specified time frame for review;
    g. Section 1-07.13 if the performance of the Work is delayed as a result of damage by others not party to the Contract;
    h. Section 1-07.17 if the removal or the relocation of any utility by forces except the Contractor caused a delay;
    i. Section 1-07.24 if a delay results from the Owner not purchasing the Right of Way necessary for construction and the Project Manual does not make specific provisions regarding unpurchased Right of Way;
    j. Section 1-08.6 if the performance of the Work is suspended, delayed, or interrupted for an unreasonable time that proves to be the responsibility of the Engineer or Owner; or
13. Causes not specifically identified in items 1. through 12., provided the request letter proves the Contractor had no control over the cause of the delay and could have done nothing to avoid or shorten it.

Unusually severe weather will be as determined by the Engineer. Minimum requirements for unusually severe weather are monthly average temperature, precipitation, or precipitation events outside of 2 standard deviations of the historical

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weather data of the past 9 years. Weather meeting the minimum requirements for unusually severe weather will be subject to evaluation based on its effect on active work. If the Contractor elects not to perform the Work during periods of normal inclement weather that does not qualify as unusually severe weather, and the Engineer does not grant an Unworkable Day(s), the Contractor is not entitled to an extension of time.

1-08.8(3)B COMPENSABLE DELAYS

Payment will be provided for an increase in cost of performance of the Work (excluding profit) if the performance of all or any part of the Work is suspended or delayed for an unreasonable period of time by an act of the Engineer or the Owner in the administration of the Work and such act is not expressly or implicitly authorized by the Contract; or by failure of the Engineer or Owner to act within a time period specified in the Contract (or if no time is specified, within a reasonable time). However, no adjustment will be made under this Section for a suspension or delay if:

1. The performance would have been suspended or delayed by any other cause including the fault or negligence of the Contractor; or
2. Payment is provided for or excluded under any other provision of the Contract (i.e. Concurrent Delays).

Compensable time extensions may be granted for reasons arising from the changes or changed conditions (differing site conditions) Contract provisions. However, a time extension granted under the changes or changed conditions (differing site conditions) Contract provisions are not considered a delay or suspension of the Work as defined in this Section. If the Contractor believes an excusable delay is compensable, the Contractor must immediately submit a written request for adjustment as specified in Section 1-08.8(1). The Engineer will determine if an equitable adjustment in cost or time is due. The equitable adjustment for increase in costs, if due, is subject to the limitations specified in Section 1-09.4, provided that no profit of any kind will be allowed on any increase in cost necessarily caused by the suspension, delay, or interruption.

The Engineer's determination as to whether an adjustment should be made will be final unless the decision is disputed per the dispute resolution procedures specified in Section 1-04.4.

1-08.8(3)C NON-COMPENSABLE DELAYS

Non compensable delays are delays to the completion of the Work arising from conditions beyond the control and without fault or negligence of the Contractor, the Engineer, or the Owner. Non compensable delays include, but are not limited to:

1. Acts of nature
2. Acts of the public enemy
3. Fires
4. Floods due to nature
5. Epidemics and quarantine restrictions
6. Unusual transportation delays (freight embargoes)
7. Strikes or combined actions of labor
8. Unusually severe weather
9. Delays of Subcontractor or Materialperson at any tier

1-08.8(4) CONCURRENT DELAYS

Concurrent delays are those delays where progress on critical path activities is impeded over the same period of time due to causes attributable to both the Contractor and Engineer or Owner. In the event of a concurrent delay, neither party is entitled to payment from the other over the period of time that concurrency of delay exists.

1-08.8(5) COST FOR SPU CREWS DUE TO CONTRACTOR DELAYS

Except for excusable delays specified in Section 1-08.8(3), the Contractor must reimburse SPU for work the Contractor has scheduled to be completed by SPU crews for water transfers and connections, if the Contractor is not prepared to allow SPU to perform the work as scheduled. The Contractor must reimburse SPU for the costs to mobilize crews for the scheduled work and for the crew time lost on a time and materials basis.

1-08.9 LIQUIDATED DAMAGES

Time is of the essence to the Contract. By entering into this Contract, the Contractor has agreed to complete the project within the specified Contract Time. Liquidated Damages have been agreed upon to provide payment for damages resulting from failure to complete the Contract on time. Such obligation is not construed as a penalty.

The Contractor:

1. Must pay Liquidated Damages for delay or for overruns in the Contract Time;
2. Authorizes the Engineer to deduct these damages from any money due or to become due to the Contractor; and
3. Is liable for any other damages as provided in this Contract.

For overruns in Contract Time occurring before the Substantial Completion Date and for overruns in Contract Time occurring before the Physical Completion Date, the Liquidated Damages amount is set forth in Section 4 of the Agreement Form.

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Liquidated Damages will not be assessed for any Day for which an extension of time is granted. No deduction or payment of such damages for delay will release the Contractor, in any degree, from further obligations and liabilities to complete the entire Contract.

1-08.10 TERMINATION OF CONTRACT

1-08.10(1) TERMINATION FOR DEFAULT

The Owner may determine sufficient cause exists to terminate the Contract. Upon determination by the Owner, the Contractor and its surety will be notified. Notification will include the reasons for the determination and provide opportunity to cure. The Owner may make a default determination upon the occurrence of any one or more of the following events:

1. If the Contractor fails to supply sufficient skilled workers or suitable Materials or equipment.
2. If the Contractor refuses or fails to prosecute the Work with such diligence as will ensure its Physical Completion within the Contract Time and any extension of time that may have been granted to the Contractor by Change Order or otherwise.
3. If the Contractor is adjudged bankrupt or insolvent, or makes a general assignment for the benefit of creditors, or if the Contractor or a third party files a petition to take advantage of any debtor's act or to reorganize under the bankruptcy or similar laws concerning the Contractor, or if a trustee or receiver is appointed for the Contractor or for any of the Contractor's property on account of the Contractor's insolvency, and the Contractor or its successor in interest does not provide the Engineer adequate assurance of future performance as specified in the Contract within 15 Days of receipt by the Contractor or its successor in interest of a request for assurance from the Engineer.
4. If the Contractor disregards any law, ordinance, rule, code, regulation, directive, or similar requirement of any public entity having jurisdiction.
5. If the Contractor disregards the authority of the Engineer.
6. If the Contractor performs any portion of the Work in a way that deviates from the Contract requirements, and neglects or refuses to correct any rejected performance.
7. If the Contractor otherwise violates in any material way any material provision or requirement of the Contract.
8. If the Contractor failed to disclose or submitted false or misleading information in the Supplemental Bidder Responsibility Criteria Form or attached documentation.

In case of an emergency such as potential damage to life or property, the response time to cure the default after the written notice may be shortened. If the cure does not take place to the satisfaction of the Engineer, the Engineer, by serving written notice to the Contractor and Surety, may either:

a. Transfer the performance of the Work from the Contractor to the Surety; or
b. Terminate the Contract and, at the Engineer's option, prosecute it to completion by Contract or by other means. Any extra costs or damages to the Owner will be deducted from any money due or coming due to the Contractor or Surety under the Contract.

If the Owner elects to pursue 1 cure, it will not bar the Owner from pursuing other cures on the same or subsequent defaults.

Upon receipt of a written notice that the Work is being transferred to the Surety, the Surety will enter on the Project Site and take possession of all Materials, tools, and appliances for the purpose of completing the Work under the Contract and employ by Contract or otherwise any person or persons satisfactory to the Engineer to complete the Work and provide the Materials without termination of the Contract. Such employment does not relieve the Surety of its obligations under the Contract and the Payment and Performance Bond. If there is a transfer to the Surety, payments on progress estimates covering the Work after the transfer is made to the extent permitted under law to the Surety or its agent without any right of the Contractor to make any claim against the Owner for such sums.

If the Contractor fails to cure any default within the time specified in the Owner's written notice and if the Owner terminates the Contract or provides such sufficiency of labor or Materials as is required to complete the Work, then the Contractor is not entitled to receive any further payment on the Work until the Work has been fully performed. The Contractor bears all extra expenses incurred by the Owner in completing the Work, including all increased costs for completing the Work, and all damages sustained, or that may be sustained, by the Owner by reason of such refusal, neglect, failure, or discontinuance of the Work by the Contractor. If Liquidated Damages are provided for in the Contract, the Contractor is liable for whatever amount of such damages accrues through the Substantial Completion Date. After all Work encompassed by the Contract has been completed, the Engineer will calculate the total expenses and damages for the completed Work. If the total expenses and damages are less than any unpaid balance due the Contractor, the excess will be paid by the Owner to the Contractor. If the total expenses and damages exceed the unpaid balance, the Contractor and the Surety are jointly and severally liable to the Owner and must pay the difference to the Owner on demand. The Contractor and its sureties are liable for all damages and costs, including but not limited to: (1) compensation for Architect and engineering services and expenses; (2) any other costs or damages incurred by the Owner in completing and/or correcting the Work; and (3) any other special, incidental or consequential damages incurred by the Owner which results from the termination.

In exercising the Engineer's right to prosecute the Work to Physical Completion, the Engineer has the right to exercise sole discretion as to the manner, method, and reasonableness of the costs of completing the Work. In the event that the

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Owner takes Bids for remedial work or Physical Completion of the project, the Contractor is not eligible for the Award of such contract.

In the event the Contract is terminated, the termination of the Contract does not affect any rights of the Owner against the Contractor, including any warranties or assurances. The rights and remedies of the Owner under the termination clause are in addition to any other rights and remedies provided by law or under this Contract. Any retention or payment of monies to the Contractor by the Owner will not release the Contractor from liability.

If a written notice of termination for default has been issued and it is later determined for any reason that the Contractor was not in default, the rights and obligations of the parties is the same as if the written notice of termination had been issued under Termination for Public Convenience in Section 1-08.10(2). This result applies where the Contract is terminated for default because of failure to prosecute the Work, and where a Contractor's delay was found to be excusable as specified in Section 1-08.8. Any termination for default may be grounds for debarment as specified in Section 1-08.10(8).

1-08.10(2) TERMINATION FOR PUBLIC CONVENIENCE

The Owner may terminate the Contract in whole, or from time to time in part, whenever:

1. The Contractor is prevented from proceeding with the Work as a direct result of an Executive Order of the President with respect to the prosecution of war or for national defense; or an Executive Order of the President or Governor of the State with respect to the preservation of energy resources.
2. The Contractor is prevented from proceeding with the Work by reason of a preliminary, special, or permanent restraining order of a court of competent jurisdiction where the issuance of such restraining order is primarily caused by an act or omission of a person or agency except the Contractor.
3. The Owner determines that such termination is in the best interest of public or the Owner.
4. The Owner determines that such termination is mutually beneficial to the Owner and the Contractor.

1-08.10(3) PAYMENT FOR TERMINATION FOR PUBLIC CONVENIENCE

Whenever the Contract is terminated as specified in Section 1-08.10(2), payment will be made for actual Work performed at Bid Item prices for completed Bid Items of the Work. An equitable adjustment for partially completed Bid Items of Work and disposal of Materials will be made as specified in Section 1-09.5.

1-08.10(4) TERMINATION CLAIM BY CONTRACTOR

After receipt of a written notice of termination of Contract for public convenience, the Contractor must submit to the Engineer a termination claim in sufficient detail to enable the Engineer to ascertain the basis and amount of the claim. The claim must provide the minimum detailed information specified in Section 1-04.4(3). The claim must be submitted promptly but in no event later than 60 Days after the effective date of termination. The Contractor must pursue resolution of the claim through the established administrative channels of the Owner. The Contractor must make its business and office records available to the extent necessary for the Engineer to verify the Contractor's claim and to determine the amount of entitlement as specified in Section 1-09.10. The decision of the Engineer is final, see Section 1-05.1.

1-08.10(5) TERMINATION FOR DELAYS DUE TO LITIGATION

Pursuant to RCW 60.28.080, if the delay caused by litigation exceeds 6 months, the Contractor may then elect to terminate the Contract and receive payment in proportion to the quantity of the Work completed plus the cost of the delay. Amounts retained and accumulated under RCW 60.28.011 will be held for a period of 60 Days following the election of the Contractor to terminate.

1-08.10(6) RESPONSIBILITY OF THE CONTRACTOR AND SURETY

Termination of the Contract or an Order of Debarment does not relieve the Contractor of any responsibilities under the Contract for Work performed.

Termination of the Contract or an Order of Debarment does not relieve the Surety or Sureties of obligations under the Payment and Performance Bond, and Retainage Bond if applicable, for Work performed.

1-08.10(7) TERMINATION BEFORE COMPLETION

Pursuant to RCW 60.28.011(7), if after a substantial portion of the Work has been completed, an unreasonable delay will occur in the completion of the remaining portion of the Contract for any reason not the result of a breach thereof, the Owner may, if the Contractor agrees, delete from the Contract the remaining Work and accept as final the Improvement at the stage of completion then attained and make payment in proportion to the quantity of the Work accomplished. In such case, whatever amount of the Contractor's payment has been retained and accumulated under RCW 60.28.011(7) will be held for the statutory period of 60 Days following the establishment of the Completion Date. In the event that the Work has been terminated before Completion, the Owner may thereafter enter into a new Contract with the same Contractor without an Advertisement for Bids or Bid for the performance of the remaining Work or Improvement for an amount equal to or less than the cost of the remaining Work under the original Contract.

1-08.10(8) DEBARMENT

The Owner may debar a Contractor under SMC 20.70.

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SECTION 1-09 MEASUREMENT AND PAYMENT

1-09.1 MEASUREMENT OF QUANTITIES

In measuring all acceptably completed Bid Items of Work, the Engineer will:

1) Use United States standard measure.
2) Make all measurements as described in this Section, unless individual Specifications require otherwise.
3) Follow methods generally recognized as conforming to good engineering practice.
4) Conform to the usual practice of the Owner by carrying measurements and computations to the proper significant figure or fraction of units for each Bid Item.
5) Measure horizontally or vertically (unless otherwise specified).

The terms listed below are defined as follows in all measurements under this Section:

a) Lump sum (when used as a Bid Item of payment): Complete payment for the Work described for that item in the Contract.

b) Gauge: In the measurement of plates as the U.S. Standard Gauge; in the measurement of galvanized sheets used to manufacture corrugated metal pipe, metal plate pipe Contracts and arches, and metal cribbing, as specified in AASHTO M 36, M 167, M 196, M 197, or M 219; and in the measurement of wire as specified in AASHTO M 336 and ASTM A 1064.

c) Ton: The short ton is equal to 2,000 pounds of avoirdupois weight. All Materials that are measured or proportioned by weight will be weighed according to the requirements of Section 1-09.2. If Material is shipped by rail, the car weight may be accepted provided only the actual weight of Material is paid for. However, car weights are not acceptable for Material to be passed through mixing facilities.

d) Calculated: When the unit of measurement is calculated, payment or deduction will be calculated per the applicable specification. Calculated (abbreviated CALC) will be used as the Bid Item unit of measurement in the Bid form. The extended Bid Item amount in the Bid Form will be either zero or an estimated amount for bidding purposes only.

For each basis of measurement listed below, the Engineer will use the method of measurement described. For Bid Items or Materials measured on the basis of:

1. Square Yard or Square Foot: The measurement must be a calculation from the neat dimensions shown on the Drawings or as changed by the Engineer. If there is an exception within the measured area where the item of Work is not performed (such as a drainage Structure within a measured sidewalk) and if the exception area is greater than 9 square feet, then the area of the exception will be subtracted from the payment area calculated from the neat dimensions.
2. Linear Foot: Measure length along an element unless otherwise specified.
3. Weight: Weighed as required in Section 1-09.2.
4. Volume:
   a. Excavation and Embankment: Measured by the average end area method or by the finite element analysis method using digital terrain modeling techniques. All or some computations may be based on ground elevations and other data derived photogrammetrically. The Engineer may correct for curvature.
   b. In Hauling Vehicle: Measured at the point of delivery. Hauling vehicles may be of any size or type the Engineer approves provided that the body is of such shape that the actual contents may be readily and accurately determined. If the Engineer requires, the Contractor must level loads at the delivery point to facilitate measurement.
   c. Mineral Aggregates: Measured by the cubic yard compacted in place to the neat line dimensions indicated on the Drawings or Standard Plans.

1-09.1(1) UNIT WEIGHT - VOLUME CONVERSION FACTORS FOR MEASUREMENTS

Bid Items for which the Contract requires measurement by volume may, at the Contractor's request and with the Engineer's approval, or at the discretion of the Engineer, be converted to weight from volume measurements using a determination of density (unit weight) factor. Bid Items for which the Contract requires measurement by weight may, at the Contractor's request and with the Engineer's approval, or at the discretion of the Engineer, be converted to volume from weight measurements using a determination of density (unit weight) factor.

The relationship between degree of compaction of aggregates or soils in a hauling unit, stockpile, or compacted in-place are unknown. The conversion for measurement will be based on bulk density (unit weight) factor at location and condition of measurement; typically compacted in-place. The following tests may be applicable:

1. ASTM D6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods
2. ASTM C29 / C29M Standard Test Method for Bulk Density (Unit Weight) and Voids in Aggregate
3. ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
4. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort

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5. Other methods as approved by the Engineer

When proposed by the Contractor, conversion factor testing must be performed at the Contractor's expense by an Engineer approved independent materials Laboratory retained by the Contractor; the Engineer may verify testing and if testing results are in conflict, the Engineer's conversion factor will govern. When directed all testing for conversion factor will be by the Engineer.

For each item listed below, the Engineer will use the method of measurement described:

a. Structures: Measured on the neat lines shown on the Drawings or as changed by the Engineer. When a complete Structure or Structural unit is specified as the unit of measurement, the unit must include all fittings and accessories.

b. Timber: Measured by the thousand board feet (MBM) actually used in the Structure. Measurements will be based on the nominal width, thickness, and the extreme length of each piece.

c. Standard Manufactured Items: Materials such as fence, wire, plates, rolled shapes, or pipe conduit, when specified, must be measured by the manufacturer's identification of gage, unit weight, and section dimension. The Engineer will accept manufacturing tolerances set by each industry unless cited Specifications require more stringent tolerances.

d. Portland Cement: Measured by the pound, ton, or sack. A sack weighs 94 pounds.

e. Asphalt: Measured by the gallon or ton. If measured by gallon, measurement will be made at 60 °F (or will be corrected to the volume at 60 °F in keeping with ASTM D 1250). If shipped by rail, truck, or transport, measurement will be by net certified scale weights or certified volumes (corrected for Material lost en-route or not actually incorporated into the Work). The Engineer will use the volume weight conversion table below to compute asphalt measurements:

Conversion Factors

Average Weights and Volumes of Asphalt

Grade	Gallons per Ton	Pounds per Gallon
Liquid Asphalt	**@ 60 °F**	**@ 60 °F**
70	253	7.90
250	249	8.03
800	245	8.16
3000	241	8.30
Paving Asphalt		
All PG Grades	235	8.51
Emulsified Asphalt		
All Grades	240	8.33

No measurement will be made for:

1) Work performed or Materials placed outside lines shown on the Drawings or set by the Engineer;
2) Materials wasted, used, or disposed of as contrary to the Contract;
3) Rejected materials (including those rejected after placement if the rejection resulted from the Contractor's failure to comply with the Contract);
4) Hauling and disposing of rejected materials;
5) Material remaining on hand after the Work is completed, except as provided in Section 1-09.8; or
6) Any other Work or Material contrary to any Contract provision.

1-09.2 WEIGHING EQUIPMENT

1-09.2(1) GENERAL REQUIREMENTS FOR WEIGHING EQUIPMENT

Materials proportioned, or measured and paid for by weight must be weighed on accurate, approved scales by competent, qualified personnel at locations satisfactory to the Engineer.

Scales for the weighing of natural, manufactured, or processed construction materials obtained from natural deposits, stockpiles, or bunkers which are required to be proportioned or measured and paid for by weight, must be furnished, erected and maintained by the Contractor, or must be certified, permanently installed commercial scales.

Each truck to be weighed must have a unique identification number. This number must be legible and in plain view of the scale operator. Trucks used to haul Material being paid for by weight must be weighed empty at least once daily or at such times as the Engineer directs. Duplicate weight tickets must be prepared and accompany each truckload of Material delivered to the project. The duplicate weight tickets must be submitted to the Engineer on the Day of delivery. The tickets must be legible and contain the following information:

a. Preprinted ticket serial number

b. Identification number of truck/truck trailer
c. Date and hour of weighing
d. Type of Material
e. Weight of load including gross, tare, and net weights. If the scale has a tare beam so the net weight can be read directly, only the net weight need be recorded on the ticket.
f. Weighperson's identification
g. Item number
h. Contract number
i. Unit of measure
j. Legal gross weight in remarks section
k. Location of delivery (station or by street name)

The net weight of Material measured by the ton that is being placed in each truck must be printed on the ticket by an automatic weighing device from a certified scale.

Scales must:

1. Be accurate to within 1/2 of 1 percent throughout the range of use
2. Not include spring balances
3. Include beams, dials, or other reliable readout equipment
4. Be arranged so that operators and inspectors can safely and easily see the dials, beams, rods, and operating scale mechanisms
5. Be built to prevent scale parts from binding, vibrating, or being displaced and to protect all working parts from falling material, wind, and weather
6. Be carefully maintained, with
   a. Bunkers and platforms kept clear of accumulated materials that could cause errors.
   b. Knife edges given extra care and protection.

At each batch and platform scale location, the Contractor must keep 10 standard 50 pound weights for scale calibration and testing. If the Engineer has approved other calibration and testing equipment, the Contractor may substitute the approved other equipment for these weights.

1-09.2(2) SPECIFIC REQUIREMENTS FOR BATCHING SCALES

All Materials proportioned by weight must be weighed on an accurate, approved scale by qualified operators. Scale locations require the Engineer's approval.

Each scale must be designed to support a weighing hopper. The arrangement must make it convenient for the operator to remove Material from the hopper while watching readout devices. Any hopper mounted on a platform scale must have its center of gravity directly over the platform centerline.

Marked intervals on the readout device must be spaced evenly throughout and must be based on the scale's nominal rated capacity. These intervals must be at least 1 pound, but less than 1/10 of 1 percent of nominal rated capacity.

An agent of the scale manufacturer must test and service any batch scale before its use at each new site and then at 6 month intervals. The Contractor must provide the Engineer a copy of the final results after each test. Whenever the Engineer requests, the Contractor's operator must test the scale while the inspector observes.

Portland or asphalt cement must be weighed on a scale not used for other materials.

1-09.2(3) SPECIFIC REQUIREMENTS FOR PLATFORM SCALES

Platform scales must be certified scales that automatically print the net, tare, and gross weights on the ticket and must have the size and capacity to weigh an entire hauling vehicle or combination of connected vehicles at one time. No part of the connected vehicle or combination can be off the platform when weighing.

A platform scale operator must be assigned by the Contractor to weigh all materials on the Contractor's platform scales and make the records thereof. The Contractor may also elect to use commercial scales. The Contractor must furnish approved load tickets at the scale and legible duplicate copies to the Engineer at the delivery point and guarantee permission for Owner personnel to periodically observe the weighing and to check and compile the daily record of scale weights. Tare weights of each conveyance must be taken 2 or more times daily.

The scales must be calibrated daily. The scales check methods and documentation procedures for scale checks and recording tare weights must be approved by the Engineer. Checks must be made throughout each Day to see that the scales are balanced and return to zero when no load is on them.

Any Contractor supplied scale must include a scale house with a floor space of at least 6' x 10'. The scale house must:

1. Be wind and weather tight.
2. Have windows for light and ventilation.

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3. Include a door.
4. Be lockable.

The scale house must include a table, a chair, electrical power, and a space heater. The Contractor must provide a rest room near the scale house.

Platform scales must be installed and maintained with the platform level and rigid bulkheads at each end to eliminate binding and shifting. The platform scale beam or dial must have graduated intervals of no more than 40 pounds. When testing the scales, the weights must be read and recorded to the nearest 20 pounds and during weighing operations, weights must be read and recorded to the nearest hundred weight (cwt.).

Before use at a new site and every 6 months thereafter, the scales must be approved per local ordinances or rules of the State Department of Agriculture's Weights and Measures Section, or be serviced and tested by a scale company representative with at least 10,000 pounds, with a copy of the final test results provided to the Engineer.

1-09.2(4) SPECIFIC REQUIREMENTS FOR BELT CONVEYOR SCALES

Conveyor belt weighing may be accepted for untreated Materials provided that this method or device meets the general requirements of weighing equipment.

Belt conveyor scales must comply with the requirements for belt conveyor scales as specified in the National Bureau of Standards, Handbook No. 44, except as modified by these Specifications.

A daily static load test must be made after an approximate 1/2 hour of continuous running of the belt conveyor and whenever the air temperature varies significantly. A chain test will be required whenever a need for adjustment has been determined by the daily static load test.

The test chain calibration computation, calibration procedures and results, and related documents must be available for review by the Engineer. The test chain must be clearly marked with its calibration. The test chain must be carried in a suitable container and must be immediately available for testing of the belt conveyor scales.

Comparisons of accuracy may be made by checking the average of 5 or more sequential hauling unit payloads on platform scales meeting the requirements of these Specifications. A comparative accuracy of ± 0.5 percent of the payload of the average hauling unit will be acceptable. Since the recording odometer, of conveyor belt scales in general use, is graduated in 0.1 ton (200 lb.) increments and, since the recording is a cumulative process, minor differences in reading or variations smaller than 0.1 ton carry over from one vehicle unit to another. For greater accuracy, confirmation of the conveyor weights will be based on the tonnage values obtained from readings taken from the sealed odometer at the starting and end of each check period. The number of check loads may be increased by the Engineer should the test results fluctuate.

The Contractor must furnish appropriate serially numbered tickets as approved by the Engineer for self-printing of the time and date of loading and the approximate load out weight. Each ticket must be imprinted from a recording device at the loading point by the truck driver and delivered to the Engineer at the Project Site. The delivered ticket must be marked with hauling conveyance equipment number.

The recording tape, odometer, totalizer, calibration adjustment, and clock time imprinter must be secured and locked. All keys must be in the possession of the Engineer.

1-09.2(5) UNDERWEIGHING / OVERWEIGHING SCALES

In the event inspection, or random checks, reveals that scales have been under-weighing, the scales must be adjusted and no additional payment to the Contractor will be allowed for Materials previously weighed and recorded. Scales overweighing (indicating more than true weight) are not permitted to operate and all Materials received after the last previous corrected weighing accuracy test will be reduced by the percentage of error in excess of 1/2 of 1 percent. No payment will be made for Materials received by weight which have not been weighed per the foregoing Specification or other methods specifically approved in writing for the individual project. In the event these random checks result in net weights that are different by more than 1 percent of the smaller net weight, the Contractor must, at the Engineer's option, use a certified scale of the Engineer's choice.

1-09.2(6) PAYMENT

All costs in connection with furnishing, installing, certifying and maintaining scales for furnishing check weights and scale house and for all other items specified in this Section for the weighing of construction Materials for proportioning or payment are included in the Bid Item prices for the various Bid Items of Work which comprise the Contract.

1-09.3 SCOPE OF PAYMENT

1-09.3(1) GENERAL

The Contractor must receive and accept payment provided in the Contract as full payment for the following:

1. Furnishing all Materials and for performing all Work under the Contract in a complete and acceptable manner including changes in the Work, Materials, or Drawings as provided for by approved Change Orders.
2. All risks, loss, damage, or expense of whatever character arising out of the nature or prosecution of the Work.
3. All expense incurred as a result of the suspension or discontinuance of the Work as specified in the Contract.

The payment of any estimate or retained percentage does not relieve the Contractor of the obligation to make good any defective Work or unauthorized Work or defective Materials.

Unless the Contract provides otherwise, the Bid Item prices for the various Bid Items of the Work listed in the Bid Form will be full payment for all labor, Materials, Supplies, equipment, tools, and all things of whatever nature required for the complete incorporation of the Bid Item into the Work.

The term lump sum, when used as a Bid Item or Bid Items of payment, means full payment for the Work described for that Bid Item in the Contract.

Unless modified otherwise in the Contract, the Bid Items listed or referenced in the payment clause of each Section of the Specifications will be the only Bid Items for which payment will be made for the Work described in or specified in that particular Section. Should the Contractor perform Work that is listed as a Bid Item in a payment clause but not in the Bid Form, payment for that Work will be made as specified in Section 1-04.1(2).

If the payment clause in the Specifications relating to any Bid Item price in the Bid Form requires that said Bid Item price cover and be considered payment for certain Work or Material essential to the item, then the Work or Material will not be measured or paid for under any other Bid Item which may appear elsewhere in the Bid Form or Specifications.

Certain Bid Items appearing in the Standard Specifications may be modified in the Contract to include words such as:

a. "For Structure," or "For Concrete Barrier," or "For Bridge" with the intent of clarifying specific use; and/or

b. "Site (site designation)," with the intent of clarifying where a specific item of Work is to be performed.

Modifications of the Bid Items in this manner do not change the intent of the Specifications relating to these items.

Payment for Bid Items listed or referenced in the payment clause of any particular Section of the Specifications includes all Work required, specified, or described in that particular Section. Payment items will generally be listed generically in the Specifications (e.g. "Maintenance hole (type)") and specifically in the Bid Form (e.g. "Maintenance hole, Type 204A"). When items are to be furnished under one payment item and installed under another payment item, such items must be furnished FOB to the Project Site or, if specified in the Contract, delivered to a designated Owner site. The Contractor is responsible for Materials furnished or furnished and installed under these conditions, with regard to storage, until such items are incorporated into the Work or, if such items are not to be incorporated into the Work, delivered to the applicable City storage site if specified.

Payment for Material furnished but not yet incorporated into the Work may be made on progress estimates to the extent allowed.

1-09.3(2) LUMP SUM BREAKDOWN

This breakdown will be used to determine partial lump sum Bid Item payments on progress payments. Without an accepted lump sum breakdown, partial lump sum payments will be at the discretion of the Engineer. Submittals must be as specified in Section 1-05.3

Within 3 Working Days of the Notice to Proceed or at the preconstruction conference, the Contractor must submit a lump sum breakdown for each lump sum Bid Item except mobilization, Bid Items less than $5,000, and short term Bid Items for scopes of work that can be completed in less than 2 weeks. The Contractor's lump sum breakdown must be by elements of work. For elements of work with a cost greater than $5,000, the breakdown must also include costs by labor, equipment, and Material. Short term Bid Items and elements of Work in a lump sum breakdown that are partially complete will be paid at a prorated percentage as determined by the Engineer.

1-09.4 EQUITABLE ADJUSTMENT FOR CHANGES

1-09.4(1) CHANGES IN CONTRACT WORK

The equitable adjustment provided for elsewhere in the Contract will be determined by agreement between the Contractor and the Owner using:

1. Unit prices; or
2. Other agreed on prices including lump sum.

When payment is by lump sum the Contractor must provide substantiation of the lump sum price as specified in Section 1-09.3(2). The payment includes all costs for the Work, overhead, and profit.

The Contractor must include retail sales tax in the agreed price, as specified in Section 1-07.2.

The following limitations apply in determining the amount of the equitable adjustment:

a. The equipment rates must not exceed the rates set forth in the AGC/WSDOT Equipment Rental Agreement in effect at the time the Work is performed as specified in Section 1-09.6.

b. To the extent any delay or failure of performance was concurrently caused by the Owner and the Contractor as specified in Section 1-08.8(4), the Contractor is entitled to a time extension for the period of delay, provided it make such a request as specified in Section 1-08.8; however, the Contractor is not entitled to any adjustment in Contract Price.

c. No claim for anticipated profits on deleted, terminated, or uncompleted Work will be allowed.

d. No claim for consequential damages of any kind will be allowed.

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If the parties cannot come to an agreement then the Owner will determine the total price for the Work including overhead and profit.

1-09.4(2) CHANGES IN LAW OR TAXES

Adjustments in the amount to be paid by the Owner under the terms and conditions of the Contract will not be made as a result of any change in laws, ordinances or regulations except as specifically provided by the following:

1. Changes in Laws: The Owner will not adjust payment to compensate the Contractor for changes in legal requirements unless those changes are specifically within the scope of RCW 39.04.120. For changes under RCW 39.04.120 the Owner will compensate the Contractor as specified in Section 1-09.4(1).
2. Changes in Taxes: The Owner will adjust payment to compensate for tax changes under the following conditions:
   a. The changes involve federal or state taxes on Materials used in or consumed for the Work.
   b. The changes increase Contractor paid taxes by more than $500.
   c. For items in the original Contract, the tax change must occur after the Bid Opening Date.
   d. For negotiated Contracts, the tax change must take place after the Execution Date of the Contract.
   e. The Contractor if requested by the Engineer certifies in writing that the awarded Contract Price does not include an extra amount to cover a possible change in taxes.
   f. The Contractor permits the Owner to audit the Contractor's records to the extent necessary to substantiate any claim for payment under this Section.

Within the above conditions the Owner will adjust payment by the actual dollar amounts of increase or decrease caused by the tax changes.

1-09.5 DELETED OR TERMINATED WORK

The Engineer may delete work by Change Order as specified in Section 1-04.3. The Owner may terminate the Contract in whole or part as specified in Section 1-08.10. When the Contract is terminated in part, the partial termination will be treated as a deletion Change Order for payment purposes under this Section.

Payment for completed items will be at Bid Item prices.

When any item is deleted in whole or in part by Change Order or when the Contract is terminated in whole or in part, payment for deleted or terminated work will be made as follows:

1. Payment will be made for the actual number of units of work completed at the Bid Item unit prices unless the Engineer determines the Bid Item unit prices are inappropriate for the work actually performed. When that determination is made by the Engineer, payment for work performed will be as mutually agreed. If the parties cannot agree the Engineer will determine the amount of the equitable adjustment as specified in Section 1-09.4.
2. Payment for partially completed lump sum Bid Items will be as mutually agreed. If the parties cannot agree, the Engineer will determine the amount of the equitable adjustment as specified in Section 1-09.4.
3. To the extent not paid for by the Bid Item prices for the completed units of work, the Owner will pay as part of the equitable adjustment those direct costs necessarily and actually incurred by the Contractor in anticipation of performing the Work that has been deleted or terminated.
4. The total payment for any 1 Bid Item in the case of a deletion or partial termination cannot exceed the Bid Item price as modified by approved Change Orders less the estimated cost (including overhead and profit) to complete the Bid Item of work and less any amount paid to the Contractor for the Bid Item.
5. The total payment where the Contract is terminated in its entirety cannot exceed the revised Contract Price less those amounts paid to the Contractor before the effective date of the termination.
6. No claim for damages of any kind or for loss of anticipated profits on deleted or terminated work will be allowed because of the termination or Change Order.

Contract Time will be adjusted as the parties agree. If the parties cannot agree, the Engineer will determine the equitable adjustment for Contract Time.

Acceptable Materials ordered by the Contractor before the date the Work was terminated as specified in Section 1-08.10(2) by the Owner or deleted as specified in Section 1-04.3 by the Engineer, will either be purchased from the Contractor by the Owner at the actual cost and become the property of the Owner, or the Owner will reimburse the Contractor for the actual costs connected with returning these Materials.

1-09.6 FORCE ACCOUNT

1-09.6(1) GENERAL

The terms of the Contract or of a Change Order may call for Work or Material to be paid for by force account. The Owner will reimburse the Contractor for all costs associated with the force account Work, including costs of labor, small tools, Supplies, equipment, specialized services, direct material costs, disposal costs, and applicable taxes, The mark-up values provided in this Section are intended to compensate for all applicable overhead, and profit. The amount to be paid is determined as specified in this Section.

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Nothing in this provision precludes the Contractor from seeking an extension of time or time-related adjustments to unchanged Work arising as a result of the force account Work. The amount and costs of any Work to be paid by force account will be computed by the Engineer, and the result is final as specified in Section 1-05.1.

The parties may agree at any time to convert items included in the Bid as force account or added by Change Order as force account into agreed on unit prices or lump sums applicable to the remaining Work.

Mark-up in Sections 1-09.6(2) to 1-09.6(5) will only be applied once, regardless of whether such items are provided by the Contractor or by any tier of Subcontractor. However, the mark-up in Sections 1-09.6(2) to 1-09.6(5) will not be applied for services acting in the manner of a Subcontractor. Services acting in the manner of a Subcontractor as specified in Section 1-09.6(7) are considered a Subcontractor. Mark-up on work performed by a Subcontractor specified in Section 1-09.6(7) will only be applied once, regardless of tier of Subcontractor, and not at all for work performed by the prime Contractor.

1-09.6(2) LABOR

Labor reimbursement calculations are based on a Contractor's Project Labor List (Labor List) prepared and submitted to the Engineer by the Contractor for the Contractor and for any Subcontractor before that firm commences force account Work. All Labor List submittals must be made as specified in Section 1-05.3. The Engineer will have 10 Working Days to review and either approve or reject a Labor List. If a Labor List is rejected, the Engineer will identify the reasons for rejection and the Contractor or Subcontractor will have 2 Working Days to submit a new Labor List for review and approval. Once a Labor List is approved by the Engineer, it will be used to calculate force account labor payment until a new Labor List is submitted and approved. The Engineer may compare the Labor List to payrolls and other documents and may, at any time, request the Contractor to submit a new Labor List. The Contractor may also submit a new Labor List at any time subject to the same procedure for review and approval as the initial Labor List. Prior payments will not be adjusted as a result of a new Labor List.

To be approved, the Labor List must be accurate and comply with the requirements of this Section. The Labor List must include regular time rates and overtime rates for all employees and work classifications expected to participate in force account Work. These rates must meet or exceed the basic prevailing wage and fringe benefits, the current rates for Federal Insurance Compensation Act (FICA), Federal Unemployment Tax Act (FUTA) and State Unemployment Tax Act (SUTA), the firm's present rates for medical insurance and Industrial Insurance premiums, and the planned payments for travel and per diem payment. The rates cannot include any type of overhead cost or profit.

If there is no approved Labor List at the time for Work or Material to be paid for by force account the Engineer may elect to unilaterally develop a Labor List, using data that the Engineer determines to be the best available. Prior calculations prepared using the Engineer's Labor List will not be changed as a result of differences with the Contractor's Labor List.

In addition to payment for direct labor costs defined above, the Owner will pay the Contractor 27 percent of the sum of the costs calculated for labor reimbursement to cover project overhead, general company overhead, profit, bonding, insurance specified in Section 1-07.18, Business & Occupation tax, and any other costs incurred. This overhead amount will include any costs of standard safety training and health tests.

1-09.6(3) MATERIALS

The Owner will reimburse invoice cost for Contractor-supplied Materials. For the purpose of the provision, direct material costs include those items incorporated into the Work, Supplies used during the Work and items consumed as part of the Work. This cost includes freight and handling charges and applicable taxes. Before Work is started, the Engineer may require the Contractor to obtain multiple quotations for the Materials to be used and the Engineer may select the vendor with prices and terms most advantageous to the Owner.

The Owner may provide Materials. In this case, the Contractor will not receive payment for any costs, overhead, or profit arising from the value of the Materials themselves. Additional costs to handle and place the Owner (or Agency) furnished Material will be compensated as specified in Section 1-09.6.

Tipping fees, material disposal services, and other material disposal costs are not considered Materials, and are considered subcontracted services as specified in Section 1-09.6(5).

The Contractor will provide a list of the types and quantities of Contractor-supplied Materials, subject to verification by the Engineer. This list will be furnished promptly after the Material is incorporated, on a daily basis unless agreed otherwise. The Contractor must attach valid copies of vendor invoices to the list. Tickets of lading must be submitted to the Engineer the Day Materials are received.

The Engineer will have 10 Working Days to review the prices and quantities on the Contractor- supplied Materials list. If the Engineer agrees to the proposed prices, the Engineer will approve the completed list. If the Engineer does not agree, the list will be returned to the Contractor for revision. The Contractor must submit the revised list to the Engineer within 3 Working Days. If the Engineer does not agree with revised prices or if the list has not been received by the Engineer within 3 Working Days after the list has been returned to the Contractor for revision, the Engineer will determine the cost for all or part of those Materials, using the best data available.

If invoices are not available for Materials from the Contractor's stocks, the Contractor must certify actual costs at a reasonable level by Affidavit including an explanation of how the actual costs certified were determined and supported by any relevant information supporting the certification. The Engineer will have 5 Working Days to review. If the Engineer agrees to the certified prices, the Engineer will approve the completed list. If the Engineer does not agree, the list will be returned to the Contractor for re-certification. If the Engineer does not agree with revised prices or if the list has not been received by the

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Engineer within 3 Working Days after the list has been returned to the Contractor for re-certification, the Engineer will determine the cost for all or part of those Materials, using the best data available.

Once the list is approved, the prices will be used in the calculation of force account reimbursement for Materials.

In addition to payment for direct Materials cost, the Owner will pay the Contractor 17 percent of the sum of direct Material costs to cover project overhead, general company overhead, profit, bonding, insurance specified in Section 1-07.18, Business & Occupation tax, and any other costs incurred.

1-09.6(4) EQUIPMENT

The Owner will reimburse the Contractor for the cost of equipment used in the force account Work. The equipment provided by the Contractor must be of modern design and in good working condition. For the purpose of this provision, provided means that the equipment is owned (either through outright ownership or through a long-term lease) and operated by the Contractor or Subcontractor, or that the equipment is rented and operated by the Contractor or Subcontractor.

Equipment that is not being directly used for the force account work will not be compensated on a stand-by or any other basis. Equipment that is being used on-site for Contract work and for force account Work will only be compensated under force account for the actual operational use, not on a stand by basis. Equipment required by the Engineer to be on-site for force account Work and no other Contract Work will be compensated either for actual operational use or on a stand by basis. Equipment that is rented with operator cannot be included here, but is considered a service or service acting as a Subcontractor and addressed according to Section 1-09.6(5) Services.

The amount of payment for any Contractor-owned equipment that is used is determined according to the version of the AGC/WSDOT Equipment Rental Agreement in effect at the time the force account Work is authorized. The rates listed in the Rental Rate Blue Book (as modified by the current AGC/WSDOT Equipment Rental Agreement) will be full payment for all fuel, oil, lubrication, ordinary repairs, maintenance, and all other costs incidental to furnishing and operating the equipment except labor for operation.

Contractor-owned equipment reimbursement calculations are based on a Contractor-owned equipment list (equipment list) prepared and submitted by the Contractor and by any Subcontractor before that firm commences force account Work. All equipment list submittals must be made as specified in Section 1-05.3. Once an equipment list is approved by the Engineer, it will be used to calculate force account Contractor-owned equipment payment until a new equipment list is submitted and approved. The equipment list must contain only equipment expected to be used in force account Work. The Engineer will compare the equipment list to the Rental Rate Blue Book, at any time, and may require the Contractor to submit a new equipment list. The Contractor may submit a new equipment list at any time. Prior payment will not be adjusted as a result of a new equipment list.

To be approved, the equipment list must be accurate and comply with the requirements of this Section. The equipment list must be supplemented with a rental equipment list showing daily, weekly, and monthly rental rates as applicable. Rental agreements must be attached for all equipment that may be used on force account.

In the event that an acceptable initial equipment list or a revised equipment list is not received within 3 Working Days of a request by the Engineer, the Engineer will unilaterally develop an equipment list, using the best data available. The Engineer's equipment list will be used until a Contractor's equipment list is received and approved. Prior payments, prepared using the Engineer's equipment list, will not be changed as a result of differences with the Contractor's equipment list.

Payment for rented equipment will be made on the basis of a valid invoice, covering the time period of the Work. Before this Work is started, the Engineer may require the Contractor to obtain multiple quotations for the rental of equipment to be used and select the vendor with prices and terms most advantageous to the Owner. In the event that prior quotations are not obtained and the vendor is not a firm independent from the Contractor or Subcontractor, then after-the-fact quotations may be obtained by the Engineer from the open market in the vicinity and the lowest such quotation may be used in place of submitted invoice.

In addition to the payments for Contractor-owned and rented equipment, 1 or more lump sum payments may be made for small tools. The amount to be paid is determined as outlined in the AGC/WSDOT Equipment Rental Agreement.

The Owner will add 17 percent to equipment costs to cover project overhead, general company overhead, profit, bonding, insurance as required by Section 1-07.18, Business & Occupation tax, and any other costs incurred. This markup will be over and above those equipment costs and will not be adjusted for any equipment overhead amounts included in the Blue Book rates.

Copies of the AGC/WSDOT Equipment Rental Agreement are maintained on the WSDOT's website: http://www.wsdot.wa.gov/.

1-09.6(5) SERVICES

A service is one that is typically billed through invoice in standard industry practice and consists of work that is being directly supervised or overseen by the Contractor. Tipping fees, material disposal services, and other material disposal costs incurred as a result of a force account item are considered subcontracted services. Payment under force account for services will be made on the basis of an invoice from the service provider unless otherwise directed as provided for within this Section.

Before force account Work is started, the Engineer may require the Contractor to obtain multiple quotations for the service to be used and select the provider with prices and terms most advantageous to the Owner. A service will be approved by the Engineer before the start of the service provider's work. If services are not preapproved, or in the event that prior

quotations are not obtained and the service invoice is submitted, then after-the-fact quotations may be obtained by the Engineer from the open market in the vicinity and the lowest such quotation may be used in place of the submitted invoice, or the Engineer may require the services to itemize labor, equipment, and Materials and be paid based on these itemized rates, whichever results in the lower cost to the Owner.

Except as noted below and up to and including $10,000 of invoiced cost, the Owner will pay the Contractor an additional 17 percent of the sum of the costs included on invoices for services to cover initial and ongoing project overhead, general company overhead, profit, bonding, insurance required by Section 1-07.18, Business & Occupation tax, and any other costs incurred.

Mark ups for services which are acting in the manner of a Subcontractor are specified in Section 1-09.6(7). When a Supplier of services is compensated through invoice cost over $10,000, the firm is acting in the manner of a Subcontractor as specified in Section 1-09.6(7), and the markup for the invoiced costs over $10,000 must be as specified in Section 1-09.6(7).

1-09.6(6) FORCE ACCOUNT MOBILIZATION

Force account mobilization is defined as the preparatory Work performed by the Contractor including procurement, loading and transportation of tools and equipment, and personal travel time (when such travel time is a contractual obligation of the Contractor or a customary payment for the Contractor to all employees). Mobilization also includes the costs incurred during demobilization. Pro-rata adjustments may be made when the mobilization applies to both force account and other Contract Work. The Owner will pay for mobilization for off-site preparatory Work for force account items provided that notice has been provided sufficiently in advance, as determined by the Engineer, to allow the Engineer to witness the off-site preparatory Work, if desired.

Any costs experienced during mobilization activities for labor, equipment, Materials, Supplies, or services will be listed in those Sections of the force account summary and paid accordingly.

1-09.6(7) CONTRACTOR MARKUP ON SUBCONTRACTORS AND SERVICES ACTING IN THE MANNER OF A SUBCONTRACTOR

When Work is performed on a force account basis by one or more approved Subcontractors (including lower-tier Subcontractors or Suppliers), or through invoice by service firm acting in the manner of a Subcontractor, the Contractor will be allowed a markup, from 1 of the tables below.

The markup in this Section will only be applied once, regardless of tier level of Subcontractor.

The markup rates for the Contractor are calculated based on the accumulative cost, as specified in Sections 1-09.6(2) to 1-09.6(4), and Section 1-09.6(5) if applicable, for the Work done by each Service or each Subcontractor on each force account item established.

The Engineer may request detailed breakdown of invoices as needed to verify costs and markups have been applied as specified in the Contract.

A service provider or any other firm may be considered to be acting as a Subcontractor when the Engineer observes one or more of the following characteristics:

1. The person in charge of the firm's activities takes an active role in managing the overall project, including extensive coordination, interpretation of Drawings, interaction with the Owner or Engineer, or management of a complex and inter-related operation.
2. Rented equipment is provided, fueled, operated, and maintained by the firm. Operators of rented equipment are supervised directly by the firm's representative. There is little interaction between the Contractor and the employees of the firm.
3. The firm appears to be holding the risk of performance and quality of the work.
4. The firm appears to be responsible for liability arising from the work.
5. The firm is performing a significant amount of work for the project, or force account item if applicable; the firm has performed over $10,000 of invoiced work on the project, or force account item.

Markups on Work Performed by Subcontractors

Accumulative Costs	Applicable Mark-up
On amounts of $25,000 or less	12 percent
On amounts greater than $25,000 up to $100,000	10 percent
On amounts greater than $100,000	7 percent

Markups on Work Performed by Services Acting in the Manner of a Subcontractor

Accumulative Costs	Applicable Mark-up
Up to $10,000	No additional mark up if a mark-up was provided on the first $10,000 of invoices under Section 1-09.6(5)

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Accumulative Costs	Applicable Mark-up
	or If no mark-up was provided under 1-09.6(5), then 12 percent
On amounts greater than $10,000 up to $25,000	12 percent
On amounts greater than $25,000 up to $100,000	10 percent
On amounts greater than $100,000	7 percent

1-09.7 PAYMENT FOR MOBILIZATION

Mobilization consists of preconstruction expenses and the costs of preparatory Work and operations performed by the Contractor that occur at the start of a project.

For the basis of calculating and paying mobilization as defined in this Section, the Contract Price excludes the mobilization Bid Item, the price of Change Orders, and payments made for Materials on hand. If applicable, taxes will be included in all calculations for mobilization payment.

Based on the Bid Item lump sum price for "Mobilization," progress estimates will be made as follows:

1. When 5 percent of the Contract Price (with exclusions applied) is earned from the original Contract Bid Items, the lower of either 50 percent of the amount Bid for mobilization or 5 percent of the Contract Price (with exclusions applied) will be paid.
2. When 10 percent of the Contract Price (with exclusions applied) is earned from the original Contract Bid Items, the lower of either 100 percent of the amount Bid for mobilization or 10 percent of the Contract Price (with exclusions applied) will be paid.
3. Any remaining costs for the mobilization Bid Item will be paid following the project's Physical Completion Date.

1-09.8 PAYMENT FOR MATERIAL ON HAND

Progress estimates, to a maximum of 90 percent of the invoiced cost of Materials excluding taxes, or the Bid Item price, whichever is less, may be made for Materials not yet incorporated into the Work if the Materials:

1. Meet the requirements of the Contract based on inspections or testing by the Engineer;
2. Are delivered to Project Site or are stockpiled at a storage facility not on the Project Site;
3. Are properly stored and protected; and
4. Are insured against loss or damage.

In addition to the requirements above, Material delivered to the Project Site or to a storage facility not on the Project Site as permitted in item 2 above, will be considered for progress estimate only if the following additional conditions are met:

a. The storage of Materials is required for more than 30 Days;
b. The Material is segregated from materials for any other project;
c. The Material is tagged, labeled, or otherwise identified as belonging to the project; and
d. All costs associated with transportation of Material to the Project Site or other provisions acceptable to the Engineer made with regard to eventual delivery to the Project Site, are at the sole expense of the Contractor and must be considered included in the Bid Item price.

The Materials on hand payment amount will be determined by quotes or invoices from suppliers that have sufficient detail to determine the actual cost. The Contractor must furnish the Engineer an invoice for the Material marked "paid" within 60 Days of the progress payment by the Owner for that Material on hand. If the paid invoice is not furnished within the prescribed time, and the Material has not been incorporated in the Work, a payment that has been made for that Material will be deducted from the next progress estimate and the Material is not eligible for future payment as Material on hand.

The Engineer will not consider requests for payment for individual items or group of items of Material on hand amounting to an invoice total of less than $2000. Payment for sales taxes due on the purchase of such Material or equipment will not be made unless said taxes were paid by the Contractor to the Materialperson or fabricator for transmittal to the State by the Materialperson or fabricator and such tax is included on the invoice issued by the Materialperson.

Payment for Materials will not constitute acceptance. Unacceptable Material will be rejected even though payment may have been made for such Material in a progress estimate.

Deductions at the same rates and equal in amount to the payment for Material on hand will be made to future progress estimates as Material is incorporated into the Work and paid at the Bid Item unit price, or for a Bid Item lump sum price, the progress estimates percentage of the Bid Item lump sum price. Deductions, at the same rates and equal in amount to the payment for Material on hand, will also be made for Material on hand which is rejected after a payment was made.

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1-09.9 PAYMENTS

1-09.9(1) PROGRESS ESTIMATES

Payments for completed Work and Material on hand will be based on progress estimates prepared by the Engineer and signed by the Contractor. A progress estimate cutoff date will be established at the preconstruction meeting.

Within 3 Days after the progress estimate cutoff date but not more often than once a month, the Contractor must submit an Application for Payment to the Engineer for review. The Application for Payment, filled out and signed by the Contractor, must cover the Work completed, accepted, and not in dispute for the payment period before the progress estimate cutoff date. Application for Payments that include force account Work must be accompanied by documentation supporting the claim for payment.

Payment requested for Materials and equipment on hand must be as specified in Section 1-09.8. The initial progress estimate will be made not later than 30 Days after the Contractor commences the Work, and successive progress estimates will be made every month thereafter until the Completion Date. Progress estimates made during progress of the Work are tentative, and made only for the purpose of determining progress payment. The progress estimates are subject to change at any time before the calculation of the final payment.

The value of the progress estimate will be the sum of the following:

1. Unit Price Bid Items in the Bid Form: The approximate quantity of Bid Item units of Work completed multiplied by the Bid Item unit price.
2. Lump Sum Bid Items in the Bid Form: The estimated percentage of each lump sum Bid Item completed multiplied by the Bid Item lump sum price.
3. Materials on Hand: To a maximum of 90 percent of invoiced cost of Material delivered to the Project Site or other storage area specified in Section 1-09.8.
4. Change Orders: Entitlement for approved extra cost or completed extra work as determined by the Engineer.

Progress payments will be made per the progress estimate less:

a. 5 percent per RCW 60.28.

b. The amount of progress payments previously made.

c. Funds withheld by the Owner for disbursement as specified in the Contract.

Progress payments for Work performed is not evidence of acceptable performance or an admission by the Engineer that any Work has been satisfactorily completed.

Payments will be made by warrants, issued by the Owner's fiscal officer, against the appropriate fund source for the project.

Payments received by the Contractor on account of Work performed by a Subcontractor are subject to RCW 39.04.250.

1-09.9(1)A FINAL PROGRESS PAYMENT

The Final Contract Price will be calculated based on a final progress estimate made by the Engineer. The final progress payment will not be paid until the Contractor has submitted on the Owner-provided form a complete list of all Subcontractors of all tiers and Suppliers who worked on the project and information including but not limited to Subcontractor name, UBI Number, Intent and Affidavit Numbers, and total amount paid.

Acceptance by the Contractor of the final payment is a release to the Owner from the Contractor:

1. Of all claims and all liabilities of the Owner, except claims in stated amounts which have been asserted under the Dispute and Claim Resolution process as specified in Section 1-04.4;
2. For all things done or furnished in connection with the Work;
3. For every act and neglect by the Owner; and
4. For all other claims and liability relating to or arising out of the Work.

A payment (monthly, final, retainage, or otherwise) does not:

a. Release the Contractor or the Contractor's Surety from any obligation required under the terms of the Contract or the Payment and Performance Bond; or

b. Preclude the Owner from recovering damages, setting penalties, or obtaining such other remedies as may be permitted by law.

1-09.9(2) RETAINAGE OPTIONS

Pursuant to Chapter 60.28 RCW there will be reserved and retained from monies earned by the Contractor on progress estimates during the progress of the Work, a sum equal to 5 percent of the monies earned by the Contractor. Such retainage will be used as a trust fund for the protection and payment of:

1. Claims by the State with respect to taxes imposed under Titles 50, 51, and 82 RCW that may be due from such Contractor;

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2. The claims of any person or persons, mechanic, Subcontractor or Materialperson who performs any labor under such Contract or the doing of said Work, and all persons who supplies such person or persons or Subcontractors with provisions or Supplies for carrying on such Work; and
3. After satisfaction of the foregoing claims, the Owner may withhold from the remaining retained amounts or bond for claims it may have against the Contractor and thereafter must pay or in the case of a bond, release, the balance, if any, to the Contractor under RCW 60.28.021.

At the option of the Contractor, monies reserved under provisions of Chapter 60.28 RCW will be:

a. Retained in a non-interest bearing fund by the Owner.
b. Deposited by the Owner in an interest bearing account in a bank, mutual savings bank, or savings and loan association. Interest on moneys reserved by the Owner under a public improvement Contract will be paid to the Contractor.
c. Placed in escrow with a bank or trust company by the Owner. When the monies reserved are to be placed in escrow the Owner will issue a check representing the sum of the monies reserved payable to the bank or trust company and the Contractor jointly. Such check must be converted into bonds and securities chosen by the Contractor and approved by the Owner and the bonds and securities held in escrow. Interest on the bonds and securities may be paid to the Contractor as the interest accrues.
d. Provided for by the Contractor's submission of a retainage bond (bond instead of retained funds). The Owner may accept the retainage bond if it is complete, on a form provided by the Owner, provided by a Surety meeting the requirements of Section 1-03.3(2), for the amount equal to 5 percent of the Contract Price, less Washington State sales tax, and meets the provisions of RCW 60.28.

The Contractor must select the option desired on the Agreement Form at the time the Contractor executes the Contract with the Owner. If the Contractor chooses option 2) or 3) on the Agreement Form, the Contractor assumes full responsibility to pay all costs that may accrue from escrow services, brokerage charges or both, and further assumes all risks in connection with the investment of the retained percentages in securities.

Retainage will not be reduced for any reason below the minimum limit provided by law.

1-09.9(3) OWNER'S RIGHT TO WITHHOLD AND DISBURSE CERTAIN AMOUNTS

The Contractor agrees that in addition to moneys retained per RCW Ch. 60.28, RCW 39.04.250, RCW Ch. 39.12, and RCW Ch. 39.76, the Owner may withhold progress payments to cover the costs to remedy the following situations:

1. Damage to another contractor when there is evidence thereof and a claim has been filed.
2. Where the Contractor has not paid fees or charges to public authorities or municipalities that the Contractor is obligated to pay.
3. Using Material, tested and inspected by the Engineer, for purposes not connected with the Work, see Section 1-05.6.
4. Landscape damage assessments as specified in Section 1-07.16.
5. For overtime work performed by City personnel as specified in Section 1-08.1(5).
6. Anticipated or actual failure of the Contractor to complete the Work on time:
    a. As specified in Section 1-08.8; or
    b. Lack of construction progress based on the Engineer's review of the Contractor's approved progress schedule that indicates the Work will not be completed within the Contract Time. When calculating an anticipated time overrun, the Engineer will make allowances for weather delays, approved unavoidable delays, and suspensions of the Work. The amount withheld under this subparagraph will be based on the Liquidated Damages amount per Day set forth in Contract multiplied by the number of Days the Contractor's approved progress schedule, in the opinion of the Engineer, indicates the Contract may exceed the Contract Time.
7. Failure of the Contractor to perform any of the Contractor's other obligations under the Contract, including but not limited to:
    a. Failure of the Contractor to promptly pay as specified in Section 1-09.11.
    b. Failure of the Contractor to provide the Engineer with a field office when specified in the Contract.
    c. Failure of the Contractor to protect items such as survey stakes or markers, or to provide adequate survey work as specified in Section 1-05.5.
    d. Failure of the Contractor to submit approved Washington State Department of Natural Resources permits prior to the destroying or removing of survey monuments, or failure to submit completion reports after destroying or removing survey monuments as specified in Section 1-07.28, item 17.
    e. Failure of the Contractor to correct defective or unauthorized Work as specified in Section 1-05.8.
    f. Failure of the Contractor to furnish a Manufacture's Certificate of Compliance instead of Material testing and inspection as specified in Section 1-06.3.
    g. Failure to submit weekly payrolls, Intent to Pay Prevailing Wage forms, or correct underpayment to employees of the Contractor or Subcontractor of any tier as specified in Section 1-07.9.
    h. Failure of the Contractor to pay worker's benefits (Title 50 and Title 51 RCW) as specified by Section 1-07.18(7).

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i. Failure of the Contractor to submit and obtain approval of, and revise as required, a progress schedule as specified in Section 1-08.3.

j. Failure to comply with non-discrimination requirements as specified in Section 1-07.11.

k. Failure of the Contractor to comply with the outcome of the resolution of payment disputes. In this instance, the withholding of funds will be consistent with the terms of the dispute resolution process, including any cost of the dispute resolution process as applicable, see Section 1-04.4.

l. Failure of the Contractor to timely comply with submittal requirements, including providing the Engineer with updates to the submittal control document, see Section 1-05.3.

m. Failure of the Contractor to comply with requirements of the social equity provisions, including but not limited to WMBE Inclusion, Priority Hire, labor standards, or related submittals and deliverables.

The Contractor authorizes the Owner to act as agent for the Contractor in disbursing such funds as have been withheld under this Section to a party or parties who are entitled to payment. Disbursement of such funds, if the Owner elects to do so, will be made only after giving the Contractor 15 Calendar Days prior written notice of the Owner's intent to do so, the reason the funds are being withheld or deducted, and stating what action, if any, the Contractor must take to remedy the situation or resolve the dispute. The Owner will withhold or disburse the funds after the expiration of the 15 Calendar Day period so long as:

1) No legal action has commenced to resolve the validity of the claims; and

2) The Contractor has not disputed such disbursement as specified in Section 1-04.4.

A proper accounting of all funds disbursed on behalf of the Contractor as specified in this Section will be made. A payment made under this Section is considered as payment made under the terms and conditions of the Contract. The Owner is not liable to the Contractor for such payment made in good faith.

If legal action is instituted to determine the validity of the claims before expiration of the 15 Day period mentioned above, the Owner will hold the funds until determination of the action or written settlement agreement of the parties.

1-09.9(4) CONTRACT COMPLETION AND RETAINAGE RELEASE

1-09.9(4)A REQUEST FOR CONTRACT COMPLETION DATE

The Engineer will submit an acceptance package with supporting documents to PC after the Physical Completion Date and after all obligations, including disputes and settlements, of the Contract except retainage release have been completed. In order for PC to declare the project complete, PC requires the following:

1. Documents that all Work is completed:
   a. The State Notice of Completion (NOC) of Public Works Contract form (LNI form F215-038-000) filled out electronically by the administering department with as much information as possible (PC will submit the form);
   b. NTP, Substantial, and Physical Completion Notices with Dates;
   c. All Change Orders;
   d. All calculations of Liquidated Damages;
   e. All claims under Section 1-04.4 resolved and the Final Contract Price set;
   f. All permit conditions completed;
   g. The Contractor Performance Evaluation is completed for all applicable projects; and
   h. Evidence that all other requirements of the Work are met.
2. The Contractor must furnish all documentation and reports electronically online, or via paper where allowed, as required by the Contract and required by law, necessary to allow the Owner to certify the Contract as complete. These include but are not limited to:
   a. List from the Contractor on the Owner-provided form of all Subcontractors of all tiers and Suppliers who worked on the project and information including but not limited to Subcontractor name, UBI Number, Intent and Affidavit Numbers, and total amount paid;
   b. The Contractor's approved Affidavit of Wages Paid on file with L&I;
   c. Final Subcontractor Payment Report submitted online as specified in Section 1-07.11(3)A;
   d. Audits as specified in Section 1-04.4(6);
   e. Material certifications as specified in Section 1-06.3 if not provided by Physical Completion;
   f. Certified payrolls and prevailing wage statements as specified in Section 1-07.9;
   g. All Apprenticeship Utilization Reports as specified in Section 1-07.11(6), if applicable;
   h. If it is a federally-funded Contract, all federal final approvals have been received, and all final federal reports including training, EEO, and prevailing wage certified payrolls have been submitted; and any other federally-required reports; and
   i. Any other reports or documentation required.

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1-09.9(4)B COMPLETION DATE

PC will review the acceptance package and supporting documents to ensure all obligations of the Contract are complete except release of retainage.

PC will then:

1. Set the Completion Date and issue the Certificate of Completion.
2. Send the Notice of Completion of Public Work Contract to the state agencies as required by RCW 60.28.051.
3. Publish a Notice of the Completion and the deadline for filing liens and claims in the City's Official Publication.
4. Notify the Surety and the Contractor.

The Contractor agrees that establishment of the Completion Date does not relieve the Contractor of the responsibility to indemnify, defend, and protect the Owner against any claim of loss resulting from the failure of the Contractor, a Subcontractor of any tier, or any other person who provides labor, Supplies, or provisions for carrying out the Work or for any payments required for unemployment payment under Title 50 RCW or for Industrial Insurance and medical insurance required under Title 51 RCW. The establishment of the Completion Date will not constitute acceptance of unauthorized Work or defective Work or Material.

Failure of the Contractor to perform any or all Contractor's obligations under the Contract does not bar the Owner from unilaterally certifying the Contract as complete.

1-09.9(4)C RELEASE OF RETAINAGE

Release of the retainage or retainage bond will be made following the Completion Date under Chapters 39.12 RCW, 39.76 RCW, and 60.28 RCW provided all following conditions are met:

1. On Contracts totaling more than $35,000.00 (excluding tax), a release has been obtained from the Washington State Department of Revenue, the Employment Security Department, and the Department of Labor and Industries (RCW 60.28.051).
2. No claims, as provided by law, have been filed against the retainage (RCW 60.28.021).
3. The Owner has no claim against the Contractor for unpaid fees, taxes, or other amounts.

For retainage bonds, notification will be provided to the Surety and Contractor of the release of the retainage bond.

Retainage will be released no later than 10 Working Days after all legal requirements have been met and retainage has been approved for release.

1-09.10 AUDITS

1-09.10(1) GENERAL

The Contractor's wage, payroll, and cost records on this Contract must be open to inspection or audit by representatives of the Owner during the life of the Contract and for a period of not less than 3 years after the Completion Date. The Contractor must retain these records for that period. If requested, the Contractor must promptly furnish copies of these records to the Owner. The Contractor must also guarantee that the wage, payroll, and cost records of all Subcontractors, regardless of tier, be retained and open to similar inspection or audit for the same period of time.

The audit may be performed by employees of the Owner or by an auditor under Contract with the Owner. The Contractor and Subcontractors of any tier must provide adequate facilities, acceptable to the Owner, for the audit during normal business hours and must make a good faith effort to cooperate with the auditors.

If an audit is to be commenced more than 60 Calendar Days after the Completion Date, the Contractor will be provided 20 Calendar Days Written Notice of the time when the audit is to start. If any litigation, claim, or audit arising out of, in connection with, or related to this Contract is initiated, the wage, payroll, and cost records will be retained until such litigation, claim, or audit involving the records is completed.

1-09.10(2) CLAIMS

All claims, and documentation for mediation, filed against the Owner are subject to audit at any time following the filing of the claim or request for mediation as applicable. Failure of the Contractor or a Subcontractor of any tier or their agents, if applicable, to maintain and retain sufficient records to allow the auditors to verify all or a portion of the claim and documentation for mediation when applicable, or to allow the auditor access to books and records, constitutes a waiver of a claim and will bar any recovery thereunder.

1-09.10(3) REQUIRED DOCUMENTS FOR AUDITS

The Contractor must make available all documents requested by the auditors including, but not limited to, the following documents:

1. Daily time sheets and supervisor's daily reports.
2. Union agreements.
3. Insurance, welfare, and benefits record.
4. Payroll registers.

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5. Earnings records.
6. Payroll tax forms.
7. Material invoices and requisitions.
8. Material cost distribution worksheet.
9. Equipment records (e.g. list of company equipment and rates).
10. Vendors, rental agencies, Subcontractors, and agents invoices.
11. Subcontractor agreements and, as specified in Section 1-08.1(3), payment certifications including those of second and lower tier Subcontractors when applicable.
12. Cancelled checks (payroll and Vendors).
13. Job cost report.
14. Job payroll ledger.
15. General ledger.
16. Cash disbursements journal.
17. Financial statements for all years that reflect the operations on this Contract. In addition, City auditors may require additional financial statements for 3 years preceding the Execution Date of the Contract, and for 3 years following the Completion Date.
18. Depreciation records on all company equipment whether these records are maintained by the company involved, its accountant, or others.
19. If a source other than depreciation records is used to develop costs for the Contractor's internal purposes in establishing the actual cost of owning and operating equipment, all such other source documents.
20. All documents that relate to each and every claim together with all documents that support the amount of damages as to each claim.
21. Worksheets or software used to prepare the claim establishing the cost components for items of the claim including but not limited to labor, benefits and insurance; materials, equipment, Subcontractors; all documents which establish the time periods, individuals involved, the hours for the individuals, and the rates for the individuals; and home office overhead.
22. Worksheets, software, and all other documents used by the Contractor to prepare its Bid.

1-09.11 PROMPT PAYMENT TO SUBCONTRACTORS AND PERSONS SUPPLYING LABOR, MATERIALS AND SUPPLIES

1-09.11(1) GENERAL

This Section requires every Contractor of any tier to pay every Subcontractor who is also a small business, within 30 Calendar Days of satisfactorily completed Work and delivered Materials. A Subcontractor who is also a small business is defined as those the Contractor has engaged by agreement to provide labor or Materials for the project, including a person or persons, mechanic, Subcontractor, Supplier or Materialperson, when the Subcontractor is registered as a WMBE firm with the City of Seattle, is a business certified by the King County Small Business Concerns Program, or is certified by the State of Washington as a DBE or by the State of Washington as a WMBE firm.

Payment is considered made when mailed or personally delivered to the Contractor; an invoice is considered received when date-stamped or marked as delivered. If not date-stamped or marked as delivered, the invoice date is the date recorded by the Contractor.

Nothing in this Section negates the right or importance of Subcontractors filing a claim against the bond or retainage and otherwise protecting their legal rights.

1-09.11(2) PROGRESS PAYMENTS AND PROMPT PAYMENT TO SUBCONTRACTORS

The Contractor must promptly pay, within 30 Calendar Days, for invoiced Work satisfactorily completed or Materials delivered by a certified small business Subcontractor (defined as above as a Subcontractor who is a WMBE firm who is registered with the City of Seattle, a certified Small Business Concern by King County, or a DBE or a WMBE firm certified by the State of Washington) and no later than 10 Working Days of receipt of a progress payment from the Owner for all other work by Subcontractors which are not certified small businesses.

The Contractor of any tier must pay such Subcontractor, less applicable retainage, for all work that the Contractor has found to comply with the quality and performance agreed on with the Subcontractor. This includes payment for actual mobilization costs incurred. This also includes work that has been directed to the Subcontractor when the price has been agreed to by the Owner, Contractor, and Subcontractor, whether the Owner has provided payment or executed a Change Order to the Contractor. Amounts withheld are limited to the value of the portion of work that has not been satisfactorily completed, with a documented dispute as specified in 1-09.11(3). Such withheld amount cannot exceed 150 percent of the disputed amount.

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1-09.11(3) UNSATISFACTORY PERFORMANCE BY SUBCONTRACTOR

If any work or product is unsatisfactory and subject to withholding of payment, the Contractor must provide written notification to the Subcontractor and Owner of corrective actions required by the Subcontractor including a date to be completed. Such written notice must be provided as soon as practicable after work has been performed.

After the Subcontractor satisfactorily completes the corrections, the Contractor must pay the Subcontractor within 8 Working Days the remaining amounts withheld, less retainage. Should a Contractor find work unsatisfactory without reasonable cause, fail to provide written notification within a reasonable time, or otherwise fail to comply with the scheduled Days herein, the Contractor may be found to be in breach of the Contract by the Owner, subject to all remedies.

1-09.11(4) PAYMENT OF RETAINAGE TO SUBCONTRACTORS

The following procedure applies to all subcontracts entered into as a part of this Contract.

1-09.11(4)A REQUIREMENTS

The Subcontractor must make a written request to the Contractor for the release of the Subcontractor's retainage or retainage bond.

Within 10 Working Days of the request, the Contractor must determine if the subcontract has been satisfactorily completed and must notify the Subcontractor, in writing, of the Contractor's determination.

If the Contractor determines that the subcontract has been satisfactorily completed, the Subcontractor's retainage or retainage bond must be released by the Contractor within 10 Working Days from the date of the written notice.

If the Contractor determines that the Subcontractor has not achieved satisfactory completion of the subcontract, the Contractor must provide the Subcontractor with written notice, stating specifically why the subcontract work is not satisfactorily completed and what has to be done to achieve completion. The Contractor must release the Subcontractor's retainage or retainage bond within 10 Working Days after the Subcontractor has satisfactorily completed the work identified in the notice.

In determining whether satisfactory completion has been achieved, the Contractor may require the Subcontractor to provide documentation such as certifications and releases, showing that all laborers, lower-tiered Subcontractors, Suppliers of material and equipment, and others involved in the Subcontractor's work have been paid in full. The Contractor may also require any documentation from the Subcontractor that is required by the subcontract or by the Contract between the Contractor and Owner or by law such as Affidavits of wages paid, material acceptance certifications and releases from applicable governmental agencies to the extent that they relate to the Subcontractor's work.

If the Contractor fails to comply with the requirements of the Specification and the Subcontractor's retainage or retainage bond is wrongfully withheld, the Subcontractor may seek recovery against the Contractor under applicable prompt pay statutes in addition to any other remedies provided for by the subcontract or by law.

1-09.11(4)B CONDITIONS

This clause does not create a contractual relationship between the Owner and any Subcontractor as stated in Section 1-08.1(3). Also, it is not intended to bestow upon any Subcontractor, the status of a third-party beneficiary to the Contract between the Owner and the Contractor.

This Section of the Contract does not apply to retainage withheld by the Owner from monies earned by the Contractor. The Owner will continue to process the release of that retainage based on the Completion Date of the project as defined in Section 1-08.5 Time for Completion and per the requirements and procedures set forth in RCW Chapter 60.28.

1-09.11(5) INCORPORATION OF PROVISIONS

The Contractor must include either specifically in each of its subcontracts a provision setting forth the payment and interest penalty clause of this Section 1-09.11, or in each of its subcontracts a provision incorporating by reference all terms of its Contract with the Owner. In addition, the Contractor must require its Subcontractors to include such a payment and interest penalty clause in each of their subcontracts and to require each of their Subcontractors to include such clauses in their subcontracts with each lower tier Subcontractor, either specifically or by reference.

1-09.11(6) OTHER SUBCONTRACT PAYMENT PROVISIONS

Any subcontract agreement, at any tier, with provisions for Subcontractor payment sooner than those specified in this Section, or interest payments greater than those specified in this Section, takes precedence over the Specifications of this Section.

1-09.11(7) SUBCONTRACTOR CLAIMS AGAINST BONDS

Notification of the Owner is only part of the lien and claim process; All Subcontractors and Suppliers are responsible to take all actions required under law to perfect their claims and liens including taking additional legal steps beyond notification of the Owner.

To obtain a copy of a bond or notify the Owner of a lien or claim against the Contractor's Payment and Performance Bond or the Retainage Bond, send the request or notification to the PC Director at the PC mailing address, see Section 1-02.9(1).

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SECTION 1-10 TEMPORARY TRAFFIC CONTROL

1-10.1 GENERAL

The Contractor must plan, manage, supervise, and perform all temporary traffic control activities needed to support the Work of the Contract.

Installation and maintenance of temporary traffic control for pedestrian and vehicular traffic within the street Right of Way must be performed as specified in Section 1-10.2(5)B.

The Contractor must:

1. Provide flaggers, signs, and other traffic control devices not otherwise specified as being furnished by the Owner.
2. Not work on or adjacent to any traveled way until all necessary signs and traffic control devices are in place.
3. Unless the section of street is to be completely closed to vehicular traffic, schedule and plan the Work to:
    a. Meet any lane closure restrictions that are specified in Section 1-10.2(5)D, and current approved traffic control plan for the Work being performed.
    b. Permit the maximum number of normally available traffic lanes to be opened in the direction of the heaviest flow of traffic during the peak hours.
    c. Maintain 2-way traffic at all times except on one-way streets. Additional width for facilitating traffic flow may be obtained by requesting on-street parking be prohibited adjacent to the Work area.
    d. Maintain traffic on a paved surface whenever possible. In the event that a graveled or dirt surface must be used as a detour, maintain a smooth surface and control dust. Deviations from a paved surface require specific approval from the Engineer.
    e. Maintain safe conditions adjacent to the Job Site:
        1) Clean up spillage from trucks and debris on the pedestrian or driving surface as specified in Sections 1-07.5 and 1-07.23.
        2) Provide safe and protected pedestrian ways as specified in Section 1-07.23.
        3) Not park or place construction equipment in a manner that creates unnecessary sight distance obstructions or other safety issues for vehicular or pedestrian traffic.
        4) Maintain, in proper condition, Job Site traffic control devices on an around the clock basis whether or not work is actively being pursued. In addition, the Contractor must assure that tools and equipment are properly stored and excavation bridging is secure and adequately covers excavation.
4. Erect and maintain all construction signs, warning signs, detour signs, and other traffic control devices necessary to warn and protect the public at all times from injury or damage resulting from the Contractor's operations.
5. Be liable for injuries and damages to persons and property suffered by reason of the Contractor's operations or any negligence in connection therewith.
6. Construct, maintain in a safe condition, keep open to traffic, and remove when no longer needed detours and temporary approaches that will accommodate traffic diverted from the roadway, walkway, or bridge during construction. The Contractor is responsible for all on-site or off-site detours required or necessitated by the Work, including side street crossings, temporary bridges, utilization of 1 or more lanes of the construction area for maintenance of through traffic, and related traffic control.
7. Comply with the requirements of the Street Use Permit as specified in Section 1-07.6.

1-10.1(1) DESCRIPTION

The Contractor must provide signs and other traffic control devices not otherwise specified as being furnished by the Owner. The Contractor must erect and maintain all construction signs, warning signs, detour signs, and other traffic control devices necessary to warn and protect the public at all times from injury or damage as a result of the Contractor's operations which may occur on highways, roads, streets, sidewalks, or paths. Do not start work on any traveled way until all necessary signs and traffic control devices are in place.

Upon failure of the Contractor to immediately provide flaggers; erect, maintain, and remove signs; or provide, erect, maintain, and remove other traffic control devices when ordered to do so by the Engineer, the Owner may, without further notice to the Contractor or the Surety, perform any of the above and deduct all costs from the Contractor's payments.

The Contractor must provide adequate labor, traffic control devices, and sufficient signs to perform traffic control procedures needed for the protection of the Work and the public at all times, regardless of whether or not the labor, devices, or procedures have been ordered by the Engineer, furnished by the Owner, or paid for by the Owner.

Wherever possible when performing Contract Work, the Contractor's equipment must comply with normal and legal traffic movements. The Contractor's ingress and egress of the Work area must be accomplished with as little disruption to traffic as possible. Traffic control devices must be removed by picking up the devices in the opposite direction of traffic. When located behind barrier or at other locations shown on approved traffic control plans, equipment may operate in a direction opposite to adjacent traffic.

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1-10.1(2) MATERIALS

Materials must comply with the requirements of the following Sections:

Material	Section
Stop/Slow Paddles	9-38.1
Construction Signs	9-38.2
Wood Sign Posts	9-38.3
Sequential Arrow Signs	9-38.4
Portable Changeable Message Signs	9-38.5
Barricades	9-38.6
Traffic Safety Drums	9-38.7
Traffic Cones	9-38.9
Tubular Markers	9-38.10
Warning Lights and Flashers	9-38.11
Truck-Mounted Attenuator	9-38.12
Tall Channelizing Devices	9-38.13
Portable Temporary Traffic Control Signal	9-38.14
Type III or Type IV Reflective Sheeting	9-38.15
Temporary Pedestrian Curb Ramps	9-38.16
Pedestrian Channelizing Devices	9-38.17

1-10.2 TRAFFIC CONTROL MANAGEMENT

1-10.2(1) GENERAL

It is the Contractor's responsibility to plan, conduct, and safely perform the Work. The Contractor must manage temporary traffic control with its own staff. The Owner may inspect Work in the street Right of Way with regard to type and placement of pedestrian and vehicular traffic control devices. Traffic control devices not meeting the requirements of the MUTCD, Seattle Traffic Control Manual (STCM), and the Contract are considered non-standard. Do not use non-standard traffic control devices unless specifically approved for use, in writing, by the Engineer.

The Contractor must patrol the traffic control area at least once a Day and as often as necessary, to reset all disturbed signs and traffic control devices. Signs and other traffic control devices must be removed or covered during periods when they are not necessary.

Before starting work, the Contractor must assign an individual or individuals to perform the duties of Traffic Control Manager (TCM) and Traffic Control Supervisor (TCS). Traffic control management responsibilities must be formally assigned to 1 or more company supervisors who are actively involved in the planning and management of field Contract activities. The Contractor must provide the Engineer with a copy of the formal assignment. The traffic control management duties of the TCM may not be subcontracted.

The Contractor must assign an individual or individuals to perform the duties of the primary TCS. The designation must also identify an alternate TCS who can assume the duties of the primary TCS in the event of that person's inability to perform. The TCS is responsible for safe implementation of approved traffic control plans.

The primary and alternate TCS must be certified as worksite traffic control supervisors by 1 of the organizations listed below or others as approved by the Engineer:

The Northwest Laborers-Employers Training Trust
27055 Ohio Ave.
Kingston, WA 98346
(360) 297-3035

Evergreen Safety Council
12545 135th Ave NE
Kirkland, WA 98034-8709
1-800-521-0778

The American Traffic Safety Services Association

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15 Riverside Parkway, Suite 100
Fredericksburg, Virginia 22406-1022
Training Dept. Toll Free (877) 642-4637
Phone: (540) 368-1701

Possession of a current flagging card by the TCS is mandatory. A traffic control management assignment and a TCS designation are required on any Contract that will use traffic control. The Contractor must provide documentation of TCS certifications.

The Contractor must maintain 24-hour telephone numbers at which the Contractor's assigned traffic control management personnel and the TCS can be contacted and be available upon the Engineer's request except on normal working hours. These persons must have the resources, ability, and authority to expeditiously correct any deficiency in the traffic control system.

1-10.2(2) TRAFFIC CONTROL MANAGER (TCM)

The responsibilities of the Contractor's traffic control management personnel include:

1. Overseeing and approving the actions of the TCS to ensure that proper safety and traffic control measures are implemented and consistent with the specific requirements created by the Contractor's work zones and the Contract. Some form of oversight must be in place and effective even when the traffic control management personnel are not present at the Job Site.
2. Providing the Contractor's assigned TCS with approved traffic control plans that are compatible with the Work operations and traffic control for which they will be implemented.
3. Discussing proposed traffic control measures and coordinating implementation of the Contractor-adopted traffic control plan with the Engineer.
4. Coordinating all traffic control operations, including those of Subcontractors and Suppliers, with each other and with any adjacent construction or maintenance operations.
5. Coordinating the project's activities, such as ramp closures, road closures, and lane closures, with appropriate police, fire control agencies, city or county engineering, medical emergency agencies, school districts, disposal companies, and transit companies (for KCM transit, Streetcars, and Sound Transit Link Light Rail, see Section 1-07.28).
6. Overseeing all requirements of the Contract that contribute to the convenience, safety, and orderly movement of vehicular and pedestrian traffic.
7. Reviewing the TCS's diaries daily and being aware of field traffic control operations.
8. Being present on-site a sufficient amount of time to adequately satisfy the above-listed responsibilities.

Failure to carry out any of the above-listed responsibilities is a failure to comply with the Contract and may result in a suspension of Work as specified in Section 1-08.6.

1-10.2(3) TRAFFIC CONTROL SUPERVISOR (TCS)

A TCS must be present on the Project Site whenever flagging or spotting or other traffic control labor is being used or less frequently, as authorized by the Engineer.

The TCS must personally perform all duties of the TCS. During non-work periods, the TCS must be present at the Job Site within a 45-minute time period after notification by the Engineer.

The TCS's duties include:

1. Having a current approved traffic control plan, the SCTM, and the latest adopted edition of the MUTCD, including the Washington State Modifications to the MUTCD, the book Quality Guidelines for Work Zone Traffic Control Devices, and applicable standards and specifications.
2. Inspecting traffic control devices and nighttime lighting for proper location, installation, message, cleanliness, and effect on the traveling public. Traffic control devices must be inspected at least once per hour during working hours except that Class A signs and nighttime lighting need to be checked once per week. Traffic control devices left in place for 24-hours or more must also be inspected once during the nonworking hours when they are initially set up (during daylight or darkness, whichever is opposite of the working hours). The TCS must correct, or arrange to have corrected, any deficiencies noted during these inspections.
3. Preparing a daily traffic control diary on each Day that traffic control is performed and submitting them to the Engineer before the end of the next Working Day. Diary entries must include:
    a. Time of Day when signs and traffic control devices are installed and removed.
    b. Location and condition of signs and traffic control devices.
    c. Revisions to the traffic control plan.
    d. Lighting used at night.
    e. Observations of traffic conditions.

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4. Making minor revisions to the traffic control plan to accommodate Project Site conditions provided that the original intent of the traffic control plan is maintained and the revision has the concurrence of both the Contractor and the Engineer.
5. Attending traffic control coordinating meetings or coordination activities as necessary for full understanding and effective performance.
6. Ensuring that all needed traffic control devices and equipment are available and in good working condition before the need to install or use them.

The TCS may perform the Work described by the Bid Item for "Maintenance and Protection of Traffic Control" as long as the duties of the TCS are accomplished. Possession of a current flagging card by the TCS is mandatory.

The TCS must wear a reflective vest and a hard hat.

1-10.2(4) CONTRACTOR'S REFUSAL OR FAILURE TO ACT

Upon failure or refusal of the Contractor to comply with the Engineer's written notice to:

1. Provide adequate flaggers;
2. Provide, erect, maintain, and remove, as applicable, barricades, signs, lights, on-site or off-site detours or detour bridges; or
3. Provide any Work specified in Section 1-07.23:

The Engineer has the option to do one or any combination of the following:

a. Suspend the Work without further notice to the Contractor or the Contractor's Surety until the Contractor complies with the Engineer's direction as specified in Section 1-08.6;
b. Immediately provide an off-duty uniformed peace officer;
c. Immediately provide flagging by Owner forces or by others; and/or
d. Provide, erect, maintain, and remove barricades, signs, and lights by Owner forces or by others.

All costs related to items a., b., c., and d. will be deducted from any progress payments due or coming due the Contractor as specified in Section 1-09.9(3).

The above options do not bar the Owner from exercising other remedies because of the Contractor's failure or refusal to comply with a contractual obligation.

1-10.2(5) TRAFFIC CONTROL PLANS

1-10.2(5)A CONTENT AND SUBMITTAL REQUIREMENTS

Based on the Contractor's intended method of performing the Work, the Contractor must develop, adopt, and submit to the Engineer a specific traffic control plan for protecting and controlling pedestrian, bicycle and vehicle traffic during construction operations. A separate traffic control plan is required for each work location within the street Right of Way. When the Project Site cannot be fully opened to traffic after a workshift is completed, a separate traffic control plan is required for the after workshift conditions.

Typical plans may be submitted for areas with identical traffic requirements. Typical plans must be clearly labeled to indicate all locations the plan is to be implemented. Traffic control plans must take into consideration any street and lane closure or other restrictions that may be specified in the Contract.

For non-SDOT projects, traffic control plans must be submitted to SDOT as part of the Street Use Permit application process. The submittal must be made to SDOT and the Engineer at least 10 Working Days before planned implementation to allow for SDOT evaluation. A copy of the approved TCP must be submitted to the Engineer for information and in case of any additional neighborhood restrictions on traffic. The Contractor must not start Work in the street Right of Way until an approved traffic control plan for the specific location has been returned by the Engineer. Submittals must be as specified in Section 1-05.3.

Traffic control plans must indicate:

1. Vehicular, bicycle, and pedestrian traffic routing.
2. Proposed location of flaggers, barricades, lighting, signing, and other traffic control devices in relation to existing and temporary roadway edges and lane markings.
3. Proposed number of working hours.
4. Arrangements for access to buildings within and immediately adjacent to the Project Site.
5. Arrangements for emergency exiting from buildings within and immediately adjacent to the Project Site.
6. Anticipated driveway blockage resulting from construction operations.
7. Restrictions to on-street parking within immediate vicinity of the Project Site, including arrangements for hooding parking meters, and parking pay stations and associated appurtenances, as necessary.
8. Arrangements for temporary passenger and commercial loading and unloading zones, and temporary transit stop zones.

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9. Identification and description of temporary lateral relocations of trolley overhead wire system if necessary to maintain trolley service.
10. Routing of construction trucks.
11. Coordination in sequencing traffic control with scheduling of Work and work locations.
12. Sequencing and layout of temporary pavement marking and removal as it relates with the scheduling of Work and work locations.

When the signing of a particular area will be provided as detailed on 1 or more of the figures included in the STCM without modification, the Contractor may reference the applicable figure number, shown on the manual, at the appropriate location on the Drawings. When this procedure is used, variable distances such as minimum length of taper must be specified by the Contractor. The spacing proposed for barricades and cones must also be specified.

If the Contractor's proposed pedestrian or traffic control measures differ from the traffic control requirements in the STCM, the Contractor's alternate traffic control plan must detail the specific location of each necessary construction sign, flagging, and other traffic control device required. The Contractor's alternate method for traffic and pedestrian control must be developed per the same established standards for plan development demonstrated by the figures in the STCM. Acceptance of alternative traffic control measures is entirely at the discretion of the Engineer. The Contractor has no claim for an equitable adjustment:

a. For using alternative measures.
b. If the proposed alternate measures are rejected or modified.
c. If requests to use non-standard traffic control devices are rejected or modified.

The Contractor must plan and schedule Contractor work activities to conform to and allow time for notifications, reviews, approvals, acceptances, and other conditions of the Contract. Most notifications are specified in Section 1-07.28.

1-10.2(5)B CONFORMANCE TO ESTABLISHED STANDARDS

Flagging, signs, and all other traffic control devices and procedures furnished or provided must conform to the standards established in the current version (in effect on the Day the Work was advertised for Bid) of the MUTCD as modified and adopted by WSDOT, as supplemented by the current edition of The City of Seattle STCM , and such additional requirements as may be included in the Contract. RCW 47.36 requires traffic control devices along city streets to conform to the WSDOT adopted standards to the extent possible.

The WSDOT adopted version of the MUTCD may be accessed at:

https://wsdot.wa.gov/engineering-standards/all-manuals-and-standards/manuals/manual-uniform-traffic-control-devices-mutcd

The City of Seattle STCM may be accessed at:

https://www.seattle.gov/documents/departments/sdot/about/documentlibrary/2024_traffic_control_manual.pdf

Judgment of the quality of devices furnished will be based on Quality Guidelines for Temporary Traffic Control Devices, published by the American Traffic Safety Services Association. Copies of the MUTCD and Quality Guidelines for Temporary Traffic Control Devices may be purchased from the American Traffic Safety Services Association, 15 Riverside Parkway, Suite 100, Fredericksburg, Virginia 22406-1022. The Washington State Modifications to the MUTCD may be obtained from the Department of Transportation, Olympia, Washington 98504.

In addition to the standards of the MUTCD, and the requirements described above, the Contractor must use crashworthy devices. The National Cooperative Highway Research Project (NCHRP) Report 350 has established requirements for crash testing. Work zone devices are divided into 4 categories. Each of those categories and, where applicable, is described below:

Category 1 includes those items that are small and lightweight, channelizing, and delineating devices that have been in common use for many years and are known to be crashworthy by crash testing of similar devices or years of demonstrable safe performance. These include cones, tubular markers, flexible delineator posts, and plastic drums. All Category 1 devices used on the project must comply with the requirements of NCHRP 350 as certified by the manufacturer of the device.

Category 2 includes devices that are not expected to produce significant vehicular velocity change, but may otherwise be hazardous. Examples of this class are barricades, portable sign supports and signs, intrusion alarms and vertical panels. All Category 2 devices must comply with the requirements of NCHRP 350. For the purpose of definition, a sign support and sign is considered a single unit. A new sign may be purchased for an existing sign support and the entire unit will be defined as existing equipment.

Category 3 is for hardware expected to cause significant velocity changes or other potentially harmful reactions to impacting vehicles. Barriers, fixed sign supports, crash cushions, and other work zone devices not meeting the definitions of Category 1 or 2 are examples from this category. Many Category 3 devices are defined in the design of the project. Where this is the case, NCHRP 350 requirements have been incorporated into the design and the Contractor complies with the requirements by constructing devices according to the Contract and Specifications. Where the device is a product chosen by the Contractor, the device chosen must be compliant with the requirements of NCHRP 350.

Category 4 includes portable or trailer-mounted devices such as arrow displays, temporary traffic signals, area lighting supports, and portable changeable message signs. Crash testing is not required for these devices.

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The condition of signs and traffic control devices must be acceptable or marginal as defined in the book Quality Guidelines for Temporary Traffic Control Devices. The Contractor's TCM and TCS must verify the temporary traffic control devices and materials comply with these Specifications. If the Engineer determines a sign or traffic control device is unacceptable, it must be removed and replaced within 12 hours of notification. The Engineer's decision on the condition of a sign or traffic control device is final.

1-10.2(5)C GENERAL TRAFFIC CONTROL RESTRICTIONS

In addition to any street and lane closure restrictions specified in the Contract, traffic control plans must be developed to comply with the following restrictions:

1. Arterial Paving: Arterial approaches to the streets being paved must remain open to vehicular traffic for their full roadway widths except when paving across arterial crossings. During such periods, the cross streets may be closed for a minimum amount of time as approved by the Engineer. Before the closure of any arterial cross street the Contractor must submit to the Engineer a traffic control plan for the location detailing the traffic controls to be used to reroute traffic. Do not reroute traffic without approval of the traffic control plan by the Engineer. The Contractor has no claim because of the traffic control plan being rejected or modified by the Engineer.
2. Time of Work: Except as may be otherwise itemized in the street and lane closure restrictions specified in the Project Manual, do not schedule Work in the traveled way on arterials during peak traffic hours without written authorization from the Engineer. Unless otherwise specified, peak traffic hours are from 7:00 a.m. to 9:00 a.m. and from 4:00 p.m. to 6:00 p.m. with the following exceptions:
   a. For the Central Business District (City of Seattle) peak hours are from 6:00 a.m. to 9:00 a.m. and 3:00 p.m. to 6:00 p.m.
   b. For Aurora Avenue (City of Seattle) peak hours are from 6:00 a.m. to 9:00 a.m. and 3:00 p.m. to 7:00 p.m.

   The Contractor must discontinue Work if a conflict exists with special events such as parades, sporting events, miscellaneous rallies, and large public meetings; or with seasonal conditions, such as the Holiday Construction Moratorium. Information concerning such events can be obtained by emailing: dot_events@seattle.gov.
3. Holiday Construction Moratorium (City of Seattle Only):
   a. No construction activities will be allowed on any portion of a project that lies within the Central Business District or the Pioneer Square area from Thanksgiving Day through New Year's Day inclusive.

      The Central Business District is that area within the boundaries of Interstate 5 on the east, Seneca Street on the south, First Avenue on the west, Virginia Street and Denny Way (east of Fairview Avenue) on the north.

      The Pioneer Square Area is that area within the boundaries of Alaskan Way on the west, Second Avenue and Second Avenue South on the east, Columbia Street on the north and King Street on the south.
   b. No construction activities will be allowed on any portion of a project that lies within the Chinatown-International District during the period beginning three weeks before Lunar New Year holiday and ending three weeks after Lunar New Year holiday. The exact date of the Lunar New Year holiday changes each year. See the SDOT Street Use Construction web page for additional information: https://www.seattle.gov/transportation/permits-and-services/permits/construction-use-in-the-right-of-way The Chinatown-International District boundary, for the purposes of the Holiday Construction Moratorium, is the area delineated by the International Special Review District boundary defined on Map A in SMC 23.66.302.
4. Parking: Where parking restricts traffic flow or is a hazard to through traffic or to the construction work, parking may be restricted either entirely or during the time when it creates a hazard. Parking restrictions may be requested by the Contractor and upon approval of the Engineer be established within construction and maintenance areas.

In areas where (City of Seattle) parking meters are present, the Contractor must apply to SDOT for installation of meter covers restricting such parking. In areas with parking pay stations and sidewalk containing D-22 signage (Pay R, Pay L, Pay H, and Pay RL signs and posts), and numbered base plates, the Contractor must apply to SDOT for no parking markers restricting such parking.

The Contractor must reimburse SDOT for lost parking revenue unless this is an SDOT Project.

Where no meters, parking pay stations, and D-22 signage and numbered base plates are present, the Contractor must contact SDOT so that the Contractor may install No Parking (T038 or T039) easel signs. Signs must be inspected by a parking enforcement officer or uniformed peace officer 24 hours before enforcement. See Section 1-07.28, item 3) for notification requirements. Load zone, consulate parking zone, and carpool parking zone restrictions must be per the STCM.

No Parking signs must conform in message, dimension, and color as specified in Part V of the STCM. Spacing of signs must be per Project Site conditions.

No Parking (T038 or T039) easel signs must be installed at an approximate interval of 50 feet to 75 feet, with a minimum of 4 units, per each full block. For partial block parking prohibition, R-101's or T-38's or T039's must be installed at approximately 50-foot intervals with R-160 signs at the terminus as shown in Figure V-1 of the STCM.

The employees of the Contractor must not park their private vehicles on the street, at the Project Site, or in commercial areas where general parking has been prohibited for construction or safety purposes.

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1-10.2(5)D RESERVED

1-10.3 TRAFFIC CONTROL LABOR, PROCEDURES AND DEVICES

1-10.3(1) TRAFFIC CONTROL LABOR

The Contractor must furnish all personnel for flagging, spotting, for the execution of all procedures related to temporary traffic control and for the setup, maintenance, and removal of all temporary traffic control devices and construction signs necessary to control traffic during construction operations.

Workers engaged as flaggers or spotters must wear reflective vests and hard hats. During hours of darkness, white coveralls or white or yellow rain gear must also be worn. The vests and other apparel must be as specified in Section 1-07.8.

1-10.3(1)A FLAGGERS AND SPOTTERS

Flaggers and Spotters must be posted where shown on approved traffic control plans or where directed by the Engineer. All flaggers and spotters must possess a current flagging card issued by the State of Washington, Oregon, Montana, or Idaho. The flagging card must be immediately available and shown to the Owner upon request.

Show flagging stations on traffic control plans at locations where construction operations require stopping or diverting traffic. Flagging stations must be staffed only when flagging is required. This staffing may be continuous or intermittent, depending on the nature of the construction activity. Whenever a flagger is not required to stop or divert traffic, the flagger must move away from the flagging station to a safer location. During hours of darkness, flagging stations must be illuminated as that ensures that flaggers can easily be seen but that does not cause glare to the traveling public. Flaggers must be equipped with portable two-way radios, with a range suitable for the project. The radios must be capable of having direct contact with project management (e.g. individuals such as foremen and superintendents).

The Contractor must furnish Stop/Slow paddles as specified in Section 9-38.1 for all flagging operations.

Show spotting stations on traffic control plans at locations where a spotter can detect errant drivers or other hazards and provide an effective warning to other workers. Spotting stations are not allowed at locations where the spotter will be in unnecessary danger. The Contractor must furnish noise-makers or other effective warning devices for spotting operations. The duties of a spotter do not include flagging.

1-10.3(1)B OTHER TRAFFIC CONTROL LABOR

In addition to flagging or spotting duties, the Contractor must provide personnel for all other traffic control procedures required by the construction operations and for the labor to install, maintain and remove any traffic control devices shown on traffic control plans.

Before performing any traffic control Work on the Project Site, these personnel must be trained in work zone safety.

1-10.3(1)C TRAFFIC CONTROL PEACE OFFICERS

Only use an off-duty uniformed peace officer as a flagger to:

1. Countermand a traffic signal indication at a signalized intersection.
2. Direct vehicle and pedestrian traffic when a traffic signal indication is turned off or inoperative.
3. Perform flagging duties outside of the required uses in items 1 or 2 above only if it is determined by the Engineer that such work would present an extenuating safety risk if not performed by personnel who are Uniformed Peace Officers. Such use of Uniformed Peace Officers must be specified in the accepted traffic control plan.
4. If flagging duties indicated exclude the required uses in item 1, 2, or 3 above, or any combination of the above, then the Engineer will direct the Contractor to stop use of the Uniformed Peace Officer before the next Working Day.

For new traffic signal Work, officers are also required as specified in Section 8-31.3(1)A. The off-duty uniformed peace officer must be provided by the Contractor.

On the next Working Day, the Contractor must submit to the Engineer a copy of the daily time card for Traffic Control Peace Officers showing the hours actually worked.

1-10.3(2) TRAFFIC CONTROL PROCEDURES

1-10.3(2)A ONE-WAY TRAFFIC CONTROL

The project may require that traffic be maintained on a portion of the roadway during the Work using one-way traffic control. If this is the case, the Contractor's operation must be confined to one-half of the roadway, permitting traffic on the other half. If shown on an approved traffic control plan or directed by the Engineer, one-way traffic control, per the MUTCD, must be provided and conform to the following:

1. In any one-way traffic control configuration, side roads and approaches will be closed or controlled by a flagger or by appropriate approved signing. A side road flagger will coordinate with end flaggers where there is line of sight and with the pilot car where the end flaggers cannot be seen.
2. Queues of vehicles will be allowed to take turns passing through the work zone in the single open lane. When one-way traffic control is in effect, Contractor vehicles must not use the open traffic lane except while under the same rules and routes required of the traffic.

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3. As conditions permit, the Contractor must, at the end of each Day, leave the Job Site in such condition that it can be traveled without damage to the Work, without danger to traffic, and without one-way traffic control. If, in the opinion of the Engineer, one-way traffic control cannot be dispensed with after working hours, then the operation will be continued throughout the Non-Working hours.

1-10.3(2)B LANE CLOSURE SETUP/TAKEDOWN

Where allowed by the Contract and where shown on approved traffic control plans or directed by the Engineer, the Contractor must set up traffic control measures to close 1 or more lanes of a multi-lane facility. When this is to occur and called for in the approved traffic control plan, the following sequence must be followed:

1. Advance warning signs are set up on the shoulder of the roadway opposite the lane to be closed;
2. Advance warning signs are set up on the same shoulder as the lane to be closed;
3. If required, a transportable attenuator, with arrow board, is moved into place at the starting of the closure taper; and
4. Channelization devices are placed to mark the taper and the length of the closure as shown on the traffic control plan.

If transportable attenuator /arrow board is required, once the lane is closed, the transportable attenuator /arrow board combination may be replaced with an arrow board without attenuator.

If additional lanes are to be closed, they must be closed in sequence with previous lane closures using the same sequence of activities. If an arrow board is required, each closed lane must be marked with a separate arrow board at all times.

Traffic control for lane closures must be removed in the reverse order of its installation.

1-10.3(2)C MOBILE OPERATIONS

Where construction operations are such that movement along the length of a roadway is continuous or near-continuous to the extent that a stationary traffic control layout will not be effective, the Contractor must implement a moving, or mobile, traffic control scheme. Such moving control must always be conducted in the same direction as the adjacent traffic.

Where shown on an approved traffic control plan or where directed by the Engineer, mobile traffic control consists of portable equipment, moving with the operation. A portable changeable message sign must be established in advance of the operation and far enough back to provide warning of both the operation and of any queue of traffic that has formed during the operation. The advance sign must be continuously moved to stay near the back of the queue at all times. A truck-mounted attenuator, with arrow board, must be positioned and maintained at a fixed distance upstream of the Work. A shadow vehicle, with truck-mounted attenuator, must be positioned and maintained immediately upstream of the Work.

1-10.3(2)D PATROL & MAINTAIN TRAFFIC CONTROL MEASURES

At all times, when temporary traffic control measures are in place, the Contractor must provide for patrolling and maintaining these measures. The Work must consist of resetting mislocated devices, assuring visibility of all devices, cleaning and repairing where necessary, providing maintenance for all equipment, including replacing batteries and light bulbs as well as keeping motorized and electronic items functioning, and adjusting the location of devices to respond to actual conditions, such as queue length, unanticipated traffic conflicts and other areas where planned traffic control has proven ineffective.

This Work must be performed by the Contractor, either by or under the direction of the TCS, with vehicles if necessary, must be dispatched so that all traffic control can be reviewed at least once per hour during working hours and at least once during each Non-Working Day.

1-10.3(3) TRAFFIC CONTROL DEVICES

1-10.3(3)A CONSTRUCTION SIGNS

All construction signs required by approved traffic control plans, as well as any other signs as directed by the Engineer, must be furnished by the Contractor. The Contractor must provide the posts or supports and erect and maintain the signs in a clean, neat, and presentable condition until the need for them has ended. Post mounted signs must be installed as shown on the Standard Plans. When the need for construction signs has ended, the Contractor, upon approval of the Engineer, must remove all signs, posts, and supports from the project.

No passing zones on the existing roadway that are marked with paint striping that will be obliterated by construction operations must be replaced by Do Not Pass and Pass With Care signs. The Contractor must provide and install the posts and signs. The signs must be maintained by the Contractor until they are removed or until the Contract is Physically Completed. When the project includes striping by the Contractor, the signs and posts must be removed by the Contractor when the no passing zones are reestablished by striping. The signs and posts become the property of the Contractor. When the Contractor is not responsible for striping and when the striping by others is not completed when the project is Physically Completed, the posts and signs must be left in place and become the property of the Owner.

All existing signs, new permanent signs installed under this Contract, and construction signs installed under this Contract that are inappropriate for the traffic configuration at a given time must be removed or completely covered with metal, plywood, or an Engineer approved product specifically manufactured for sign covering during periods when they are not needed.

Construction signs will be divided into 2 classes. Class A construction signs are those signs that remain in service throughout the construction or during a major phase of the Work. They are mounted on posts, existing fixed Structures, or

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substantial supports of a semi-permanent nature. Class A signs will be designated as such on the approved traffic control plan. Do Not Pass and Pass With Care signs are classified as Class A construction signs. Sign and support installation for Class A signs must be per the Contract or the Standard Plans. Class B construction signs are those signs that are placed and removed daily, or are used for short durations which may extend for 1 or more Days. They are mounted on portable or temporary mountings.

Where it is necessary to add weight to signs for stability, the only allowed method will be a bag of sand that will rupture on impact. The bag of sand must have a maximum weight of 40-pounds, and must be suspended no more than 1 foot from the ground.

Signs, posts, or supports that are lost, stolen, damaged, destroyed, or which the Engineer deems are unacceptable while their use is required on the project must be replaced by the Contractor.

1-10.3(3)B SEQUENTIAL ARROW SIGNS

Where shown on an approved traffic control plan or where ordered by the Engineer, the Contractor must provide, operate, and maintain sequential arrow signs. In some locations, the sign will be shown as a unit with an attenuator. In other locations, the traffic control plan will indicate a stand-alone unit.

1-10.3(3)C PORTABLE CHANGEABLE MESSAGE SIGN

Where shown on an approved traffic control plan or where ordered by the Engineer, the Contractor must provide, operate, and maintain portable changeable message signs. These signs must be available, on-site, for the entire duration of their projected use.

1-10.3(3)D BARRICADES

Where shown on an approved traffic control plan or where ordered by the Engineer, the Contractor must provide, install, and maintain barricades. Barricades must be kept in good repair and must be removed immediately when, in the opinion of the Engineer, they are no longer functioning as designed.

Where it is necessary to add weight to barricades for stability, the only allowed method will be a bag of sand that will rupture on impact. The bag of sand must have a maximum weight of 40-pounds, and must be suspended no more than 1 foot from the ground.

1-10.3(3)E TRAFFIC SAFETY DRUMS

Where shown on an approved traffic control plan, or where ordered by the Engineer, the Contractor must provide, install, and maintain traffic safety drums.

Used drums may be used, provided all drums used on the project are of essentially the same configuration.

The drums must be designed to resist overturning by a weighted lower unit that will separate from the drum when impacted by a vehicle.

Drums must be regularly maintained to ensure they are clean and the drum and reflective material are in good condition. If the Engineer determines a drum has been damaged beyond usefulness, or provides inadequate reflectivity, a replacement drum must be furnished.

When the Engineer determines drums are no longer required, they must be removed from the project and remain the property of the Contractor.

1-10.3(3)F RESERVED

1-10.3(3)G TRAFFIC CONES

Where shown on an approved traffic control plan or where ordered by the Engineer, the Contractor must provide, install, and maintain traffic cones. Cones must be kept in good repair and must be removed immediately when directed by the Engineer. Where wind or moving traffic frequently displace cones, employ an effective method of stabilizing cones, such as stacking 2 together at each location.

1-10.3(3)H TUBULAR MARKERS

Where shown on an approved traffic control plan or where ordered by the Engineer, the Contractor must provide, install, and maintain tubular markers. Tubular markers must be kept in good repair and must be removed immediately when directed by the Engineer. Tubular markers are secondary devices and are not to be used as substitutes for cones or other delineation devices without an approved traffic control plan.

Where the traffic control plan shows pavement-mounted tubular markers, the adhesive used to fasten the base to the pavement must be suitable for the purpose, as approved by the Engineer. During the removal of pavement-mounted tubular markers, take care to avoid damage to the existing pavement. Any such damage must be repaired by the Contractor at no cost to the Owner.

1-10.3(3)I WARNING LIGHTS AND FLASHERS

Where shown attached to traffic control devices on an approved traffic control plan or where ordered by the Engineer, the Contractor must provide and maintain flashing warning lights. Lights attached to advance warning signs must be Type B, high-

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intensity. Lights attached to traffic safety drums, barricades or other signs must be Type C, steady-burning low intensity or, where attention is to be directed to a specific device, Type A, flashing low-intensity units.

1-10.3(3)J TRANSPORTABLE ATTENUATOR

Where shown on an approved traffic control plan or where ordered by the Engineer, the Contractor must provide, operate, and maintain transportable impact attenuators. These attenuators must be available, on-site, for the entire duration of their projected use.

The transportable attenuator must be positioned to separate and protect construction work zone activities from normal traffic flow.

During use, the attenuator must be in the full down-and-locked position. For stationary operations, the host vehicle's parking brake must be set.

A transportable attenuator may be used instead of a temporary impact attenuator when approved by the Engineer as part of a stage traffic control shift to protect an object such as blunt barrier end or bridge pier column that is located within the work zone clear zone. This use of a transportable attenuator is restricted to a maximum of 3 days or approved extension by the Engineer.

1-10.3(3)K PORTABLE TEMPORARY TRAFFIC CONTROL SIGNAL

Where shown on an approved traffic control plan, the Contractor must provide, operate, maintain, and remove a portable temporary traffic control signal to provide alternating one-lane traffic operations on a two-way facility. A portable temporary traffic control signal is defined as a traffic control signal that may be trailer mounted, fully self-contained unit and designed so it can be easily transported and deployed at different locations.

The Contractor must submit the manufacturer's specifications for the portable temporary traffic control signal to the Engineer for approval at the preconstruction meeting or a minimum of 2 weeks before installation, whichever occurs first. A manufacturer's representative is required to demonstrate the capabilities of the temporary portable signal before approval and provide training to Contractor personnel as necessary. The Contractor must provide a minimum of 1 manufacturer trained operator on-site during all hours of portable traffic control signal operation.

Remote manual control of the portable traffic control signal by the TCS or a qualified operator may be allowed if necessitated by Work area or traffic conditions and as approved by the Engineer.

Maximum length between signal heads is 1500 feet unless otherwise shown on the Drawings or ordered by the Engineer as specified in Section 1-04.3.

The Engineer will inspect the signal system at initial installation/operation and either provide or approve the signal timing. Final approval will be based on the results of the operational inspection.

If repairs or adjustments are required, the Contractor must respond immediately and provide flagger traffic control if the roadway cannot be safely reopened to two-way traffic, until such time repairs can be made. The Contractor must either repair the signal or replace with a backup unit within 24 hours.

The Engineer will monitor the traffic, signal operation and order adjustments as needed based on traffic conditions. Timing adjustments require the approval of the Engineer.

As shown on the traffic control plan, temporary stop bars and Stop Here on Red Signs (R10-6) must be provided at the location traffic is expected to stop during the red display. The stop bar locations must be illuminated at night. The Contractor is responsible for illumination, which must be adjusted to ensure minimal glare to motorists.

When not in operation, remove signal heads from the view of traffic or cover signal heads with bags made of non-ripping Material specifically designed for covering signal heads. Do not use trash bags of any type. Remove, cover, fold, or turn all inappropriate signs so that they are not readable by oncoming traffic.

The Contractor must provide and install all field wiring to make a complete and operational portable traffic control signal and must maintain the system throughout the life of the Contract.

Do not install portable temporary traffic signals within 300 feet of at-grade railroad crossing, or if driveways or roadway access points are located between the portable temporary traffic control signals.

1-10.3(3)L PAINT LINES AND LEGENDS

Temporary pavement markings must be provided when permanent markings are removed because of construction operations. Temporary pavement markings must be maintained in serviceable condition and removed only on installation of permanent traffic channelization. When lane shifts resulting from construction activities will be in place for more than 15 Calendar days, temporary centerline striping and temporary dashed lane line striping must be installed.

Temporary centerline striping must consist of placing yellow strips of pressure sensitive pavement marking tape or temporary paint at 15-foot intervals along the centerline. Temporary markings must be placed in sets of two 36-inch strips of yellow 4-inch wide markings set 16 inches apart and parallel to the center line with each set of 3-foot double line spaced every 15 feet along the center line of the roadway, or the equivalent surface area in yellow temporary lane markers.

Temporary dashed lane line striping must consist of placing white strips of pressure sensitive pavement marking tape or temporary paint at 15-foot intervals along the dashed lane lines, separating multiple lanes of traffic moving in the same

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direction. Temporary markings must be placed in 36” strips of white 4-inch wide marking spaced every 15 feet along the lane lines, or the equivalent surface area in white temporary lane markers.

Temporary stop bars must conform to the dimensions and location requirements provided in Standard Plan 712. Stop bars may consist of parallel adjacent 4-inch strips of temporary pavement marking tape.

When permanent green pavement markings are temporarily removed during construction, and the temporary traffic control plans require the bike lanes to remain operational in the same location, install temporary skip lines for the outer edge of the bike lane or cross-bike using the same skip pattern of the permanent markings as provided in standard plan 780 and 781. Infilling with green markings is not required.

Temporary crosswalks must be “ladder style” conforming to the dimensions and placement requirements in Standard Plan 712. Crosswalks may consist of parallel adjacent 4-inch strips of temporary pavement marking tape.

Temporary symbols and legends must conform to the dimensions of permanent installations as provided in the 700 series Standard Plans using white temporary marking tape or approved traffic paint with reflectivity.

Pressure-sensitive pavement marking tape or temporary paint used on the wearing course before installation of permanent lane markers, traffic buttons, or permanent paint striping must be removed from the pavement current with, or immediately after, the installation of permanent pavement markings.

Temporary pavement markings must be maintained in serviceable condition by the Contractor for the duration of time it is in use. The Contractor must lay out temporary markings for the permanent marking application and, after installation of the permanent markings, must remove the temporary striping.

Temporary pavement marking tape and paint must comply with Section 9-29. Damage to the pavement resulting from removal of temporary pavement marking, including the use of high heat sources, must be repaired by the Contractor at no expense to the Owner.

1-10.3(3)M LIGHTING DEVICES

Roadway and pedestrian illumination systems must be maintained in operation for all traveled ways open to traffic as specified in Section 8-30.3(1).

Barricades or drums used at night must be equipped with approved yellow warning lights. The Contractor must keep existing traffic signal systems and pedestrian and street lighting systems in operation for the benefit and safety of the traveling public during progress of the Work, unless otherwise directed by the Engineer. The Owner will continue the routine maintenance of traffic signal, pedestrian and street lighting systems. The Contractor must repair or replace missing or damaged signal devices or lights.

1-10.3(3)N SPEED AND PARKING CONTROL

In those areas where construction operations have changed road conditions, such additional hazards as reduced lane width, open trenches, and temporary roadway, may be considered as evidence of the need for an alteration of the legal (or posted) speed limit. Construction operations may also require the occupancy of, or restrict access to public parking. In these cases, requests for alteration of the legal speed limits or for parking control on streets within the City of Seattle require a traffic permit.

To request covering of parking meters and placing no parking markers on numbered base plates where parking pay stations exist, to reserve metered parking for construction or traffic control use, and to obtain a traffic permit, see Section 1-07.28. Requests for alteration of the legal speed limits or parking control on streets outside the City of Seattle must be submitted to the appropriate governing jurisdiction and copied to the Engineer.

All costs related to speed limit revisions and parking control including payment for lost parking revenue are borne by the Contractor at no additional cost to the Owner. This does not apply if this is an SDOT project or if it is otherwise provided for in the Contract.

1-10.4 MEASUREMENT

Measurement for "Maintenance and Protection of Traffic Control including Flagging" will be by the lump sum.

Measurement for "Traffic Control Peace Officers" will be by the hour and will be made for the actual hours worked by a uniformed off-duty peace officer as specified in Section 1-10.3(1)C. No measurement will be made for standby time, show-up time, and all other time not as specified in Section 1-10.3(1)C.

Class A and Class B signs will not be measured.

1-10.5 PAYMENT

1. **“Maintenance and Protection of Traffic Control including Flagging",** per lump sum

Payment for “Maintenance and Protection of Traffic Control including Flagging" includes all costs for the Work required to control traffic as specified in Section 1-10 not including Traffic Control Peace Officers.

2. **"Traffic Control Peace Officers"**, per hour

Payment for "Traffic Control Peace Officers" includes all costs for the Work specified in Section 1-10.3(1)C.

3. **Other payment information**

When the Contractor's employees are called out to provide emergency traffic protection during Non-Working hours, payment for labor, equipment, and Materials deemed necessary by the Engineer will be made as specified in Section 1-04.3.

END OF DIVISION

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DIVISION 2 EARTHWORK

SECTION 2-01 CLEARING, GRUBBING, AND ROADSIDE CLEANUP

2-01.1 DESCRIPTION

2-01.1(1) GENERAL

Section 2-01 describes clearing, grubbing, and roadside cleanup requirements, including protecting from harm all trees, bushes, shrubs, and other objects identified in the Contract or the approved Tree, Vegetation and Soil Protection Plan (TVSPP).

2-01.1(2) CLASSIFICATION

Clearing means removing and disposing of all unwanted material from the ground surface, including but not limited to, trees 6 inches and less in diameter measured at 1 foot above the ground, brush, downed timber, rotted wood, and rubbish; building sheds, fences, and other obstructions interfering with the Work, when removal and disposal of the surface obstructions are not specifically provided for in Section 2-02; and protecting from all harm any trees, bushes, shrubs, or other existing improvement which are to remain. Trees greater than 6 inches in diameter measured 1 foot above the ground must remain unless marked for removal on the Drawings or approved for removal in the TVSPP, see Sections 1-07.16(2), 2-02.3(3)I, Section 8-01 and Section 8-02.

Grubbing means removing and disposing of all unwanted vegetative matter from below the ground surface, including but not limited to sod, stumps, roots, buried logs, and timber; and removing and disposing of drains, Culverts, wood catch basins, foundations, stairways, steps, and other obstructions that interfere with the Work when removal and disposal of sub-surface obstructions are not specifically provided for in Section 2-02.

Roadside cleanup means cleaning and maintaining the roadside to an attractive appearance.

2-01.2 CLEARING AND GRUBBING DISPOSAL

Requirements for disposal of clearing and grubbing waste and debris are specified in Section1-07.3.

Requirements for borrow sites are specified in Section 2-10.2.

Unless otherwise specified in the Contract, the Contractor is allowed to sell all usable material such as timber, chips, or firewood produced by clearing and grubbing. The Contractor must not allow the public to fell trees.

2-01.3 CONSTRUCTION REQUIREMENTS

2-01.3(1) CLEARING

The Contractor must fell trees marked for removal within the area to be cleared. The Contractor must notify the Engineer at least 10 Business Days in advance of tree removal and must post Engineer-provided placards on trees before removal. The Contractor must comply with Section 1-07.28 whenever tree removal is near overhead wires. For removal of trees larger than 6 inches diameter at 1 foot above the ground, see Section 2-02.3(3)I.

If pruning is specified or approved in the TVSPP or otherwise deemed necessary in areas to be cleared, the Contractor must conduct pruning per Section 8-02.3(7)A.

The Contractor must dispose of refuse resulting from the clearing operation at an approved disposal site, as specified in Section 1-07.3. Refuse material must not be left on the Project Site, on abutting properties, or buried in embankments or excavations on the Project Site. See Sections 1-04.10, 1-07.3, 1-07.5, 1-07.15, 1-07.24, and Section 8-01 regarding prevention of pollution, cleanup, and stormwater and erosion control.

2-01.3(2) GRUBBING

The Contractor must remove all stumps, roots, foundations, and planking embedded in the ground, within the limits described in the Contract, to a minimum depth of 2 feet below subgrade or 2 feet below existing ground level, whichever is lower.

Removal of tree stumps in improved areas as part of grubbing operations must comply with Section 2-02.3(3)I.

2-01.3(3) LIMITS OF CLEARING AND GRUBBING

The limits of clearing and grubbing is defined in the Contract and/or the approved TVSPP.

2-01.3(4) ROADSIDE CLEANUP

See Section 1-04.10.

2-01.3(5) PROTECTION OF EXISTING IMPROVEMENTS

See Section 1-07.16.

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2-01.4 MEASUREMENT

Measurement for “Clearing”, “Grubbing”, and “Clearing and Grubbing” is by lump sum or by square foot as described in the Bid Form.

2-01.5 PAYMENT

1. **“Clearing”**, per square foot, or per lump sum.
2. **“Grubbing”**, per square foot, or per lump sum.
3. **“Clearing and Grubbing”**, per square foot, or per lump sum.

The Bid Item prices for “Clearing”, for “Grubbing”, and for “Clearing and Grubbing” include all costs for the specified work.

4. **Other payment information**

Payment for “Remove Tree” is as specified in Section 2-02.5.

All costs involved in securing, operating and maintaining any waste or borrow site, including related final cleanup, and any erosion or anti-pollution controls required in related permits, property owner agreements, grading regulations, or other Contract requirements, are considered included in the Bid Item prices for the Work and no separate or additional payment will be made.

If the Bid Form does not include a Bid Item pertaining to the work of “Clearing”, “Grubbing”, or “Clearing and Grubbing", then this work is considered included in the Bid Item prices of the various Bid Items and no separate or additional payment will be made.

SECTION 2-02 REMOVE, ABANDON, OR RELOCATE STRUCTURES AND OBSTRUCTIONS

2-02.1 DESCRIPTION

Section 2-02 describes removing and disposing of, salvaging, or abandoning selected items identified in the Contract within a Right of Way or an area of existing improvement. This work also involves backfilling of trenches, holes, or pits resulting from the removal of the existing improvements.

For projects within the City of Seattle, actual pavement and related restoration may be modified by the extended limits of restoration required to comply with the current version of the “Right-of-Way Opening and Restoration Rule” at the date of Advertisement for Bids. This document may be obtained at The Street Use Counter, Room 2300, 23rd Floor, Seattle Municipal Tower, 700 Fifth Avenue, Seattle, WA 98104 or found at:

http://www.seattle.gov/transportation/stuse_pavementopen.htm

Any modifications to the Contract based on the “Right-of-Way Opening and Restoration Rule” must be approved by the Engineer.

The Contractor must conduct all removal operations included in this Section per Section 1-07.16(2) when removals fall within the dripline of existing trees to be protected.

Projects outside the City of Seattle must comply with the applicable local jurisdiction requirements.

2-02.2 MATERIAL

Cement concrete pavement must comply with the requirements of Section 6-02.

Aggregates must comply with Section 9-03. Cement Concrete, Class 3000 must be used for plugging pipe ends and filling inlets.

Backfill Material for filling structure voids and Structures other than inlets must be either Mineral Aggregate Type 9 or Type 17 meeting the requirements of Section 9-03, selected Material excavated on the Project Site, or other Material as assigned in the Contract.

2-02.3 CONSTRUCTION REQUIREMENTS

2-02.3(1) GENERAL REQUIREMENTS

The Contractor must demolish, remove, and dispose of buildings and foundations, Structures, fences, and other obstructions that lie wholly or partially within the Right of Way, unless they are public and private utility-owned equipment or items identified in the Contract to remain.

The Contractor must:

1. Remove abandoned Structures and other infrastructure to a depth of at least 5 feet below finished ground elevation, roadway subgrade elevation, or surfacing subgrade elevation, whichever is lower.
2. Break up basement floors to promote drainage.
3. Fill basements or other cavities left by the removal of Structures to match the level of surrounding ground. Complete backfilling as specified in Section 2-10.
4. Notify the Engineer of construction near existing survey monumentation, or removal of pavement containing existing survey monumentation, as required in Sections 1-07.16(1)A and 1-07.28 Item 18.

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5. Provide protective systems as specified in Section 2-07 when the removal of Structures creates voids greater than 4 feet in depth.

When salvageable material remains Owner property, the Contract will identify the material and provide removal requirements. The material must either be stored on the Project Site or delivered to a location identified in the Contract.

Any material not named in these Specifications or in the Contract as Owner property belongs to the Contractor.

The Contractor must dispose of surplus material or debris as specified in Section 1-07.3.

When limits are not shown on the Drawings, utility cuts and other openings in Seattle's streets, alleys, and other public places for construction or related activities must comply with the current edition of the "Right-of-Way Opening and Restoration Rule," see Section 2-02.1. The Engineer must approve utility cuts and other openings.

Joints and cracks referenced within this Section must include the abutment between differing surface materials such as asphalt, concrete, brick, or cobblestones; roadway surface and curb; non-monolithic curb and sidewalk; separately placed cement concrete slabs such as sidewalks, driveways, and bus shelter foundations; separately placed rigid pavement slabs without overlay; and separately placed rigid pavement base slabs with visible overlay.

When working adjacent to a signalized intersection, contact Signal Operations before removing or sawcutting asphalt overlay, pavement, or sidewalk, see Section 1-07.28.

2-02.3(2) REMOVAL OF BRIDGES, BOX CULVERTS AND OTHER DRAINAGE STRUCTURES

During salvage work, the Contractor must prevent unnecessary damage to any steel or wooden bridge that will remain Owner property. Steel members must be match-marked.

The Contractor must complete all blasting before the placement of new work. Blasting must be as specified in Section 1-07.22.

2-02.3(3) REMOVAL OF EXISTING STREET IMPROVEMENTS

2-02.3(3)A REMOVE NON RIGID PAVEMENT AND UNTREATED ROADWAY SURFACES

Non-rigid pavements are defined as streets, driveways, alleys, parking lots, sidewalks, or other surfaces constructed from a bituminous mix or any combination of bituminous mixes or surface treatments, placed directly on the subgrade or over a base material composed of treated or non-treated granular or selected materials. Non-rigid pavement does not contain cement concrete, brick, or cobblestones.

The thickness of a non-rigid pavement is measured as the thickness of the bituminous mix, or any combination of bituminous mixes and surface treatments.

Non-rigid pavement must be sawcut full depth before removal, to ensure a straight neat line. Full depth precut may be performed using an asphalt cutting wheel at the discretion of the Engineer.

When asphalt is removed by planing, edges must be vertical along a neat straight line. Sawcutting is not required.

No sawcutting is required where pavement removal limits extend to joints or cracks.

Untreated roadway surfaces are defined as oil mat, crushed rock, and gravel surfaces. Untreated roadway surfaces are not considered pavements.

2-02.3(3)B REMOVE ASPHALT OVERLAY

When removing an asphalt overlay from a rigid base pavement, the Contractor must use methods and equipment that do not structurally damage the existing rigid base.

Sawcutting is not required if the asphalt overlay is removed by planing and edges are vertical along a neat straight line.

No sawcutting is required where pavement removal limits extend to joints or cracks.

Planing bituminous pavement is described in Section 5-04.3(3)D.

2-02.3(3)C REMOVE RIGID PAVEMENT

Rigid pavements are streets, driveways, alleys, parking lots, and other pavement structures including cement concrete, brick, cobblestone, or any combination of these materials, and may or may not incorporate an asphalt overlay.

The thickness of a rigid pavement is measured as the thickness of the cement concrete, brick, cobblestone, or any combination of cement concrete, brick, or cobblestone. Overlaying asphalt depth is not included in determining the thickness of the rigid pavement.

In trenching operations, rigid pavement must be removed at locations shown on the Drawings or on Standard Plan 404a or 404b, if not shown on the Drawings.

Unless otherwise specified, rigid pavement must be sawcut or line drilled. Line drilling requires the approval of the Engineer, see Section 2-02.3(6).

No sawing or line drilling is required where pavement removal limits extend to joints or cracks.

Use of a “headache ball” or other methods that generate excessive vibrations to break concrete pavement are not permitted.

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Removal of former street car foundation, abandoned railroad track foundation, or other thickened slabs may be required. Former street car foundation may include rails and ties and rigid pavement extending over 14 inches in depth.

2-02.3(3)D REMOVE CATCH BASIN, SANDBOX, VALVE CHAMBER, MAINTENANCE HOLE, OR INLET

The Contractor must excavate and completely remove the Structure, including casting and outlet trap, concrete encasement, and bricks, as applicable to each removal Bid Item.

Plug connecting pipes as specified in Section 2-02.3(5)B. Backfill as specified in Section 2-10.

2-02.3(3)E CURB REMOVAL AND CLASSIFICATION, AND REMOVE CURB AND GUTTER

There are 4 types of curb:

1. Doweled curb includes mountable and other curb attached to underlying pavement structure
2. Full depth curb
3. Curb and gutter
4. Monolithic curb (cement concrete)

Unless the Drawings indicate otherwise, doweled curb, full depth curb, curb and gutter, or monolithic curb removal adjacent to pavement removal is considered part of the pavement removal paid as “Remove Pavement.” If doweled curb, full depth curb, curb and gutter, or monolithic curb removal is isolated from full depth pavement removal, then removal of doweled curb, full depth curb, and monolithic curb is considered curb removal, and removal of curb and gutter is considered curb and gutter removal. Monolithic curb is considered the first 6 inches of cement concrete along the curb-line monolithically poured with the existing sidewalk.

Sawcut the curb perpendicular to the curb line at the neat line limits of removal, or remove to the nearest joint as shown on the Drawings or directed by the Engineer. Sawcutting at the limits of removal is paid as “Sawcut Cement Concrete Sidewalk, Full Depth” for doweled curb paid as remove curb, as “Sawcut Rigid Pavement, Full Depth” for all other cement concrete curb removal, including doweled curb paid as remove rigid pavement, and as “Sawcut Asphalt Concrete, Full Depth” for all asphalt concrete curb. Sawcutting between limits of curb removal, and all other sawcutting associated with removal of curb, is considered incidental to the removal Bid Item. See Section 2-02.3(7)E for additional requirements when salvage is applicable.

2-02.3(3)F REMOVE SIDEWALK

Sidewalk removal, both asphalt and concrete, is shown on the Drawings. Sawcut must comply with the requirements of Section 2-02.3(6) and must leave straight edges and vertical faces. The minimum width of sidewalk removal, measured longitudinally, is either 2 feet for asphalt sidewalk or to the nearest panel joint or limits shown on the Drawings for concrete sidewalk.

See Section 2-02.3(3)K for removal of parking pay stations.

2-02.3(3)G REMOVE ELECTRICAL AND TRAFFIC CONTROL DEVICES

The Contractor must show a schedule for removing the existing traffic control and electrical systems in the CPM schedule and in the weekly 3-week look-ahead. The Contractor must notify and coordinate with the Engineer at least 5 Working Days before proceeding with removal.

The Contractor must remove equipment from the span wire before the span wire is disconnected from the poles. Release tension from the span before cutting existing span wire.

The Contractor must provide the notification described in Section 1-07.28 item 17 for the removal of any part of a loop detector system, whether or not in conjunction with pavement, curb, or sidewalk removal.

2-02.3(3)H REMOVE GUARDRAIL

Removal of the various types of guardrail and anchors includes removal of the rail, cable elements, hardware, posts, concrete bases, and steel tubes. Fill all holes resulting from guardrail removal as specified in Section 2-10. Deliver any removed guardrail items the Engineer deems reusable either to the Charles Street Facility or to the Haller Lake Facility, whichever is nearest the Job Site of removal. The Contractor must dispose of any damaged and unusable items as specified in Section 1-07.3.

2-02.3(3)I REMOVE TREE

Trees greater than 6 inches in diameter at 1 foot above the ground and marked for removal are shown on the Drawings or identified in the approved TVSPP.

The Contractor must notify the Engineer at least 10 Business days in advance of tree removal, and must post Engineer-provided placards on trees before removal. The Contractor must comply with Section 1-07.28 whenever tree removal is near overhead wires.

In improved areas and/or areas to be paved, stump removal must be completed by grinding and removing the stump to a 2-1/2-foot depth below finished grade, unless otherwise specified in the Contract. In unimproved areas, removal of the tree does not include complete removal of the stump unless directed by the Engineer.

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Approval by the Engineer is required before removing any tree not identified in the Drawings.

2-02.3(3)J REMOVE PAVEMENT MARKING

Pavement paint and plastic stripes and markings, traffic buttons, and lane markers to be removed, as described in the Contract, must be obliterated until blemishes caused by the pavement marking removal conform to the coloration of the adjacent pavement. Grinding to remove painted markings is not allowed. Grinding to remove plastic markings is allowed to a depth just above the pavement surface; water blasting or shot blasting is required to remove the remaining markings. Traffic button and lane marker removal are considered incidental to pavement marking removal. The Contractor is responsible for repairing any material damage caused by pavement marking removal, as specified in Section 1-07.13. Sand or other material deposited on the pavement as a result of removing pavement markings must be removed as the work progresses, to avoid hazardous conditions. See Section 1-07.5 regarding pollution control requirements.

2-02.3(3)K REMOVE SIGN AND POST

Unless the Contract specifies otherwise, SDOT is responsible for removal of parking pay stations, D-22 signage (“Pay L”, “Pay R”, “Pay H”, and “Pay LR” signs and posts) and numbered base plates, and parking meters. KCM is responsible for removal of bus stop signs. See Section 1-07.28 for notification requirements.

Removal of the various types of signs, posts, and hardware must include patching the holes with a suitable material flush with the existing surface. Fill holes created by removal of posts in earth as specified in Section 2-10. Removal of posts and concrete foundations from sidewalk or other improvement must include the removal and replacement of surrounding improvements necessary to reasonably accommodate the removal. The Engineer may direct additional removal to a joint or score line. The replacement of improvements must be conducted per the Bid Items in the Bid Form. If Work is not specified in the Bid Form, replacement of improvements must be conducted per Specifications or in-kind to the satisfaction of the Engineer, and incidental. The Contractor must properly dispose of any damaged and unusable items. Salvage of useable Material must be conducted as specified in Section 2-02.3(7).

2-02.3(3)L REMOVAL OF EXISTING STREETLIGHT EQUIPMENT

Removal of streetlight equipment, wiring, or the disconnection of power from street light equipment requires a submittal to the Engineer. The submittal must include the scope of the Work and the schedule for the Work to be performed. The submittal must be submitted to the Engineer 10 Working Days before the planned activities as specified in Section 1-05.3.

2-02.3(4) ABANDON CATCH BASIN, VALVE CHAMBER, MAINTENANCE HOLE, OR INLET

As applicable to each structure designated on the Drawings to be abandoned, the Contractor must: remove the casting and debris; dewater; break down the structure to a depth of the cone sections or 4 feet below the surface, whichever is greater; plug the outlet pipe as specified in Section 2-02.3(5); and fill the remaining structure and void with Mineral Aggregate or concrete as defined in this Section.

The Contractor must not abandon any existing water service unless specified otherwise in the Contract. When abandonment of an existing water service is required, the Contractor must first make the notification as specified in Section 1-07.28 item 8.

Fill valve chambers, catch basins, and maintenance holes as specified in Section 2-10. Fill old Type 164 inlets with cement Class 3000 concrete, see Section 6-02. Deliver inlet grates to the Owner.

The upper portion of abandoned Structures must be replaced with Material matching the existing pavement structure unless specified otherwise in the Contract.

2-02.3(5) ABANDON AND FILL, AND PLUG PIPE

2-02.3(5)A ABANDON AND FILL PIPE

Fill pipes designated on the Drawings to be abandoned and filled with a pumpable, flowable cement slurry completely filling the pipe, see Section 9-05.15.

2-02.3(5)B PLUG PIPE

At each end of pipe designated on the Drawings as “abandon and fill” or “plug”, the pipe end must be completely plugged with Cement Concrete, Class 3000, see Section 6-02, for a minimum length of 12 inches with no voids.

2-02.3(6) SAWING AND LINE DRILLING

2-02.3(6)A REMOVAL

When sawcutting cement concrete pavement, cement concrete driveway, cement concrete sidewalk, or other cement concrete slabs, with or without asphalt overlay for removal, the sawcut must be full-depth of the concrete material or rigid pavement unless the Drawings indicate otherwise or the Engineer directs or allows otherwise. Rigid pavements may consist of mortared decorative or other type special pavement units, such as brick, cobblestone or paver block, as well as cement concrete pavement, see Section 2-02.3(3)C. Rigid pavements may also include an asphalt overlay.

Curb removal must be sawcut full height and width of curb.

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Use diamond blades for sawing concrete where a full-depth cut face adjoins new concrete. The Contractor may use carbide cutting wheels to saw concrete that will be overlaid or for full-depth cuts where the cut face does not join the new concrete. Limit penetration of wheel into the subbase to a maximum of 1/2 inch. Do not allow the wheel to cut into pavement that is remaining in place. Discontinue using a wheel saw if the Engineer determines the results are unsatisfactory.

Asphalt removal must be sawcut full depth, straight, and the surface must be generally vertical over its full depth.

When line drilling, space drilled holes 6 inches center to center maximum with minimum hole diameters of 1-1/2 inches. Holes must be perpendicular to the surface and must penetrate completely through the pavement.

Sawcutting is the required method for removals unless otherwise noted in the Contract, in the permit for work in the Right of Way, or if accepted in writing by the Engineer.

To thoroughly clean sawcut, the Contractor must use non-polluting methods using, or as effective as using, high pressure water (minimum 1400 psi.) to thoroughly flush the sawcut. See Section 1-07.5(2) Water Quality, “Sawcutting, Planing, and Grinding By-Products:” for sawcutting water quality requirement and considerations.

2-02.3(6)B PAVEMENT JOINTS

See Standard Plans and Section 5-05 when sawcutting concrete pavement for contraction joints.

2-02.3(7) SALVAGE

2-02.3(7)A GENERAL

Unless otherwise specified in the Contract, any material identified as salvageable by the Engineer to be removed from the project must be carefully salvaged in its existing condition as amended in the following paragraph. Delivery of salvageable material must be as specified in Sections 2-02.3(7)B through 2-02.3(7)E. Delivery of salvageable guardrail components must be as specified in Section 2-02.3(3)H. The Contactor must remove and dispose of any materials deemed not salvageable by the Engineer.

The Contractor must remove all excess concrete, debris and dirt from castings and other materials removed from the project which will not be re-used on the project, but which the Engineer deems suitable for salvage.

2-02.3(7)B WATER MAINS AND APPURTENANCES

The Contractor must excavate and completely remove hydrants, valves, and any appurtenance where new Water Main and appurtenances are to be installed. Items assigned for salvage are specified in the Contract with specific direction on who to contact, lead time advance notice, how to handle, and where to deliver. Removed Water Main and appurtenances must be disposed of by the Contractor as specified in Section 1-07.3. Backfilling must be as specified in Section 2-10.

2-02.3(7)C ILLUMINATION, SIGNALS, ELECTRICAL, AND SIGNS

Electrical and traffic control items to be salvaged must include the following:

1. High pressure sodium, Induction and LED luminaires, lamps and photoelectric cells
2. Aluminum bracket arms
3. Aluminum lighting poles
4. Wood and metal lighting poles
5. Traffic poles, including joint lighting and traffic poles
6. Mast arms
7. Pedestals
8. Traffic signal cabinets
9. Signal heads
10. Illuminated signs
11. Handholes
12. Junction and terminal boxes
13. Traffic signs overhead
14. Traffic sign
15. Signal appurtenances identified in the Contract
16. Miscellaneous channelization items

The Contractor must deliver items 1 through 4 to City Light South Service Center at Fourth Avenue South and South Spokane Street. Call (206) 386 1707 before delivery of wood poles, metal poles, high pressure sodium, induction and LED luminaires, lamps, photoelectric cells, and aluminum bracket arms.

Return items 5 through 16 to SDOT Traffic Shops at 4200 Airport Way South. Call (206) 386-1206 a minimum of 2 Working Days before delivery.

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2-02.3(7)D REINSTALLING SALVAGED ELECTRICAL MATERIAL

See Section 8-30.3(4).

2-02.3(7)E GUTTER BRICK, PAVEMENT BRICK AND COBBLESTONE, AND GRANITE CURB

When the Bid Item description includes "with salvage," the Contractor must exercise reasonable care in the removal and salvage of existing gutter brick, pavement brick, cobblestone, and granite curb encountered during removal operations. The method of removal must not damage the brick, cobblestone, or granite curb. When necessary, the Contractor must hand excavate to ensure these materials are not damaged. The Contractor must coordinate the loading operations with the SDOT Pavement Supervisor, see Section 1-07.28. The Contractor is responsible for loading, hauling, and unloading of the salvaged material.

2-02.3(8) STEEL PLATES

2-02.3(8)A GENERAL

When excavations or other openings in the Right of Way cannot be completely backfilled at the end of the Day or as may be required, and traffic must be accommodated over the opening, street saddles or steel plates that meet the following requirements must be used to temporarily cover the excavation or opening.

2-02.3(8)B RESERVED

2-02.3(8)C STEEL PLATE REQUIREMENTS

In general, where a steel plate covers an excavation or opening, the Contractor must ensure the steel plate withstands the traffic loading, remains in place over the opening, does not rock, does not generate noise, and is fully supported for the length of time the plate is in-place.

Steel plates must be capable of withstanding, at minimum, HS-20 loading.

All bearing ends of steel plates must overlap existing remaining pavement at least 12 inches. Flanges or angle irons must be welded to the plate underside conforming to the size of the street opening to ensure the plate does not move relative to the opening. The edges of all plates must be highlighted with 12-inch minimum width Safety Orange (Federal Standard 595 Color 595 FS 12246 or approved equal) paint.

All steel plates must be bedded on temporary pavement patch Material or other suitable Material that extends beyond the plate's edge to form a tapered transition (shim). The taper must provide a smooth, gradual transition between pavement and the plate at least 12 inches in length to accommodate wheelchair, bicycle, and other traffic. The tapered transition shim must be highlighted with paint stripes consisting of the color Safety Orange approximately 2 inches wide on 16-inch centers.

Where spans are excessively long or where multiple steel plates are required to cover a long span, adequate additional support beneath the plates must be provided, such as braced steel beams. The space between the steel beam and the plate must be covered with a material, such as an old carpet, to prevent rattling and noise.

When directed by the Engineer, the Contractor must use steel pins welded at the corners of the plate. When pins are used, holes must be drilled through an opening in the plate full depth into underlying pavement structure. The pins must be long enough to be driven full depth of pavement and be of cross-section to be snug in the holes. The pin head must be of sufficient area and mass to allow for welding the pin to the plate with sufficient strength of weld ensuring the pin does not pop up, come loose, or separate from the plate at any time.

Steel plates must have a permanent non-skid surface in both dry and wet conditions, and must supply even coverage across the plate.

2-02.4 MEASUREMENT

When specified for payment in the Contract, measurement for sawcutting is by the linear foot along the slope of the surface cut. When acceptable full depth precut is performed using an asphalt cutting wheel, and where payment for sawcutting is specified, it will be measured as sawcutting. Sawcutting not specified for payment in the Contract will not be measured. No measurement will be taken for line drilling.

Unless otherwise specified: sawcutting of cement concrete pavement (or rigid pavement) at the limits of removal will be measured as "Sawcut Rigid Pavement, Full Depth"; Sawcutting of cement concrete sidewalk at the limits of removal will be measured as "Sawcut Cement Concrete Sidewalk, Full Depth"; Sawcutting of asphalt concrete at the limits of removal will be measured as "Sawcut Asphalt Concrete, Full Depth"; sawcutting of curb at the limits of removal (end points of removal segments) will be measured as "Sawcut Cement Concrete Sidewalk, Full Depth" for doweled curb paid as curb removal, as "Sawcut Rigid Pavement, Full Depth" for all other cement concrete curb including doweled curb paid as rigid pavement removal, and as "Sawcut Asphalt Concrete, Full Depth" for all asphalt concrete curb.

Measurement for openings in pavement structure is based on the removal and replacement limits as shown on the Drawings, as determined by the Engineer, or, if not shown on the Drawing, as shown on Standard Plan 404a or 404b as modified by the extended limits of restoration required to comply with the "Right-of-Way Opening and Restoration Rule".

"Remove Asphalt Pavement" with an average thickness less than 6 inches is measured by the square yard except when the removal is required to install underground utilities. There will be no measurement for asphalt pavement removal to install underground utilities.

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Abandon pipe will not be measured.

"Abandon and Fill Pipe" is measured by linear feet of pipe abandoned and filled.

"Remove Paint Striping" and "Remove Plastic Striping" is measured by the actual linear foot. Unpainted skips in pavement marking removal, and removal of traffic buttons and lane marker incidental to pavement marking removal, will not be measured.

"Remove Paint Legend/Symbol" and "Remove Plastic Legend/Symbol" is measured per each.

Removal of cement concrete sidewalk is measured by the square yard except the monolithic curb (the 6 inches adjacent the roadway).

Unless the Drawings indicate otherwise, curb and gutter, dowelled curb and full depth curb, and monolithic curb removal adjacent to pavement removal paid as "Remove Pavement" is considered part of the pavement removal paid as "Remove Pavement" and will be included in the surface area measurement.

Doweled curb, full depth curb, and monolithic curb isolated from pavement removal paid as "Remove Pavement" is measured by the linear foot along the curb face as "Remove Curb".

Curb and Gutter isolated from pavement removal paid as "Remove Pavement" is measured by the linear foot along the curb face as "Remove Curb and Gutter".

"Abandon Existing Water Service" is measured per each service permanently retired and disconnected from the existing Water Main.

Removal of former street car foundation or abandoned railroad track foundation is measured per square yard using the Bid Item "Remove Pavement, Over Fourteen Inch Depth, Including Rails and Railroad Ties" or "Remove Pavement, Over Fourteen Inch Depth, Including Railroad Ties". No separate measurement will be made for the removal of rails and railroad ties.

Removal of rigid pavement over 14 inches is measured per square yard using the Bid Item "Remove Pavement, Over Fourteen Inch Depth". No separate measurement will be made for the removal of overlaying asphalt.

For all pavement removal including rigid pavement, overlaying asphalt is excluded from the measurement of the pavement depth and is incidental to the removal Bid Item. "Average thickness" is determined by the Engineer using 3 to 7 randomly selected locations per sub-lot or representative area.

2-02.5 PAYMENT

1. **"Remove (Item)"**, per square yard.
2. **"Remove (Item)"**, per linear foot.
3. **"Remove (Item)"**, per each.
4. **"Remove (Item)"**, per lump sum.

The Bid Item price for "Remove (Item)" includes all costs for the work required to completely remove and dispose of or salvage the item as applicable. The removal (item) will include "with salvage" when salvage of brick, cobblestone, granite curb or a combination of brick, cobblestone or granite curb is required. Salvage of other materials will not require the "with salvage" in the Bid Item description.

Payment for removal of items not listed in the Bid Form and not specified in this Section will be included in the Bid Item prices of the various Bid Items and no separate or additional payment will be made.

Removal of non-rigid pavement less than or equal to 6 inches in average thickness will be measured and paid as "Remove Asphalt Pavement", with the following exception: when excavating through non-rigid pavement less than or equal to 6 inches in average thickness to install underground facilities, the costs of removal of non-rigid pavement is considered incidental to and included in the Bid Item price of installing the new underground facility.

Payment for removal of rigid pavement, whether as a rigid base or as a surface course, averaging greater than 4 inches in thickness, or averaging greater than 6 inches in thickness when combined with the overlaying asphalt, will be paid as "Remove Pavement".

Removal of non-rigid pavement greater than 6 inches in average thickness will be measured and paid as "Remove Pavement".

Removal of non-rigid pavement without removal of any underlying rigid pavement base will be paid as "Remove Asphalt Overlay".

When rigid base is to be removed, the removal of the 12-inch asphalt overlay step-back as shown on Standard Plans 404a and 404b is considered included in the removal Bid Item. Payment for removal of rigid base includes the removal of the overlaying asphalt in the removal Bid Item.

Payment for removal of rigid pavement, whether as a rigid base or as a surface course, averaging 4 inches or less will be paid as "Remove Cement Concrete Sidewalk", unless the average thickness of the rigid pavement base combined with the overlaying asphalt is greater than 6 inches in average thickness.

Payment for removal of untreated roadway surfaces will be paid as "Common Excavation".

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Removal, including stump grinding of trees 6 inches or greater in diameter as measured 1 foot above the ground surface will be paid as "Remove Tree". Removal of trees less than 6 inches in diameter as measured 1 foot above the ground surface will be paid as specified in Section 2-01.

Payment for all minor utility devices such as meter boxes, handholes, inlets, sandboxes and pipe marked for removal in the Contract and which are within the excavation area between pipe trench neat lines or within the neat line area of a structural excavation shown on the Drawings, is considered incidental to and included in the Bid Item price for installation of pipe or for structural excavation. Removal of catch basin and maintenance hole will be paid for at the Bid Item price bid for their removal.

Costs for sidewalk thickened edge removal are considered incidental to and included in the cement concrete sidewalk removal Bid Item price.

Payment for removal of sign posts includes all costs for the removal of the post, sign(s), mounting hardware and restoration of the surface where sign posts were removed. No separate payment will be made for removal and salvage of signs from a removed post that is paid as "Remove Post, (Description)".

The Bid item price for "Remove Paint Striping", "Remove Plastic Striping", "Remove Paint Legend/Symbol" and "Remove Plastic Legend/Symbol" includes all costs for the work required to remove and dispose of pavement marking including traffic buttons and lane markers. Pavement materially damaged by Contractor removal methods requiring restoration of the damaged pavement will be at the sole expense of the Contractor and no separate or additional payment will be made. No payment will be made for removal of pavement marking when the underlying pavement is removed.

The Bid Item prices for "Remove Luminaire" and "Remove Luminaire and Bracket Arm" includes all costs for the work required to remove the existing luminaire, or luminaire and bracket arm and its ballast, wiring and appurtenances.

The Bid Item price for "Remove Pole, Metal" includes all costs for the work required to remove and salvage the pole.

The Bid Item price for "Remove Pole, Wood" includes all costs for the work required to remove and salvage the pole, and to backfill and compact the void left after pole removal.

The Bid Item price for "Remove Pole, Concrete or Fiberglass" includes all costs for the work required to remove the pole, and, if direct buried, to backfill and compact the void left after pole removal.

The Bid Item price for "Remove Foundation, (Type)" includes all costs for the work required to remove and dispose of the foundation, and to backfill and compact the void left after removing the foundation.

Required sawcutting on the perimeter of full depth non-rigid pavement openings is paid as "Sawcut Asphalt Concrete, Full Depth." All other sawcutting associated with removal of non-rigid pavement is considered incidental to the removal Bid Item. Pavement openings will be shown on the Drawings or determined by the Engineer. Adjacent openings are considered 1 opening regardless of the method of Work.

Required sawcutting on the perimeter of an asphalt overlay removal area will be paid as "Sawcut Asphalt Concrete, Full Depth." All other sawcutting associated with removal of asphalt overlay is considered incidental to the removal Bid Item. Areas of asphalt overlay removal must be as shown on the Drawings or determined by the Engineer. Contiguous asphalt overlay removal areas are considered a single area regardless of the method of Work.

Required sawcutting on the perimeter of sidewalk removal is paid as "Sawcut Asphalt Concrete, Full Depth" or "Sawcut Cement Concrete, Full Depth." All other sawcutting associated with removal of sidewalk is considered incidental to the removal Bid Item. Sidewalk removal areas are shown on the Drawings or directed by the Engineer. Adjacent sidewalk removal areas are considered 1 area regardless of the method of Work.

5. **"Sawcut Rigid Pavement, Full Depth"**, per linear foot.

6. **"Sawcut Cement Concrete Sidewalk, Full Depth"**, per linear foot.

7. **"Sawcut Asphalt Concrete, Full Depth"**, per linear foot.

The Bid Item price for sawcutting includes all costs for the work required to sawcut cement concrete or asphalt concrete. No payment will be made for sawcutting concrete or asphalt done at the option of the Contractor when indicated or specified as incidental in the Contract, or when specified as being included in the payment of other Bid Items. Sawcutting will only be paid at the limits of removal specified for payment in the Contract.

Sawcutting for neat edge removal of the 12-inch asphalt overlay step-back as shown on Standard Plans 404a and 404b, will be paid per the Bid Item "Sawcut Asphalt Concrete, Full Depth".

No separate payment will be made for sawcutting through asphalt overlay when the underlying rigid pavement is being removed.

8. **"Abandon (Item)"**, per each.

The Bid Item price for "Abandon (Item)" includes all costs for the work required to abandon the specified item.

9. **"Abandon and Fill Pipe"**, per linear foot.

The Bid Item price for "Abandon and Fill Pipe", includes all costs for the work required to plug the pipe where shown on the Drawings and furnish and fill the pipe with cement slurry.

No payment will be made to abandon pipe or other subsurface items identified on the Drawings and for which no work is required. Plugging the exposed or open ends of pipes to be abandoned is considered incidental to and included in the Bid Item price for the installation of new pipe.

10. **"Remove Signalization (Location)"**, per lump sum.

The Bid Item price for "Remove Signalization (Location)" includes all costs for the work required to complete the removal, disposal, and salvage work per the Contract including salvaging, stockpiling and delivering equipment as determined by the Engineer and disposal of removed items not salvaged.

11. **Other Payment Information**

Removal of former street car foundation or abandoned railroad track foundation will be paid for as "Remove Pavement, Over 14 Inch Depth, Including Rails and Railroad Ties" per square yard. No separate payment will be made for sawcutting, or removal of the overlaying asphalt. Depth excludes overlaying asphalt, see Section 2-02.3(3)C. If railroad ties are found to be Contaminated Material, ties must be disposed of as specified in Section 1-07.29(3), the disposal costs will be paid for separately as specified in Section 1-04.3.

Removal of rigid pavement over 14 inches in depth will be paid for as "Remove Pavement, Over 14 Inch Depth" per square yard. No separate payment will be made for the removal of overlaying asphalt. Depth excludes overlaying asphalt, see Section 2-02.3(3)C.

No payment will be made for the removal of the 12-inch asphalt overlay step-back as shown on Standard Plans 404a and 404b associated with pavement patching.

When existing Type 164 or smaller inlet is to be removed with the removal of concrete pavement, the removal of the inlet is considered incidental to the cost of "Remove Pavement". Type 164 inlets have grates that are less than or equal to 10 inch wide by 24 inch long.

Unless the Drawings indicate otherwise, full depth removal of traffic islands is considered included in the Bid Item prices for "Remove Pavement", "Common Excavation", or "Remove Concrete Sidewalk" applicable to the underlying pavement structure combined with the traffic island being removed.

Traffic islands consisting of monolithic curb and sidewalk will be paid as "Remove Cement Concrete Sidewalk", except the 6 inches adjacent the curb-line will be paid as "Remove Curb" or "Remove Pavement" in accordance to this Section.

Traffic islands curb over pavement removal is considered "Remove Curb", or "Remove Curb and Gutter" when curb removal is not adjacent to or overlying pavement removal paid as "Remove Pavement".

All costs for coordination and delivery of salvageable material must be included in the various Bid Item prices.

All costs for disposal must be included in the various Bid Item prices for the Work.

SECTION 2-03 STRUCTURAL DEMOLITION

2-03.1 DESCRIPTION

This Section describes demolition of an existing Structure as shown on the Drawings. The Contractor is responsible for determining the actual demolition quantities and limits of work. All removal operations included in this Section within the dripline of existing trees to be protected must be conducted as specified in Section 1-07.16(2).

2-03.2 RESERVED

2-03.3 CONSTRUCTION REQUIREMENTS

Demolition must be done safely and must avoid damaging any portions of the Structure that are to remain. federal, local and state codes, including WAC 296-155 "Safety Standards for Construction Work" Part S "Demolition", must be observed at all times. Explosives must not be used. The Contractor must review all Drawings of the existing Structure noted in the Contract.

Drawings for the existing Structure may be available at the Seattle Public Utilities Records Vault: Seattle Municipal Tower, 700 Fifth Avenue, 47th Floor, or PO Box 34018, Seattle, Washington 98124-4018. Phone: (206) 684-5132.

For the purposes of this Section a "competent person" means one who is capable of identifying existing and predictable hazards in the surroundings and working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective action to eliminate those hazards.

Before starting demolition, the Contractor's competent person must perform an engineering survey of the Structure to determine structural integrity and the possibility of unplanned collapse of any portion of the Structure. Any adjacent Structure that may be affected by the demolition must be similarly checked. The Contractor must have written evidence that this survey has been performed.

Hazardous materials must be removed or safely contained before starting demolition. These materials include, but are not limited to, asbestos, lead or other heavy metals, and flammable or explosive materials.

Any material to be removed that will cause dust formation must be sprinkled with water to control dust.

Demolition must not proceed until electric, gas, water, steam and other utilities are located, relocated, shut-off, capped or otherwise controlled.

The Contractor must demonstrate to the satisfaction of the Engineer that the methods and equipment for demolition are safe, adequate for the intended purpose, and will provide satisfactory results. The Contractor must submit a demolition plan with Shop Drawings to the Engineer for approval. This plan must show:

1. Each stage in the demolition required by the Contract.

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2. Methods and equipment used in each stage of the demolition.
3. The area of influence for each stage of the demolition. The area of influence is that area of the Project Site where safety precautions must be taken to prevent injures due to the demolition activities.
4. Methods and equipment used to contain any hazardous materials that are in the area of influence during demolition.
5. Methods and equipment used to contain, collect, and dispose of debris.
6. Adjoining Structures that could be compromised by demolition activities. The Contractor must also provide a support system plan, prepared by a registered Professional Engineer, and submitted to the Engineer for review and approval as specified in Section 1-05.3.
7. Protocol for communications between all personnel working within the area of influence of the demolition.

A copy of the competent person's engineering survey of the demolition and the demolition plan must be maintained on the Project Site.

The Contractor must not start demolition without the Engineer's written approval of the demolition plan and support system plan. A meeting to review these plans must be held before starting demolition. Workers performing the demolition, others working within the sphere of influence of the demolition, the Contractor's competent person, and the Engineer must all attend the plan review meeting.

During demolition, the Contractor's competent person must make continuing inspections, at least daily, to ensure the demolition plan is being followed, and to assess all hazards resulting from demolition activities. If hazards are found, demolition must stop until the hazards are corrected.

If hazardous materials not previously identified are found during demolition, demolition must stop until the newly identified hazards are safely contained or removed and are addressed in a revised demolition plan, reviewed by the Engineer and returned with no exceptions taken.

2-03.4 MEASUREMENT

"Demolition (Structure Name)" is measured by lump sum.

2-03.5 PAYMENT

The Bid Item price for "Demolition (Structure Name)" will be full payment for all labor, material, and equipment required to complete the removal, hauling, disposal, and salvage work as specified and as shown on the Drawings.

All costs associated with the preparation and implementation of the demolition plan and the support system plan must be included in the Bid Item price of "Demolition (Structure Name)".

No adjustments except for approved changes will be made in Bid Item price for "Demolition (Structure Name)", even though items not listed above may be shown on the Drawings or specified elsewhere in these Specifications, or encountered in field.

SECTION 2-04 EXCAVATIONS

2-04.1 DESCRIPTION

2-04.1(1) GENERAL

Section 2-04 describes excavation, removal, and disposal of all formations, debris, and materials, natural or man-made, irrespective of nature or condition, encountered within the neat line limits defined in Section 2-04.4 and that is necessary for the construction of roadways, Structures and utilities. This work also includes stockpiling suitable material and disposing of excess or unsuitable material.

This work must be done in reasonable close conformity with the lines, grades, and dimensions shown on the Standard Plans, Drawings, or as established by the Engineer.

2-04.1(2) CLASSIFICATION

Excavations are classified as solid rock excavation, unsuitable foundation excavation, or common excavation.

Solid rock excavation consists of the removal and disposal of solid rock, such as ledge rock that requires systematic drilling and blasting for its removal and boulders exceeding 1/2 cubic yard in volume as determined by the Engineer. Hard pan, hard clay, or glacial till are not classified as solid rock excavation. Sandstone, siltstone, shale, or other sedimentary rocks which are soft, weathered, or extensively fissured are not classified as solid rock excavation. Soft rock is defined as an earth material that has a modulus of elasticity of less than 200,000 psi.

Unsuitable foundation excavation consists of the removal and disposal of unstable material, including but not limited to peat, muck, and swampy or other unsuitable materials such as buried logs and stumps, but only when removal is specified in the Contract and included in the Bid Form, or is specifically directed in writing by the Engineer.

Common excavation consists of all other material not classified as solid rock excavation, unsuitable foundation material excavation, or excavation which is considered to be incidental to other Bid Items identified in other parts of the Contract. Where widening of roadway cuts and ditches and excavation of 3 feet or less below the designated subgrade elevation are directed by the Engineer, they will be considered common excavation.

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2-04.1(3) PROTECTION OF EXISTING IMPROVEMENTS

During excavation, the Contractor must protect existing improvements, including but not limited to sidewalk, pavement, appurtenant Structure, adjacent improvement, and underground installations as specified in Section 1-07.16. For excavations more than 4 feet in depth, the Contractor must construct and maintain protective systems as specified in Section 2-07.

The Contractor must prevent stockpiled materials, debris from the Work area, and materials from roadway excavation from entering existing drainage Structures and water courses, as required in Sections 1-07.5, 1-07.15, and Section 8-01. These materials must be removed, recycled, or disposed of as required in Sections 1-07.3 and 1-04.10.

All material must be stockpiled to minimize inconvenience to public travel, and provisions made for merging traffic where necessary. Clear access to all fire hydrants, water valves, and meters is required.

2-04.2 RESERVED

2-04.3 CONSTRUCTION REQUIREMENTS

2-04.3(1) GENERAL REQUIREMENTS

All excavations must be performed in compliance with Chapter 296-155 WAC as well as all other applicable local, state, and federal laws and regulations.

The excavation size in the Right of Way within paved roadway, sidewalk, or other improved area and where near to a structure or underground installation or other improvement, must not exceed the maximum neat line width as shown on the Drawings or in the Standard Plans.

Outside the Right of Way and in unimproved areas, the size of the excavation may exceed the excavation size shown on the Drawings or on the Standard Plans by sloping or benching, at the Contractor's option. However, the Contractor is solely responsible for meeting all requirements for excavating, handling and disposing of excavated material, and placing and compacting suitable replacement backfill that is conducted outside of the neat line limits. The cost for the excavation Work in excess of that shown on the Drawings must be at the Contractor's sole expense.

Control grading and other activities nearby to prevent surface water from flowing into the excavations.

The Contractor must notify the Engineer when an excavation is completed, and Material must not be placed until permission to proceed is provided by the Engineer. The Contractor must bear all costs to remove materials placed before the Engineer's inspection of the subgrade, and all costs to replace backfill following the inspection.

2-04.3(1)A STOCKPILING AND REUSE OF EXCAVATED MATERIAL

If necessary, Material can be stockpiled at locations approved by the Engineer. Thereafter, Material must be removed from stockpile and used when needed. Excavated Material stockpiled for use as selected Materials must be protected from contamination by other materials or damage by weather, and must be prevented from producing sediment by covering with waterproof sheeting or other means as the Contractor deems necessary. Selected materials stockpiled and later found unsuitable by the Engineer must be disposed of and replaced with Material acceptable to the Engineer.

Selected Material must be stockpiled at no more than a 1 foot per linear foot slope, with the toe of the stockpile no closer than 2 feet from the edge of any excavation. The material must be protected from becoming unsuitable. Within Seattle City limits, stockpile height must not exceed 10 feet, per current City of Seattle Grading Code.

2-04.3(1)B DISPOSAL OF SURPLUS AND UNSUITABLE MATERIAL

Recycling or disposing of surplus and unsuitable material from other than the excavation must be conducted as specified in Section 1-07.3.

Material obtained from all excavations within the Project Site must not be wasted unless the Engineer designates the excavated material unsuitable for use.

Reclamation of Contractor-supplied quarry, pit, and borrow sites must conform to the requirements of Section 3-03.

2-04.3(1)C WASTING MATERIAL

If the Contractor wastes excavated material which is deemed suitable by the Engineer for reuse, and Material is later needed, the Contractor must replace the wasted material, at no cost to the Owner, with Material meeting the Engineer's approval.

2-04.3(1)D DEPOSIT OF ROCK FOR OWNER'S USE

At the Engineer's direction, the Contractor must deposit excavated rock at the Project Site or elsewhere. If this requires the Contractor to use Material that would otherwise have been used as backfill on the project, the Owner will pay for the extra cubic yards of excavation needed to complete the backfill. Any such rock deposit will become Owner property. The Contractor is responsible for safe-keeping the deposit until the Owner has removed it or until the Contract Completion Date.

2-04.3(1)E OVERBREAK

Overbreak includes that part of any material excavated, displaced, or loosened outside the staked or reestablished slope or grade. Such material is considered overbreak whether its movement resulted from blasting, from the character of the material itself, or from any other cause. Overbreak does not include material from slides as specified in Section 2-04.3(1)F.

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If the Engineer does not approve use of the overbreak, the Contractor must remove, haul, and dispose of it, at no expense to the Owner. In this case, the Contractor must comply with the procedure for handling surplus Material specified in Section 2-04.3(1)B.

If the Engineer approves, the Contractor may use overbreak as backfill.

2-04.3(1)F SLIDES

If a slide occurs on the Project Site or elsewhere as a result of construction activities, the Contractor must notify the Engineer immediately before removing the slide material, and must protect the area to prevent additional sliding.

In the event of a slide, the Contractor must provide a plan to address the area affected, for the Engineer's review.

2-04.3(1)G EXCAVATIONS NEXT TO STREAMS

When excavations are in or adjacent to streams including lakes, Puget Sound, or other waterways, the Contractor must:

1. Comply with all applicable laws and regulations and regulatory permit requirements.
2. Comply with the requirements of Section 2-05.
3. Excavate inside cofferdams, caissons, or sheet piling unless dredging or open pit excavation is permitted.
4. Not disturb the natural stream bed adjacent to the Structure.
5. Backfill after foundations are placed inside cofferdams and any open pit or dredged area behind sheet piling. Backfill must be level with the original stream bed and must prevent scouring.
6. Remove any excavation material deposited in or near the stream, so that the stream bed is free from obstruction.
7. Maintain water depth and horizontal clearances required for traffic to pass on navigable streams, furnishing any channel signals or lights required during construction.
8. Place riprap around the outside of cofferdams to repair local scour.

2-04.3(1)H SLUICING

The Contractor must not excavate by sluicing unless the Contract specifies it.

2-04.3(1)I UNSUITABLE FOUNDATION EXCAVATIONS

Where the native subgrade is determined to be unsuitable by the Engineer, and is not already addressed in the Contract, the Engineer will provide direction on how to proceed.

All additional excavation directed or specified in the Contract beyond the neat line limits shown on Standard Plans 284, 285, and 350, is considered "Extra Excavation."

Replacement of unsuitable material to return the area to grade will be specified in the Contract or directed by the Engineer, and is considered "Backfill Compaction" as specified in Section 2-11.

Material from the excavations is not classified as Unsuitable Foundation Excavation, as defined by Section 2-04.1(2), unless the removal is accomplished by special excavation methods requiring different equipment from that used for roadway excavation, as determined by the Engineer.

2-04.3(1)J OBJECTS ENCOUNTERED

The Contactor must remove and dispose of stumps, railroad ties, buried pavement, and other objects encountered in the excavation. Removal of these objects is considered incidental unless one or more of the following conditions are met:

1. The objects cannot be removed by the equipment or excavation method at hand; or
2. The excavation width or depth must be increased, causing extra work.

In the event the Contractor meets one or more of these conditions, removal of the object will be paid as specified in Section 1-04.6.

2-04.3(2) PERMANENT SLOPE TREATMENT

The tops of all permanent excavated slopes, except in solid rock, must be rounded per Standard Plan 140.

If a layer of earth covers a rock cut, the slope must be rounded above the rock as if it were an earth slope.

When the Contractor removes stumps or any embedded Material from the rounded area, the void must be backfilled and stabilized to prevent erosion.

2-04.3(3) HILLSIDE TERRACES

Unless the Contract specifies otherwise, the Contractor must terrace the original ground or embankment on hillsides, on the sides of existing embankments, and in transitions from cuts to fills. Each terrace must penetrate the slope at least 5 feet and must not be more than 5 feet high. The horizontal face of the terrace must slope outward at approximately 0.05 feet per linear foot. The Engineer may direct the Contractor to place gravel backfill, pipe drains, or both to drain any seepage.

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2-04.3(4) SOLID ROCK EXCAVATION

The Contractor must avoid breaking down, loosening, or damaging the rock under the subgrade line. If necessary, conduct excavations from the top, lift by lift, to protect the rock bench that remains. The Contractor is responsible for methods used and for any damage caused to the subgrade, regardless of any previous approvals by the Engineer.

2-04.3(4)A SCALING AND DRESSING

The Contractor must leave rock cuts in a safe, stable condition, by scaling and dressing them and removing all loose fragments and rocks not firmly fastened to the rock slope. The Contractor must also remove any overhanging rock the Engineer designates as hazardous.

If the Engineer requires it, the Contractor must remove loose fragments and rocks lying outside the slope stakes, including loading and hauling. See Section 1-04.3 regarding extra work.

2-04.3(4)B STEPPED SLOPE CONSTRUCTION

When shown on the Drawings, the Contractor must shape slopes cut in soft rock to a stepped pattern conforming closely to the typical cross-section shown on the Drawings. Each step must be 1 to 2 feet high. The treads must be approximately level in all directions. The ends of the steps must be blended into the natural ground, with loose Material removed from transitional areas. The steps must be blended into the rock if the Contractor cannot rip a rock outcropping within a cut. Large rocks and Material that may fall into the ditch line or onto the roadway must be removed, but scaling is not required.

The horizontal depth of each step depends on its relationship to the staked slope ratio. The approximate midpoint of each horizontal tread must occur on the staked slope line.

The compaction for seeding requirements in Section 8-01.3(5)C do not apply to stepped slope construction.

2-04.3(5) STRUCTURE EXCAVATIONS

The Contractor must not start excavating until after the stakes have been placed to locate or outline the structure and cross-sections, to determine how much Material to remove. The Engineer will occasionally inspect material taken from, and material remaining in, the excavation.

With written approval of the Engineer, the Contractor may omit forms when the earthen sides of a footing excavation can stand vertically. In this case, the Contractor may excavate to the neat line dimensions of the footing and pour concrete against the undisturbed earth. If the hole is larger than neat line dimensions, the Contractor is responsible for the cost of all extra Material and work.

The Engineer may stop the excavation to conduct bearing tests at any time. The Contractor must assist with these tests in any way the Engineer requires.

During any test period, the Contractor must, at no expense to the Owner, maintain ordinary working conditions at the bottom of the hole. A single bearing test will not exceed 72 hours.

2-04.3(6) UTILITY EXCAVATIONS

When utility invert or other elevations are shown on the Drawings, the Contractor must excavate to that depth plus any additional excavation necessary to accommodate the Contract-specified class of bedding. When no invert or other elevation is specified in the Contract, the Contractor must excavate to a depth sufficient to provide the minimum cover specified, including additional excavation as necessary for the class of bedding specified in the Contract. When utility elevations are specified in the Contract, any excavation below that needed to install the utility and bedding must be backfilled with Material as specified in Section 2-10, and compacted as specified in Section 2-11.3(1) Method A, at the Contractor's sole expense.

Minimize the length of trench excavation in advance of Water Main installation operations. Trench length must not exceed 150 feet in urban areas.

Minimize the length of Storm Drain and Sewer trench excavation in advance of pipe installation. Trench length must not exceed 150 feet.

The maximum trench width in the Right of Way must not exceed the neat line trench width, as shown on Standard Plans 284, 285, and 350.

The Contractor must provide over excavation for bells, such that pipe barrels and bells along the utility are uniformly supported full-length.

Excavation for valve chambers and other Water Main Structures must be sufficient to provide a minimum of 12 inches between their exterior surfaces and the sides of the excavation.

Remove all ledge rock, boulders, stones, and any object larger than 3 inches in any dimension, within 6 inches in any direction from the pipe.

The maximum size of aggregate within 6 inches of the pipe must not exceed 1 inch per linear foot of pipe diameter and in no case exceed 3 inch.

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2-04.3(7) SUBSURFACE DRAIN EXCAVATION

The clear width of the trench must be 24 inches or 1 foot greater than the outside diameter of the pipe, whichever is greater. Width is measured at the springline of the pipe in place. Standard Plan 284 is not applicable to drain pipe and subsurface drain pipe.

Filter Material must not be mixed with backfill Material.

2-04.3(8) SNOW REMOVAL

The Contractor must remove any snow deep enough to interfere with work that covers a cut or an embankment, to outside the slope stakes. Snow removal must be done at least 100 feet ahead of excavation and embankment work.

2-04.3(9) EXPLORATORY EXCAVATION AND UTILITY VERIFICATION

2-04.3(9)A DESCRIPTION

Section 2-04.3(9) describes the Work required to expose existing utilities or other underground obstructions to verify location prior to construction of improvements at the Project Site. Exposure of existing utilities may be required as shown on the Drawings, as specified in the requirements for the Utility Verification Plan, or where otherwise necessary to protect existing utilities as specified in Section 1-07.17(1). Where utility conflicts are identified during utility verification, any resulting changes to the Work will be addressed as Specified in Section 1-04.6.

2-04.3(9)B UTILITY VERIFICATION SCHEDULE AND COMPLETION

The Contractor must show all utility verification Work, including the Utility Verification Plan submittal and review timelines, on the CPM schedule, see Section 1-08.3.

The Contractor must submit a Utility Verification Plan, as specified in Section 2-04.3(9)C, to the Engineer for acceptance before beginning utility verification Work at the Project Site. The Contractor must allow 10 Working Days for the Engineer's review of the submittal, as specified in Section 1-05.3(3).

The Contractor must complete utility verifications, as specified in this Section and as shown on the Contractor's approved Utility Verification Plan, a minimum of 10 Working Days before beginning other construction work at the Project Site.

2-04.3(9)C UTILITY VERIFICATION PLAN

The Contractor must prepare and submit a Utility Verification Plan based on the Drawings and existing potholing data. The Utility Verification Plan must show all proposed locations for the excavations required to verify the targeted utilities, and must include:

1. Utilities and locations requiring verification, as shown on the Drawings.
2. Additional utilities and locations chosen by the Contractor for verification.

Each proposed excavation location must identify the targeted utility type and depth, as shown on the Drawings. The total number of proposed excavations shown on the Utility Verification Plan must be equal to the number of "Utility Verification Excavation" Bid Items in the Bid Form. The Utility verification plan must be approved by the Engineer prior to starting utility verification Work at the Project Site.

2-04.3(9)D EXPOSURE OF EXISTING UTILITIES

The Contractor must excavate to expose existing utilities at the locations shown on the approved Utility Verification Plan. Each excavation must be to the minimum exposure limits and large enough to record the location information required for the targeted utility type, as specified in the table below:

Utility Type	Minimum Exposure Limits	Record Information
Circular pipe and conduit	2 inches below spring line of pipe, expose top and both sides of pipe	Crown depth (relative to existing finished grade), measured pipe diameter, and location (station and offset to center)
Encased duct bank	2 inches below bottom edges of duct bank, expose top and both sides to full depth	Top depth and bottom (relative to existing finished grade), width, right and left edge thickness, and location (station and offset to center)
Irregular shaped conduit & utilities	2 inches below bottom of pipe/conduit, full exposure of pipe/conduit	Crown and invert depth (relative to existing finished grade), measured width, and location (station and offset to center)

Where an excavation to the depth of the targeted existing utility, as shown on the Drawings, does not expose the utility, the Contractor must expand the excavation to expose the utility as specified in this Section, or to the following maximum limits:

1. To the maximum depth specified in the Bid Item description for the targeted utility.

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2. To a maximum width of the utility width shown on the Drawings plus 4 feet.

If excavation to the maximum depth and width specified above fails to expose the targeted utility, stop excavation and notify the Engineer. The Contractor must propose a different excavation location to verify the targeted utility's location. Excavations that do not expose the targeted utility will be addressed as specified in Section 1-04.6.

The Contractor must record the location information specified in this Section in a utility verification log. All location measurements, including stationing, offsets, depths, and widths, must be recorded to the nearest 0.1 foot unless greater accuracy is specified. The Contractor must submit the utility verification log to the Engineer within 1 Working Day of completion of each utility verification location.

The Contractor must submit to the Engineer an as-built record set showing all utility verification locations, including the record information specified in this Section for each targeted utility. See Section 1-05.3(13).

2-04.3(9)E PAVEMENT PATCHING AND FINAL RESTORATION

After completing the utility verification, including excavation and recording of location information, the Contractor must backfill and compact with suitable native material or Type 17 as necessary to meet the requirements of Section 2-10 and Section 2-11. Unsuitable native materials must be disposed of as specified in Section 2-04.3 and 1-07.3. Where compaction is not practical, CDF or other approved materials may be required.

Roadway or pedestrian surfaces must be temporarily patched with cold mix asphalt or lean concrete to a depth of 4 inches and must be flush with the surface of the pavement.

Final pavement restoration must be as shown on the Drawings.

2-04.4 MEASUREMENT

Excavation is measured by the cubic yard in its original position by cross-sectioning or through the use of digital terrain-modeling techniques. Quantities will be computed to the neat lines of the cross-sections as staked or thereafter modified by the Engineer, except where such modification is the result of excavating beyond the limits established to remove and replace Material which has become unsuitable because of the Contractor's neglect, negligence, or method of operation.

The vertical neat line limits for measuring a structure excavation will be a vertical plane 1 foot (measured horizontally) outside of and parallel to the neat line of a pile cap, footing, or seal. No measurement as "Structure Excavation" will be made for material removed outside of vertical neat lines of a pile cap, footing, or seal, more than 3 feet beyond the roadway side of a wing wall, and more than 1 foot beyond the other sides and end of a wing wall.

Measurement for unsuitable foundation excavation is measured by the cubic yard in its original position by cross-sectioning.

Measurement for the amount of common excavation is specified in Section 2-04.1(2).

Measurement for extra excavation is by the cubic yard of material actually removed beyond the standard trench neat lines shown on Standard Plans 284, 285, and 350.

Measurement for stepped slope excavation is by the cubic yard as defined by the staked slope line and the existing slope.

Measurement for utility verification excavation is per each.

2-04.5 PAYMENT

1. **"Common Excavation"**, per cubic yard.
2. **"Solid Rock Excavation"**, per cubic yard.

The Bid Item prices for "Common Excavation" and for "Solid Rock Excavation" include all costs for the work specified in Section 2-04 and not otherwise provided for below. Payment for such types and classes of excavation listed above will be full payment for excavating, loading, hauling, stockpiling, placing as backfill, or disposing of the material as specified here.

Payment for earthwork or for solid rock excavation required by the Contract where a Bid Item is not provided in the Bid Form will be as specified in Section 1-04.1(2).

3. **"Unsuitable Foundation Excavation"**, per cubic yard.

The Bid Item price for "Unsuitable Foundation Excavation" includes all costs for the work required to excavate or displace unsuitable foundation material as specified in Section 2-04.3(1)I. These costs include disposal of the unsuitable material, and leveling the upheaved Material outside the excavation when the unsuitable material is displaced. Replacement Materials will be paid for as a separate Bid Item.

See Section 1-04.1(2) if the Bid Form does not have a Bid Item for unsuitable foundation excavation.

4. **"Structure Excavation"**, per cubic yard

The Bid Item price for "Structure Excavation" includes all costs for the work required in Section 2-04.3(5) but not otherwise provided for in this payment Section and which is necessary to complete the excavation within the neat line limits specified. Any additional excavation outside these limits, having been made for the Contractor's benefit, is considered incidental to the various Bid Items comprising this improvement. All costs for preserving and protecting excavated Materials to be used for backfilling structure excavation and all costs for disposal (including haul) of material obtained from structure

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excavation which is not used for backfill are considered incidental to and included in the Bid Item price for “Structure Excavation”.

All costs for storing, protecting, handling, and placing stockpiled Material as specified in Section 2-04 must be included in the Bid Item price for "Structure Excavation".

5. **“Extra Excavation”**, per cubic yard.

The Bid Item price for “Extra Excavation” includes all costs for the work required to remove, haul and dispose of the excavated material.

6. **"Stepped Slope Construction"**, per cubic yard.

The Bid Item price for "Stepped Slope Construction" includes all costs for the work required to build stepped slopes including disposal of excess material.

7. **“Utility Verification Excavation, Full Depth, (TYPE)”,** per each.

8. **“Utility Verification Excavation, 5-Foot Depth, (TYPE)”,** per each.

9. **“Utility Verification Excavation, 10-Foot Depth, (TYPE)”,** per each.

10. **“Utility Verification Excavation, 20-Foot Depth, (TYPE)”,** per each.

The Bid Item price for “Utility Verification Excavation, (Depth), (Utility Type)” includes all costs for the work required to excavate to the limits specified in this Section as necessary to verify the location of the targeted utility, including saw cutting, pavement removal, excavation, location surveying, backfill and compaction, pavement patch, and removal, haul, and disposal of excavated materials.

Costs for the work required to prepare, submit, and update the Contractor’s Utility Verification Plan are considered incidental to the utility verification excavation Bid Items on the Bid Form, and no additional payment will be made.

Costs for the work required to perform undirected utility verifications to protect existing facilities from the Contractor’s means and methods of construction, as specified in Section 1-07.17(1), are considered incidental to the various Bid Items on the Bid Form, and no separate payment will be made.

11. **Other payment information**

All costs for excavation, backfill, and compaction of sampling pits and utility trenches are considered included in the Bid Item prices for the various Bid Items and no separate or additional payment will be made.

Payment for overbreak Material used instead of borrow will be made at the Bid Item price for the type of borrow specified.

If the Contractor has dressed a permanent excavation per Section 2-04.3(4)A before the Engineer orders it widened, the Owner will pay for the resloping as provided in Section 1-09.4.

Excavation below grade required to remove a portion of the subgrade made unsuitable by the Contractor’s operations or failure to adequately protect the subgrade is at the Contractor’s sole expense and at no additional cost to the Owner.

If a slide occurs in an open pit as specified in Section 2-04.3(1)F, all costs related to removing slide material and restoring a slide area is at the Contractor's sole expense.

All work required to complete slope treatment, including excavation, haul, and slope rounding, must be included in the Bid Item price for roadway excavation.

All costs for building terraces as specified in Section 2-04.3(3) must be included in the Bid Item prices for other applicable Bid Items.

All costs to remove, haul, and dispose of overbreak material which is deemed unsuitable for use by the Engineer is at the sole expense of the Contractor.

When excavated Material unexpectedly falls short of the quantity required to complete an embankment, the Owner will pay the roadway excavation Bid Item price for the volume of Material the overbreak replaces. However, no payment will be made if overbreak is used when other Material is available within the neat lines of the roadway prism.

If an undue quantity of excavated Material deemed suitable by the Engineer is wasted by the Contractor, the Contractor must provide replacement material of the type acceptable to the Engineer at the Contractor’s sole expense.

The cost of any permits and approvals required in this Section will be included in the Bid Item prices for the applicable Bid Items of Work and no separate or additional payment will be made.

All costs associated with hauling, storing, and reusing selected Material, except in backfill compaction, are included in the Bid Item prices of the various applicable Bid Items.

Payment for reconstruction of surfacing and paving within the limits of structure excavation will be at the applicable Bid Item prices for the Bid Items involved.

Whenever excavation is carried below the elevation shown on the Drawings without written approval from the Engineer, all costs for Materials, labor and equipment necessary to bring excavation back to the elevation shown on the Drawings is at the sole expense of the Contractor. Replacement must be made with concrete or other Material acceptable to the Engineer.

Snow removal is at the sole expense of the Contractor.

All labor and materials the Contractor provides for the bearing tests as specified in Section 2-04.3(5) will be paid as specified in Section 1-04.1(2).

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SECTION 2-05 DITCH AND CHANNEL CONSTRUCTION

2-05.1 DESCRIPTION

Section 2-05 describes constructing and reshaping ditches and channels. This work may also include installation of geotextile, filter blanket, riprap, streambed aggregate, weir, in-stream log, scour protection, and other construction. This work also includes disposal of excess and unsuitable material.

2-05.1(1) CLASSIFICATIONS

Ditch excavation includes all excavation for the flow of surface water less than 8 feet wide at the bottom.

Channel excavation includes all excavation for the flow of surface water 8 or more feet wide at the bottom.

2-05.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Material	Section
Streambed Aggregate	Section 9-03.3
Filter Material	Section 9-03.10(4)
Matting	Section 9-14.5
In-stream Log	Section 9-14.15
Geotextile	Section 9-37

Erosion control, scour control, and ditch lining geotextile are specified in the Contract.

The filter blanket must comply with the gradation requirements for the ballast specified in the Contract.

2-05.3 CONSTRUCTION REQUIREMENTS

2-05.3(1) GENERAL

Work in ditches and channels over 4 feet deep are subject to the safety provisions of Section 2-07.

The Contractor must have ESCBMPs in place before any ditch or channel construction, and must have completed necessary clearing and grubbing as specified in Section 2-01. The Contractor may use excavated material for temporary dikes and berms as addressed in the CSECP.

Ditch and channel excavation, shaping, and construction must produce a finished product complying with the lines, grades, and shapes as shown on the Drawings, or as established by the Engineer, and must accommodate in-stream installations as specified in the Contract.

2-05.3(2) IN-STREAM LOG

In-stream logs of the size and shape specified in the Contract must be placed at the locations shown on the Drawings, and may require additional excavation and shaping of the ditch or channel. An existing tree identified for re-use as in-stream log must be cut, pruned, and limbed to the size and shape indicated. The Contractor must provide the Engineer at least 1 Working Day advance notice before removing a tree identified in the Contract for re-use as in-stream log, and before placing the in-stream log.

2-05.3(3) STREAMBED AGGREGATE

Streambed aggregate of the type specified in the Contract must be placed at the locations and to the dimensions and thicknesses shown on the Drawings. Additional excavation and shaping may be required to accommodate stream bed aggregate.

2-05.3(4) GEOTEXTILE – DITCH LINING AND SCOUR CONTROL

See Section 2-15.

2-05.3(5) SCOUR CONTROL MATTING

Scour control matting must be conducted as specified in Section 8-01.3(7).

2-05.3(6) IN-STREAM WEIR

In-stream weir must be constructed at the location and to the dimensions specified in the Contract. Unless the Contract specifies otherwise, both wings of the weir must slope gently toward the center section of the weir to allow fish passage over the weir during low flow. The Contract may require placement of weir rock, ecology block, or other Material, to specified elevations and contours, and may require excavation for the base and use of a geotextile for scour control.

Placement of weir components must provide non-rocking contact. As necessary, spacer rock or other suitable material must be used to ensure interlocking of weir components; this material must be sized and placed to resist the forces and scour

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of the design maximum stream flow. Openings within the weir Structure must be plugged securely with shaped rock or other suitable material as necessary to minimize any flow through the weir below the top surface.

2-05.3(7) IN-STREAM BYPASS

To accommodate in-stream construction, the Contractor may be required to install a stream bypass as specified in the Contract. Stream bypass must be coordinated with fish bypass.

The Contractor may be required to excavate a trench and install a temporary bypass Culvert to divert the stream around the area of in-stream work. The Culvert must be sized to accommodate the maximum in-stream flow specified in the Contract. The Contractor may need to make use of pumping with adequate capacity to ensure all stream flow is diverted through the bypass. The Contract may require non-pumping alternatives to accommodate the diversion of fish.

A temporary dam may be required to divert water into the stream bypass including excavation and shaping to allow for installation of the temporary dam. The dam must have controls in-place for leakage, seepage, scour, and other Project Site-specific needs. The Contractor may need to install an impermeable barrier material, which must be secured in front of and against the dam to ensure no passage of stream flow.

Unless the Contract specifies otherwise, when the stream bypass is no longer needed, the Contractor must remove all bypass material, backfill with native material including compaction of backfill, and restore the areas to the finish grades specified in the Contract.

Cofferdam or bypass channel requirements will be addressed in the Contract.

2-05.3(8) FISH BYPASS

The Contract will identify all channels, ditches, streams, and other surface flow channels containing fish where construction is required. Fish bypass must be coordinated with stream bypass.

The Contractor must first remove fish from the area of proposed work. The Contractor may need to install a fish screen on the upstream end to prevent the migration of fish into the proposed stream work area, and to divert the fish through the stream bypass, returning the fish downstream to the original stream channel. The Contractor may need to have personnel travel from upstream to downstream splashing and using netting to coax fish to relocate downstream. The Contractor may use nets to capture fish in isolated pools and in the area of the downstream silt control, and relocate these fish farther downstream.

Straw bales or other means may be required at the downstream end of the proposed stream work area to prevent silt and other sediment from being transported beyond the work area. If the Contract does not specify the means of preventing silt and other material and debris from going beyond the construction area, the Contractor must submit the means to the Engineer at least 5 Working Days in advance of their implementation.

The Contractor must frequently monitor the work area for fish and other water creatures to retrieve and relocate them.

2-05.3(9) FISH SCREEN

Fish screens must be furnished and installed as specified in the Contract.

2-05.3(10) MAINTENANCE REQUIRED DURING CONSTRUCTION

In streams with fish, and where stream bypass, fish bypass, screen, or other measures are required, the Contractor must perform maintenance as specified in the Contract.

2-05.3(11) SCOUR PROTECTION

Where the Contract specifies scour protection, the stream bank, stream bedding and invert, and other stream containing features must be protected from erosion by measures that may include groins, buried groins, barbs, engineered log jams, drop structures, and porous weirs. These measures may be permanent or temporary.

2-05.4 MEASUREMENT

Measurement for ditch and channel excavation is by the cubic yard in-place based on neat lines of staked cross-sections as determined by the Engineer. Other local excavation or shaping required to accommodate in-stream log, streambed aggregate, ditch lining and scour control, erosion control matting, in-stream weir, stream bypass, and fish bypass will not be measured and must be included in their respective Bid Items.

Measurement for in-stream log and for in-stream weir is per each.

Measurement for streambed aggregate and for filter Material is by the ton.

Measurement for geotextile and for ditch lining is as specified in Section 2-15.4.

Measurement for in-stream bypass and for fish bypass is by lump sum.

Measurement for scour control is by component Bid Items in the Standard Specifications.

Measurement for scour control matting not part of a CSECP, and used specifically for in-stream scour control is measured as geotextile for ditch lining as specified in Section 2-15.4.

Measurement for safety systems in ditches and channels over 4-foot depth, not including Division 7 pipe installation, is by lump sum.

2-05.5 PAYMENT

1. **"Ditch Excavation"**, per cubic yard.
2. **"Channel Excavation"**, per cubic yard.

The Bid Item prices for "Ditch Excavation" and for "Channel Excavation" include all costs for the work required for excavation, shaping, loading, placing, stockpiling, and disposing for the applicable excavation.

3. **"Safety Systems in Ditch and Channel Excavation"**, per lump sum.

The Bid Item price for "Safety Systems in Ditch and Channel Excavation" includes all costs for the work required to provide safety systems for ditch and channel excavation over 4 feet in depth. See Division 7 for payment of trench safety systems where ditch and channel work requires pipe and related Structure work.

4. **"In-Stream Log (Number)"**, per each.

The Bid Item price for "In-Stream Log (Number)" includes all costs for the work required to furnish, to fell, and to cut, limb, and prune; to shape the area to receive the in-stream log; to place and anchor the log; and to remove and dispose of debris and material for each in-stream log as may be necessary.

5. **"Streambed Aggregate, (Type)"**, per ton.

The Bid Item price for "Streambed Aggregate (Type)" includes all costs for the work required to furnish and install the type streambed aggregate specified in the Contract including excavating, shaping, and disposal of debris.

6. **"In-Stream Weir, (Type), (Number)"**, per each.

The Bid Item price for "In-Stream Weir" includes all costs for the work required to furnish and install a complete in-stream weir per the Drawings.

7. **"In-Stream Bypass"**, per lump sum.

The Bid Item price for "In-Stream Bypass" includes all costs for the work required to furnish, install, maintain, and remove a complete bypass including any necessary restoration work.

8. **"Fish Bypass"**, per lump sum.

The Bid Item price for "Fish Bypass" includes all costs for the work required to divert and relocate all fish around the work area and to monitor the work area for fish and other water creatures.

9. **Other payment information**

Filter Material will be paid as "Mineral Aggregate, (Type)" as specified in Section 4-01.5.

Unless the Contract specifies otherwise, payment for restorations beyond temporary constructions to accommodate in-stream work are considered incidental to the various Bid Items and no separate or additional payment will be made.

Payment for geotextile of the type specified will be as specified in Section 2-15.5.

No separate or additional payment will be made for additional excavation and shaping to accommodate in-stream log, streambed aggregate, ditch lining and scour control, erosion control matting, in-stream weir, in-stream bypass, and fish bypass.

SECTION 2-06 HAUL

2-06.1 DESCRIPTION

Section 2-06 describes transporting excavated Material from its original site or borrow site to its designated location on the Project Site or to a waste or recycle site.

2-06.2 RESERVED

2-06.3 CONSTRUCTION REQUIREMENTS

Off-highway earthmoving equipment must not haul on or across any street not being improved in the Contract.

2-06.4 MEASUREMENT

Haul work will not be measured.

2-06.5 PAYMENT

Payment for the cost necessary to complete the work specified in Section 2-06 is considered incidental to the various Bid Items comprising the Work and no separate or additional payment will be made.

SECTION 2-07 PROTECTIVE SYSTEMS

2-07.1 DESCRIPTION

Section 2-07 describes sloping or shoring an excavation to protect workers and the public from injury, and nearby infrastructure from damage, as a result of the excavation.

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2-07.2 RESERVED

2-07.3 CONSTRUCTION REQUIREMENTS

2-07.3(1) GENERAL

Where excavations are deeper than 4 feet, the Contractor must construct and maintain safety systems that comply with the requirements of the Washington Industrial Safety and Health Act (RCW Chapter 49.17), including compliance with WAC Chapter 296-155.

Protective systems for use in excavations more than 20 feet in depth must be designed by a registered professional engineer, see Section 1-05.3(12).

Sloping or benching as a means of stabilizing excavations is not permitted within paved roadway, sidewalk, or other improved areas.

In unimproved areas, the size of the excavation may, at the Contractor's option, exceed the excavation size shown on the Drawings or on the Standard Plans by sloping or benching. However, the Contractor is solely responsible for meeting all requirements for excavating, handling, and disposing of excavated material, as well as placing and compacting suitable replacement backfill that is conducted outside of the neat line limits at the Contractor's expense.

2-07.3(2) SAFETY SYSTEMS

The Contractor's safety system must be designed and maintained by a competent person and must comply with accepted engineering requirements or practices. This safety system may require the use of a support system even in locations not designated in the Contract as requiring a support system.

The safety system must provide safe working conditions in the excavation. The Contractor may use a shield system for trenches. All Work outside neat line limits required to restore conditions disturbed by the Contractor's operations, including: handling and disposal of excavated material; additional backfill beyond neat line limits; or additional surface restoration beyond limits specified in the Contract; as well as repair of damage to adjacent structure, improvement, or underground installation, will be at the Contractor's sole expense and at no additional or separate cost to the Owner. Neat line limits for trenches are shown on Standard Plans 284 and 350. For structural excavation neat line limits see Section 2-04.4.

The Contractor must prevent water from entering an excavation per Section 2-08.3(1).

When the work in the excavation is complete, the protective system must be removed from the trench or structural excavation using a method that allows reconsolidation of the bedding, backfill, or side support Material without disturbance to Structures or utilities.

The use of horizontal strutting below a pipe barrel or the use of a pipe as support for trench bracing is not permitted.

2-07.3(3) SUPPORT AND SAFETY SYSTEMS

In addition to worker safety specifications in Section 2-07.3(2): where trench or structural excavations are to be laterally supported as specified in the Contract at locations shown on the Drawings, the lateral support system must be as specified in WAC 296-155, part N. Trench boxes do not meet the requirements of a support system. Support systems may consist of underpinning, bracing, shoring, sheeting, or any other protective system, or combination of protective systems, which provides support to an adjacent structure, underground installation, and the sides of an excavation. The support system must also include the control of groundwater as specified in Section 2-08. The Contractor must use methods of installing, maintaining, and removing the system that cause the least disturbance as determined by the Contractor and approved by the Engineer. Both during and after system installation, the Contractor must fill all voids behind the support system as necessary to prevent loss of native soils or loss of soil support. When removing the support system, the Contractor must coordinate reconsolidation of bedding as necessary with backfilling to minimize disturbance.

All costs for this work will be paid by the Bid Item "Support and Safety System."

The Contractor must submit Shop Drawings per Section 1-05.3 and design calculations per Section 1-05.3(12) of the proposed support system, including loading calculations, structural member and system calculations, and sufficient details of installation, maintenance, and removal concurrent with excavation, installation, removal, and backfilling. Calculations must also address adjacent structures and/or underground installations and construction related loads imposed on the support and safety system.

The Contractor must not disturb bedding or backfill when removing any protective system. Where bedding or backfill is disturbed, the Contractor must recompact the material as specified.

The Contractor must submit for acceptance by the Engineer Shop Drawings prepared by a professional engineer as specified in Section 1-05.3 showing proposed methods and construction details of shoring or cofferdams. The Contractor must not start construction until the submittal has been returned by the Engineer. The Contractor is responsible for acceptable results. Calculations supporting the shoring or cofferdam design must be submitted with the Shop Drawings. The Shop Drawings must contain details such as member sizes, plate thickness, weld details, and bolted connections, and must be per AASHTO Specifications.

2-07.4 MEASUREMENT

Measurement for "Safety Systems in Trench Excavation" is by the square foot. The square foot quantity equals the area of a vertical plane through the pipe centerline, calculated by multiplying the average of the trench end depths by the length of

trench between points 4 or more feet deep. Depth is measured from existing surface grade at the time of excavation to pipe invert.

Measurement for “Support and Safety System” is by the square foot. The square foot quantity equals the area of a vertical plane through the pipe centerline, calculated by multiplying the average of the trench end depths by the length of trench. Depth is measured from existing surface grade at the time of excavation to pipe invert. No measurement will be made for support and safety system beyond designated locations shown on the Drawings.

Measurement for “Safety Systems in Structural Excavation” is per lump sum.

No measurement will be made for “Extra Excavation” associated with installing and removing protective systems beyond the neat lines as shown on Standard Plans 284 and 350, or as shown on the Drawings.

2-07.5 PAYMENT

1. **“Safety Systems in Trench Excavation”**, Minimum Bid = $0.80 per Square Foot.

The Bid Item price for “Safety Systems in Trench Excavation”, includes all costs for the work required to provide, construct, maintain and remove safety systems in trench excavations equal to or exceeding a depth of 4 feet as specified in Section 2-07; and all costs for excavation, backfill and compaction beyond the neat lines as shown on Standard Plans 284, 350 or as shown on the Drawings.

No additional payment for “Extra Excavation” as specified in Section 2-04 will be allowed for Work specified in Section 2-07 Protective Systems.

The minimum Bid Item price for “Safety Systems in Trench Excavation”, will be $0.80 per square foot. The Contractor’s Bid must equal or exceed that amount. If the Contractor’s Bid is less than the minimum specified amount, the Owner will unilaterally change the Bid amount to the minimum specified amount and recalculate the Contractor’s total Bid amount. The corrected total Bid amount will be used by the Owner for Award purposes and to fix the amount of the Payment and Performance Bond.

2. **“Support and Safety System”**, per square foot.

The Bid Item price for “Support and Safety System” includes all costs for the work required to design, provide construct, maintain, and remove the support and safety system at the designated locations on the Drawings as specified in Section 2-07; and all costs for excavation, backfill and compaction beyond the neat lines as shown on Standard Plans 284 and 350.

No additional payment for “Extra Excavation” as specified in Section 2-04 will be allowed for Work specified in Section 2-07 Protective Systems.

There will be no separate or additional payment for "Support & Safety System" outside of the locations specified on the Drawings. No payment for “Safety Systems in Trench Excavation” will be made for locations where payment is made for “Support and Safety System.

3. **“Safety Systems in Structural Excavation”**, per lump sum.

The Bid Item price for “Safety Systems in Structural Excavations” includes all costs for the work required to design, provide, construct, maintain and remove the safety system in the structural excavation at the designated locations shown on the Drawings as specified in Section 2-07 and all costs for excavation, backfill and compaction beyond the neat lines as specified in Section 2-04.

There will be no separate or additional payment for "Safety Systems in Structural Excavation “outside of the locations specified on the Drawings. No payment for “Safety Systems in Trench Excavation” will be made for locations where payment is made for “Safety Systems in Structural Excavation.”

SECTION 2-08 DEWATERING

2-08.1 DESCRIPTION

Section 2-08 describes maintaining a dry excavation by diverting or removing both groundwater and surface water.

2-08.2 RESERVED

2-08.3 CONSTRUCTION REQUIREMENTS

2-08.3(1) GENERAL REQUIREMENTS FOR DEWATERING

Excavations must be kept free of water. The Contractor must control surface run-off and groundwater so as to prevent entry or collection of water in excavations and to maintain the undisturbed state of the native subgrade.

The Contractor must submit the dewatering system method and installation details to the Engineer at least 10 Working Days before dewatering starts. This submittal must be designed and stamped by a licensed Hydrogeologist or Professional Engineer, as specified in Section 1-05.3(12). The submittal must indicate the number and types of equipment and pipelines to be used, dewatering capacity, dewatering pits and locations, water discharge locations, an estimate of advance time needed to dewater the excavation before work may start in the excavation, and any other information necessary to verify acceptable control and performance.

The Contractor must furnish, install, and operate all necessary equipment to keep excavations free from water during construction. The control of groundwater must prevent softening of the bottom of excavations, or formations of soil boiling,

quick sand or soil, and heaving soil conditions. Dewatering systems must be designed and operated so as to prevent any removal or flowing of native soils. In the event the native subgrade is compromised as a result of the Contractor's dewatering methods, the Contractor is fully responsible for restoring the integrity of the subgrade to preexisting conditions.

Disposal of the water must not cause injury to public or private property, or nuisance to the public. Sufficient pumping and power equipment in good working condition must be available at all times for all emergencies, including power outage. Competent personnel must be available at all times for the operation of the dewatering system. Water discharge locations must comply with required permits from the City of Seattle and/or King County, other local jurisdictions, state and federal agencies as appropriate, and be conducted per Section 8-01.

The dewatering system must be designed to prevent loss of foundation support to adjacent structure, underground installation, improvement, or the sides of an excavation, and may require recharging the groundwater outside the excavation.

The dewatering system must be installed and operated so that the groundwater level outside the excavation is not drawn down to an extent that would damage or endanger adjacent Structure, underground installation, sidewalk, pavement, other improvement, or property.

The release of groundwater to its static level must be performed in a way that maintains the undisturbed state of the natural foundation soils and supported soils, prevents disturbance of compacted bedding and backfill, and prevents flotation or movement of Structures, pipelines, Sewers, and Storm Drains.

All costs associated with dewatering the excavation and controlling groundwater must be included in the various Bid Items, provided the groundwater can be controlled using dewatering equipment from within the excavation. No separate or additional payment will be made unless the Contract specifies otherwise.

The Contractor is fully responsible for controlling groundwater.

2-08.3(2) COFFERDAMS

The Contractor may elect to use cofferdams as a means of groundwater cut off instead of dewatering the excavation.

Cofferdams are classified as any water tight enclosure that surrounds the excavated area, used in conjunction with a concrete footing seal. Within the protection of the cofferdam, the excavation is carried to the desired level and the concrete seal is poured, then the enclosure is dewatered.

If the Contract requires a cofferdam and the Engineer determines that seals are not required due to water conditions at the time of construction, the Engineer may specify that seals be omitted.

Excavation outside the cofferdam must not continue below the elevation of the top of the seal, or if no seal is used, below the top of the footing. The Contractor must anchor or otherwise hold the cofferdam in place and secure it against tipping or displacement.

Cofferdams must be constructed to protect newly placed concrete against damage from sudden rising of the water and to prevent damage to the foundation by scour, erosion, or uplift. Do not leave any timber or bracing that extends into the substructure in the cofferdams.

The Contractor must submit Shop Drawings, prepared by a professional engineer per Section 1-05.3, showing proposed methods and construction details of cofferdams. The Contractor must not start construction until the submittal has been returned by the Engineer. The Contractor is responsible for acceptable results. Calculations supporting the shoring or cofferdam design must be submitted with the Shop Drawings. The Shop Drawings must contain details such as member sizes, plate thickness, weld details, and bolted connections, and must be per AASHTO Specifications.

2-08.3(3) PLACING CONCRETE IN FOUNDATION SEALS

If the Drawings require a concrete seal, the Contractor must place the concrete underwater inside a water tight cofferdam, tube, or caisson. Place seal concrete in a compact mass in still water and keep it undisturbed and in still water until fully set. While seal concrete is being deposited, the water elevation inside and outside the cofferdam must remain equal to prevent any flow through the seal in either direction. Vent the cofferdam at the vent elevation shown on the Drawings. The thickness of the seal is based on this vent elevation.

The seal must be at least 18 inches thick unless the Drawings show otherwise.

To place seal concrete underwater, the Contractor must use a concrete pump or tremie. The tremie must have a hopper at the top that empties into a water tight tube at least 10 inches in diameter. The discharge end of the tube on the tremie or concrete pump must include a device to seal out water while the tube is first filled with concrete. Tube supports must allow the discharge end to move freely across the entire Work area and to drop rapidly to slow or stop the flow. 1 tremie may be used to concrete an area up to 18 feet per side. Use 1 additional tremie for each additional area of this size.

Throughout the underwater concrete placement operation, the discharge end of the tube must remain submerged in the concrete, and the tube must always contain enough concrete to prevent water from entering. The concrete placement must be continuous until the Work is completed, resulting in a seamless, uniform seal. If the concreting operation is interrupted, the Engineer may require the Contractor to prove that the seal contains no voids or horizontal joints, by core drilling or other tests. If testing reveals voids or joints, the Contractor must repair them or replace the seal at no expense to the Owner.

Cement Concrete, Type 4000W must be used for seals, and must comply with Section 6-02.3(4)C.

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2-08.3(4) DEWATERING CONCRETE SEALS AND FOUNDATION

After a concrete seal is constructed, the Contractor must pump the water out of the cofferdam and place the rest of the concrete in the dry. This pumping must not start until the seal has set enough to withstand the hydrostatic pressure (3 days for gravity seals and 10 days for seals containing piling or shafts). The Engineer may extend these waiting periods to ensure structural safety, or to comply with a condition of the operating permit.

If weighted cribs are used to resist hydrostatic pressure at the bottom of the seal, the Contractor must anchor them to the foundation seal. Any method used, such as dowels or keys, must transfer the entire weight of the crib to the seal.

No pumping is allowed during or for 24 hours after concrete placement, unless done from a suitable sump separated from the concrete Work by a water tight wall. Pumping must be done in a way that prevents any concrete being carried away.

2-08.4 MEASUREMENT

When used in the seals of underwater cofferdams, concrete will be measured by the cubic yard, on the basis of the actual volume deposited as determined by the average cross-sectional area of the inside of the cofferdam. No measurement will be made for the volume so determined outside of an area bounded by vertical planes 1 foot outside of the neat lines of the seal. The limiting vertical planes must be parallel to the location of the neat lines, based on the traverse and longitudinal centerlines of the seal as shown on the Drawings.

2-08.5 PAYMENT

1. **"Cofferdam"**, per lump sum.

The Bid Item price for "Cofferdam" includes all costs for the work required to furnish, install, maintain, and remove the cofferdam including dewatering.

2. **Other Payment Information**

Concrete that is placed in water for foundation seals, and that on testing as required by the Engineer reveals voids or joint(s), must be repaired or replaced by the Contractor at no additional cost to the Owner.

All costs associated with dewatering the excavation and controlling groundwater are included in the various Bid Items provided the groundwater can be controlled using dewatering equipment from within the excavation. Therefore, no separate or additional payment will be made unless the Contract specifies otherwise.

SECTION 2-09 SUBGRADE PREPARATION AND PROTECTION

2-09.1 DESCRIPTION

Section 2-09 describes preparation and protection of the subgrade for pavements, Structures and utilities. All subgrade preparation Work must be conducted as specified in the Contract and in close conformity with the lines, grades, and typical cross-sections shown on the Standard Plans, Drawings, or as established by the Engineer.

Where removals specified in this Section are within the dripline of existing trees, protection must be as specified in Section 1-07.16(2).

Subgrade preparation for non-pervious sidewalk must be conducted as specified in Section 8-14.3(2).

Subgrade preparation for pervious concrete sidewalks and pervious concrete alleys must be conducted as specified in Section 2-09.3(6).

2-09.2 RESERVED

2-09.3 CONSTRUCTION REQUIREMENTS

2-09.3(1) GENERAL

The Contractor must notify the Engineer on completing any excavation. No material may be placed until the Engineer has accepted the prepared subgrade.

Once exposed, the Contactor must protect the subgrade from adverse weather, the Contractor's operations, and traffic. The Contractor is responsible for all costs of subgrade protection, and any other costs resulting from insufficient protection, such as soft spot repair, over excavation, material replacement, and compaction.

The Contractor must maintain the subgrade by blading and compacting as frequently as necessary. All cuts, ruts, and breaks in the subgrade surface must be repaired as acceptable to the Engineer, before placing any Materials.

Subgrade protection measures may include, but are not limited to, the use of plastic polyethylene sheeting to protect the subgrade from inclement weather, planking to protect the subgrade from the Contractor's equipment, and placing paving Materials or base Materials from an adjacent area of work instead of operating equipment over the prepared subgrade.

Hauling over the finished subgrade is limited to that essential for construction purposes. Equipment used for transporting Materials over the prepared subgrade must be equipped with pneumatic tires. Equipment used for hauling over the prepared subgrade which, in the opinion of the Engineer, causes undue damage to the subgrade or to the underlying Materials must be removed from the Work on request of the Engineer. If approved by the Engineer, the Contractor may plank the subgrade before hauling Materials or operating equipment over it.

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During extended periods of seasonal inclement weather in which the Engineer deems it impractical or infeasible to protect the prepared subgrade with plastic sheeting or planking, and where the Contractor is required to operate equipment over the prepared subgrade, the Engineer may direct the use of a ballast Material to stabilize and protect the subgrade. The ballast must be either Mineral Aggregate Type 2 or Type 14, whichever the Engineer assigns. Ballast can be used for subgrade stabilization only when designated by the Engineer.

2-09.3(2) SUBGRADE FOR ROADWAY SURFACING

In preparing the roadbed for surfacing, the Contractor must:

1. Remove all brush, weeds, vegetation, grass and other debris from the roadbed immediately before placing surfacing Material
2. Dispose of all debris.
3. Drain water from all low spots or ruts.
4. Shape the entire subgrade to a uniform surface running true to the line, grade, and cross-section per the Contract or as established by the Engineer.
5. Process the subgrade in cut areas to remove materials too coarse for mechanical trimming and compaction, if necessary.
6. Compact the subgrade to a depth of 6 inches. Compaction must achieve 95 percent of maximum density determined by tests specified in Section 2-11. All portions of the surface on the subgrade that are inaccessible to large compactor units must be thoroughly compacted with smaller compactor units or mechanical tampers.
7. Remove excess Material that does not drift to low spots during blading and shaping. The Contractor must dispose of this excess by placing it where the subgrade lacks Material or by wasting it.
8. Add Materials where necessary to bring the subgrade up to grade. The Contractor must water and compact these added Materials as needed to produce a true finished subgrade.
9. Complete all underground work in the area of the subgrade, including properly backfilling and compacting, before subgrade work is started. This includes any work performed by the Owner or others.
10. Stabilize the subgrade, as directed by the Engineer, if the underlying subgrade is soft, spongy, or yielding and does not allow proper compaction.
11. Set stakes anywhere normal crown sections are being constructed. Stakes must be set at convenient offsets at intervals not to exceed 50 feet and at closer intervals where necessary, such as at street and alley intersections. The Contractor is responsible for setting any centerline grades that may be needed.
12. Keep the full width of the roadway well sprinkled with water before and during the process of rolling the subgrade.
13. Secure grade and line from the reference stakes, throughout the stages of constructing the subgrade. The subgrade must be maintained in the finished condition until the first course of surfacing is placed on it.

If the Contract requires trimming equipment, the equipment must maintain the grade and transverse slopes automatically through sensors that respond to reference lines on both edges of each roadway, and create a smooth, uniform surface free from chatter and ripples. Equipment is subject to the Engineer's approval.

2-09.3(3) SUBGRADE FOR PAVEMENT

When Drawings call for concrete pavement to be placed directly on the subgrade, the Contractor must prepare the subgrade as outlined in Section 2-09.3(2). This work includes:

1. Removing subgrade for increased thickness of pavement, for pavement headers, and for increased thickness at pavement edges. This may be done just before the concrete is placed.
2. Scarifying old gravel or macadam, where pavement is to be constructed over an old subgrade composed of gravel and macadam. The Contractor must uniformly spread and thoroughly compact the Material.
3. Compacting the subgrade, which must extend to at least 1 foot beyond the pavement edge or to a width that accommodates the paving machine without visible distortion of the subgrade. The subgrade must be compacted both before and after the forms are set.

Thoroughly wetting the subgrade with water from 12 to 48 hours before the concrete is to be placed, and maintaining this wet condition until the concrete is placed.

2-09.3(4) SUBGRADE IN ROCK

When the Contractor encounters rock or other hard Material at the subgrade elevation of roadways and utilities, it must be excavated the full width of the roadbed or to at least 6 inches below subgrade, then backfilled with rock fragments, gravel, or other free-draining Material not more than 4 inches in diameter.

If the Contractor uses a subgrade trimmer, the backfill must be rock, gravel, or other free-draining Material not more than 2 inches in diameter. The Contractor must save the finer granular Material from excavations or borrow pits to use in backfilling the top 6 inches of the subgrade. All Material must be approved by the Engineer.

When a structure foundation will rest on rock, the Contractor must cut the bottom of the excavation to a firm surface, level, stepped, or serrated as specified in the Contract, and remove all loose Material.

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2-09.3(5) SUBGRADE FOR STRUCTURE

When a foundation will rest on rock, excavation must penetrate it at least 1 foot, or more if the Contract requires, to form a key for the footing. The Contractor must cut the bottom of the excavation to a firm surface, level, stepped, or serrated as the Engineer directs, and remove all loose material.

For an arch abutment, the back face must be trimmed to true lines so that concrete can be poured against undisturbed material.

If concrete will rest on any excavated surface other than solid rock, the Contractor must not disturb the bottom of the excavation. The Contractor must also remove all loose or soft material just before pouring the concrete.

Upon completing any foundation excavation, the Contractor must notify the Engineer. No concrete or other permanent part of the Structure may be placed until the Engineer has given permission to proceed.

2-09.3(6) SUBGRADE FOR PERVIOUS CONCRETE PAVEMENTS

2-09.3(6)A GENERAL

The Contractor must notify the Engineer on completing any excavation. No material may be placed until the Engineer has accepted the prepared subgrade.

Once exposed, the Contactor must protect the subgrade from adverse weather, the Contractor's operations, and traffic.

The subgrade must be shaped and maintained to drain during construction, including temporary ditches and modifications to drainage structures necessary, to eliminate standing water on the subgrade.

Material used to protect the subgrade from traffic or provide access to adjacent facilities must be removed and the subgrade condition approved by the Engineer prior to placement of separation geotextile fabric (if required) or subbase.

Subgrade that has been over-compacted must be scarified to a minimum depth of 8 inches and compacted to a firm and unyielding condition, in accordance with this Section.

The Contractor must submit a Subgrade Preparation Plan to the Engineer for review and approval prior to beginning excavation work. The Subgrade Preparation Plan must include methods by which the Contractor plans to protect the subgrade from construction equip and adverse weather conditions, compact the subgrade to a firm and unyielding condition, and provide driveway access.

2-09.3(6)B SUBGRADE PREPARATION FOR PERVIOUS CONCRETE ALLEY

Subgrade constructed to the required line, grade, and cross-section must be in a firm and unyielding condition, as determined by the Engineer, prior to placing pavement section material.

In preparing alley roadbed for surfacing, the Contractor must:

1. Remove all brush, weeds, vegetation, grass, and other debris from the roadbed immediately before placing surfacing Material.
2. Dispose of all debris.
3. Shape the entire subgrade to a uniform surface running true to the line, grade, and cross-section per the Contract or as established by the Engineer.
4. Process the subgrade in cut areas to remove materials too coarse for mechanical trimming, if necessary.
5. Remove excess Material that does not drift to low spots during blading and shaping and are too coarse for mechanical trimming. The Contractor must dispose of this excess by placing it where the subgrade lacks Material or by wasting it.
6. Add Materials where necessary to bring the subgrade up to grade.
7. Complete all underground work in the area of the subgrade, including properly backfilling and compacting, before subgrade work is started. This includes any work performed by the Owner or others.
8. Set stakes anywhere normal crown sections are being constructed. Stakes must be set at convenient offsets at intervals not to exceed 50 feet and at closer intervals where necessary, such as at street and alley intersections. The Contractor is responsible for setting any centerline grades that may be needed.
9. Secure grade and line from the reference stakes, throughout the stages of constructing the subgrade. The subgrade must be maintained in the finished condition until the first course of surfacing is placed.

If the Contract requires trimming equipment, the equipment must maintain the grade and transverse slopes automatically through sensors that respond to reference lines on both edges of each roadway, and create a smooth, uniform surface free from chatter and ripples. Equipment is subject to the Engineer's approval.

Contractor must phase the work to prevent compromising or over-compacting the subgrade, or protect the subgrade during construction. Areas determined to be overly compacted, in the sole opinion of the Engineer, must be scarified as specified in Section 2-09.3(6)A. All costs for Work required to scarify and re-compact over-compacted areas must be at the Contractor's sole expense.

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Prior to installation of the geotextile fabric and subbase, the Contractor must scarify the subgrade to a minimum depth of 1/2 inches. The Contractor must notify the Engineer a minimum of 2 working days prior to scarifying the surface to schedule an inspection. The Engineer will probe to check for areas not in a firm, unyielding condition.

Loose or disturbed areas identified not to be firm and unyielding by the Engineer must be over-excavated to firm bearing and replaced with Mineral Aggregate Type 13. Loose or disturbed areas caused by the Contractor's operations must be repaired at the Contractor's sole expense.

2-09.3(6)C SUBGRADE FOR PERVIOUS CONCRETE SIDEWALKS

Subgrade for pervious concrete sidewalk must be excavated, graded, and compacted as specified in Section 8-14.3(2) to the required line, grade, and cross-section except that the subgrade must be compacted to a firm and unyielding condition, as determined by the Engineer. Prior to placing the geotextile fabric and aggregate discharge subbase, the surface of the subgrade must be scarified to a depth of 1/4 to 1/2 inch. Once scarified, materials or equipment must not be stored or permitted within the prepared subgrade area to avoid re-compaction of the scarified areas and diminishing the infiltration rate of the subgrade.

If geotextile is shown on the Drawings, it must be placed on the prepared subgrade prior to placing aggregate discharge subbase. Provide full coverage and prevent the geotextile from being torn. Damaged geotextile must be repaired as indicated by the manufacturer and to the satisfaction of the Engineer. Overlaps of the geotextile must be a minimum 1 foot or to the manufacturer's recommendation, whichever is greater.

2-09.4 MEASUREMENT

No measurement will be made for the Work required by Section 2-09.

2-09.5 PAYMENT

Unless otherwise specified in the Contract, all costs for the subgrade preparation will be included in the Bid Item prices Bid for the various Bid Items included in the Contract.

All costs for protecting the subgrade from siltation or over-compaction, including replacing all material that becomes unsuitable while the subgrade is exposed, temporary ditches, and structure modifications, will be considered incidental to the Work and no separate payment will be made.

Where specified in the Contract, or where directed by the Engineer, Mineral Aggregate backfill used instead of native material will be paid as "Mineral Aggregate, (Type)" as specified in Section 4-01.

SECTION 2-10 BACKFILLING

2-10.1 DESCRIPTION

Section 2-10 describes backfilling or filling for pavements, Structures and utilities. All backfilling work must be conducted as specified in the Contract and in close conformity with the lines, grades, and typical cross-sections shown on the Drawings, in the Standard Plans, or as established by the Engineer.

2-10.2 MATERIALS

Mineral Aggregate (Type) must comply with the requirements of Section 9-03.

2-10.2(1) SELECTED MATERIAL

Selected Material is Material designated by the Engineer as suitable for fill applications. Selected Material is obtained from the excavations on the Project Site and must be used first before importing new borrow Material.

Excavated Material is considered suitable for general fill applications that do not require a Material meeting specific Mineral Aggregate Type Specifications, as found in Section 9-03. Selected Material must still be capable of attaining the degree of compaction specified in Section 2-11, must be within ± 3 percent of optimum moisture content, as determined per ASTM D 1557, and must be free from deleterious Material. Selected Material must not contain more than 5 percent total, by volume, organic Material, clay, frozen lumps, rocks, concrete, asphalt, or other debris and rubble having a dimension greater than 6 inches.

Selected Material can be used for any of the following purposes as determined by the Engineer: embankment construction; instead of Mineral Aggregate (Type), meeting the requirements of Section 9-03; trench backfill; planting soil, complying with Section 8-02.3(2); and other approved uses.

Excavated material in excess of the needs of the project must be recycled or disposed of as specified in Section 1-07.3.

Selected Material must be placed and compacted per the requirements for the type of work for which the Material is being used.

Unless the Contract specifies otherwise, the Engineer may identify any Material excavated within the Project Site as Selected Material. Where the Contract specifies Material excavated from the Project Site to be labeled as Reused Amended Site Soil, Section 8-02.3(2)C applies.

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2-10.2(2) BORROW

Borrow is imported Material obtained from sources except the Project Site. When suitable native excavated Material is insufficient, borrow can be used to the neat lines shown on the Drawings.

Borrow is classified as "Unclassified Borrow" or "Borrow (Type)" as follows:

Unclassified Borrow is imported soil that meets the suitability requirements in Section 2-10.2(1)

Borrow (Type) is imported soil that meets the suitability requirements in Section 2-10.2(1), and meets all gradation and other requirements in Section 9-03 for the Mineral Aggregate Type specified (e.g. "Borrow, Mineral Aggregate Type 17).

2-10.2(2)A BORROW SITES

Sources of borrow Material, the selection of borrow sites and their operation, and the borrow Material itself are subject to the approval of the Engineer. The Contractor must not use a borrow site until obtaining the proper grading permits and property owner agreements, and submitting copies to the Engineer. Utilization of a borrow site without a legal grading permit, a Consent Agreement from the property owner, and approval of the Engineer, is considered unauthorized.

Borrow sites located within the City limits of Seattle must be per Seattle Municipal Code, Chapter 22.170 and require a grading permit issued to the property owner by the director of the Seattle Department of Construction and Inspections.

Borrow sites located outside the City limits of Seattle but within unincorporated King County must comply with the specifications of King County Code, Title 16 Building and Construction Standard. Borrow sites may also be subject to rules and regulations of a local governmental authority if located within its jurisdiction.

2-10.2(3) CONTROLLED DENSITY FILL

When specified in the Contract or when approved by the Engineer, the Contractor must supply controlled density fill (CDF) as backfill Material. The Engineer may also require the Contractor to use CDF.

2-10.2(3)A CONTROLLED DENSITY FILL (CDF)

For filling pipe and for filling the annular space between 2 pipes, see Section 9-05.15.

CDF Materials must comply with the requirements of the following sections:

CDF Application	Section
Portland and Hydraulic Cement	Section 9-01
Aggregates for Portland Cement Concrete	Section 9-03.1
Curing Materials and Admixtures	Section 9-23
Fly Ash	Section 9-23.6
Ground Granulated Blast Furnace Slag (GGBFS)	Section 9-23.7
Water	Section 9-25

The volume of water and fine aggregate for CDF may be adjusted as required to provide the desired workability within the specified limits. The specific gravity of mixing water must not exceed 1.03.

2-10.2(3)A1 CONTROLLED DENSITY FILL FOR PIPE BEDDING

For pipe bedding, the following CDF mix design must be used:

CDF Mix Design	Quantity/Cubic Yard
Portland Cement Type I II	94 lbs
Fly Ash Cl. F; or Fly Ash Cl. C	2.2 cf 1.1 cf
Mineral Aggregate Type 7 w/ Cl. F Fly Ash Mineral Aggregate Type 7 w/ Cl. C Fly Ash	16.8 cf 17.9 cf
Water	4.8 cf
Air Entrainment	2.7 cf

Slump must not exceed 7 inches.

2-10.2(3)A2 CONTROLLED DENSITY FILL FOR TRENCH BACKFILL

For trench backfill, the following CDF mix design must be used:

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CDF Mix Design	Quantity/Cubic Yard
Portland Cement Type I II	30 pounds
Fly Ash Cl. F; or Fly Ash Cl. C	2.2 cubic feet 1.1 cubic feet
Mineral Aggregate Type 7 w/ Cl. F Fly Ash Mineral Aggregate Type 7 w/ Cl. C Fly Ash	17.1 cubic feet 18.2 cubic feet
Water	4.8 cubic feet
Air Entrainment	2.7 cubic feet

Slump must not exceed 7 inches.

The Contractor may propose an alternate CDF formulation and must make a submittal on the alternate formulation as specified in Section 1-05.3(5). This submittal must include the following information:

1. Reason for alternate formulation and impact on application;
2. Mix design components and component quantities for a 1 cubic yard batch;
3. Strength data at 24 hours, 7 days, and 28 days. The strength at 24 hours must not be less than 15 psi when tested per ASTM D 4832. The strength at 28 days must not be less than 50 psi, with a maximum 100 psi when tested per ASTM D 4832.

In addition, the slump must not exceed 7 inches, and the mixture must not produce excessive bleed water.

An exception to one or more of these requirements may be allowed if the reason provided in item 1 confirms that no harm will result from the use of the alternate CDF mix formulation. Use of alternate CDF formulation is not allowed unless the Engineer provides written acceptance of the alternate formulation submittal.

2-10.2(3)A3 CONTROLLED DENSITY FILL FOR STRUCTURE BACKFILL

For structural backfill, the following CDF mix design must be used:

CDF Mix Design	Quantity/Cubic Yard
Portland Cement Type I II	50 pounds
Fly Ash Cl. F; or Fly Ash Cl. C	2.2 cubic feet 1.1 cubic feet
Mineral Aggregate Type 6 or Type 7	17.2 cubic feet w/ fly ash class F, or 18.1 cubic feet w/ fly ash class C
Water	4.8 cubic feet
Air Entrainment	2.7 cubic feet

2-10.2(3)A4 CONTROLLED DENSITY FILL MANUFACTURER'S CERTIFICATE OF COMPLIANCE

For all CDF materials, the producer must provide a manufacturer's certificate of compliance for each truckload of controlled density fill. The manufacturer's certificate of compliance must verify the delivered Material is in compliance with the mix design and must include the following:

1. Contract number
2. Date
3. Truck number
4. Batched weights of each ingredient
5. Signature of the Supplier affirming the accuracy of the information provided

2-10.3 CONSTRUCTION REQUIREMENTS

2-10.3(1) GENERAL REQUIREMENTS

During all phases of the backfilling operations and testing as outlined here, the Contractor must protect infrastructure, provide for the maintenance of traffic as may be necessary, and provide for the safety of property and people.

If water is present and prevents the Contractor from properly placing and compacting backfill as determined by the Engineer, it must be removed as specified in Section 2-08.

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Excavations must be backfilled as soon as possible. Backfill must not be placed against any new concrete Structure until the concrete has attained 90 percent of its design strength and has cured for at least 14 Days. However, the Contractor may backfill footings and columns as soon as forms have been removed, so long as the backfill is brought up evenly on all sides.

Before backfilling, all form lumber and debris must be removed. The protective system used by the Contractor must be systematically removed to allow for acceptable backfilling.

Where it is required to place a blanket of selected Material or bank run gravel on top of the native backfill, the backfill must be placed to the elevation shown on the Drawings, and must be leveled to provide a uniform thickness of the selected Material. Compaction is required and must be performed before placing the selected Material.

Backfill must be compacted as specified in Section 2-11.

2-10.3(2) FILLING ABANDONED STRUCTURES

Structures, valve chambers, catch basins, and maintenance holes must be filled with Mineral Aggregate Type 9 or Type 17, crushed concrete, or another selected Material approved by the Engineer, and compacted as specified in Section 2-11.

2-10.3(3) UTILITY BACKFILL

When backfilling, the Contractor must take all necessary precautions to protect the pipe from any damage or shifting.

Utility backfill must not be placed until all Material capable of damaging the pipe or its coating or its electrolysis monitoring system, such as rock not capable of passing a 3-inch sieve or similar objectionable Material, has been removed from the backfill Material.

Where Class D bedding is required, backfill up to 6 inches over the top and both sides of the utility must be evenly and carefully placed.

The Contractor must backfill to a uniform depth of 1 foot above ductile iron pipe before starting compaction and to a uniform depth of 2 feet above all other pipe before starting compaction.

Walking on the pipe is not allowed until at least 1 foot of cover has been placed on the pipe.

2-10.3(4) STRUCTURE BACKFILL

Unless otherwise stated in the Contract, structure backfill is the material within a 1 horizontal to 1 vertical slope from the base of the structure to the ground surface.

Special precautions must be taken to prevent any wedging action against Structures. If the excavation has sloping sides, the slopes must be broken up by stepping or serrating to prevent wedge action before the backfill is placed. Fill placed around Culverts, piers or underground utilities must be deposited on both sides to approximately the same elevation at the same time.

Unless otherwise specified, gravel backfill Material for foundations must be Class A or Class B, as specified in Section 9-03.10(1). When not specified by Class or Type in the Contract, gravel backfill Material for foundations must be Mineral Aggregate Type 2, as specified in Section 9-03.10(1)A.

Unless otherwise specified, gravel backfill Material for walls (non-mechanically stabilized earth) must be Mineral Aggregate Type 17, as specified in Section 9-03.10(2).

2-10.3(5) BACKFILLING AT BRIDGE AND TRESTLE ENDS

This work consists of filling around the ends of trestles and bridges. The Contractor must start and complete this work as soon as possible after each bridge is completed or when the Engineer requires.

To prevent the bridge from being distorted or displaced, the Contractor must place Material evenly around all sides and parts of the Structure. The Contractor must not backfill any abutment before placing the superstructure. After the superstructure is in place, small compactors may be required. Embankments must be layered and compacted concurrently at either end of the Structure. The difference in embankment height from one end to the other must not exceed 2 feet.

The Contractor must build the embankment under the bridge to the dimensions specified in the Contract.

2-10.3(6) END SLOPES

The Engineer will determine when and where to build end slopes, whether these occur at the start or end of a project, at the borders of excavation or embankments, at bridge ends, or elsewhere. The Contractor must build end slopes not detailed on the Drawings to the line and grade as established by the Engineer, regardless of center line limits shown on the Drawings. All work to complete and maintain these end slopes is considered Work to be performed under the Contract.

2-10.3(7) CONTROLLED DENSITY FILL

Compaction of controlled density fill will not be required. If water is present and prevents the Contractor from properly placing controlled density fill as determined by the Engineer, it must be removed by pumping or other means.

Special precautions must be taken to prevent any wedging action against abutments and wing walls. If the excavation has sloping sides, the slopes must be broken up by stepping or serrating to prevent wedge action before the backfill is placed. Fill placed around Culverts, piers or underground utilities must be deposited on both sides to approximately the same elevation at the same time.

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2-10.4 MEASUREMENT

"Selected Material" is measured by the cubic yard for the quantity placed.

"Borrow (Type)" and "Unclassified Borrow" is measured by the ton at the point of delivery as specified in Section 1-09.1.

"Controlled Density Fill" is measured by the cubic yard for the quantity of Material placed except when Controlled Density Fill is specified as pipe bedding, as specified in Section 7-17.4.

Compaction will not be measured.

See Divisions 7 and 8 for measurement information associated with excavation, backfill and compaction of utility trenches.

2-10.5 PAYMENT

1. **"Selected Material"**, per cubic yard.

The Bid Item price for "Selected Material" is used for all costs associated with the placement and compaction of this material when the costs are not included in other various Bid Items elsewhere in this specification. Payment for excavation backfill and compaction of utility trenches will be per Divisions 7 and 8.

2. **"Unclassified Borrow"**, per ton.
3. **"Borrow (Type)"**, per ton.

The Bid Item prices for "Unclassified Borrow" and for "Borrow (Type)" include all costs for the work required to excavate, haul, stockpile, place and compact the Material as specified in the Contract.

4. **"Controlled Density Fill"**, per cubic yard.

The Bid Item price for "Controlled Density Fill" includes all costs for the work required to furnish and place the CDF as specified. Payment for Controlled Density Fill used as bedding for utility trenches will be paid as specified in Section 7-17.5.

5. **Other Payment Information**

If the Contract does not include a Bid Item for Mineral Aggregate (Type) for rock embankment construction, any payment will be as specified in Section 1-04.3.

Stockpiled excavated Material for use as backfill that is intermingled with unsuitable Material and/or weather damaged must be disposed of and replaced with sound, untainted fill Material at the Contractor's sole expense.

When directed by the Engineer to use controlled density fill in backfilling around piers and in front of abutments and walls, any payment will be as specified in Section 1-04.3.

Costs related to all bridge embankment and trestle work specified in Section 2-10.3(5) is considered incidental to the Work and must be included in the Bid Item prices for applicable Bid Items.

All costs not defined in Section 2-10 that relate to providing, placing, and compacting backfill must be included in the Bid Item prices of the applicable Bid Items.

See Divisions 7 and 8 for payment information associated with excavation, backfill and compaction of utility trenches.

SECTION 2-11 COMPACTION

2-11.1 DESCRIPTION

Section 2-11 describes compacting material used for backfilling or filling for pavements, Structures and utilities. All compaction Work must be conducted as specified in the Contract and in close conformity with the lines, grades, and typical cross-sections shown on the Standard Plans, Drawings or as established by the Engineer.

2-11.2 RESERVED

2-11.3 CONSTRUCTION REQUIREMENTS

2-11.3(1) GENERAL REQUIREMENTS

The Contractor must not operate tractors or other heavy equipment within 2 feet of a structure or utility. Where compaction is required within 2 feet of a structure or utility, or is inaccessible by large equipment, the Contractor must use smaller, lighter equipment and smaller lifts to achieve the required compaction so as not to damage the structure or utility.

The Contractor must determine the lift thickness and compaction effort based on the equipment being used for compaction and the material being compacted, so that the compaction standard is met. The lift thickness must not be greater than 12 inches at any time.

Should excessive moisture threaten the stability of backfill, the Engineer may direct the Contractor to change the operation.

The Contractor must use 1 of the following 2 methods (A and B) when backfilling. The Contractor must use Method A when the Contract does not specify another method.

Method A: Within 2 feet of pavement or a structure, the backfill must be compacted to 95 percent of the maximum density, as determined by the compaction control tests specified in Section 2-11.3(2). All Material beyond this 2-foot range must be compacted to 90 percent of the same maximum density.

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Method B: all material must be compacted to 95 percent of the maximum density, as determined by the compaction control tests specified in Section 2-11.3(2).

If the required compaction density has not been obtained, the Contractor must remove the backfill and recompact using an improved technique, thinner lifts, heavier compaction equipment, or more effort. This process must be repeated until the Contractor has established a procedure that provides the required degree of compaction. The Contractor will then be permitted to proceed with backfilling and compacting under the approved compaction procedure.

The moisture content must not vary more than 3 percent above or more than 3 percent below the optimum moisture content as determined by test method ASTM D1557.

The Engineer may allow the Contractor to place Materials having higher moisture content than specified in this Section if the Contractor can indicate the compaction standard can still be met. However, the Engineer may at any time require the Contractor to return to specified moisture-content levels.

The Owner will consider all costs of drying Material to be incidental to other Work and at no additional cost to the Owner.

If weather prevents drying excavation or borrow Materials to the required moisture content, the Engineer may direct the Contractor to change normal procedures or equipment.

The Contractor must repair any partial or complete backfilled area that loses stability because of continued hauling across it. Evidence of lost stability includes pumping or rutting. The Contractor must also change hauling equipment or procedures to prevent further damage.

If it appears that rain or snow is likely to soak an area that has been aerated, the Contractor must temporarily seal it against the weather. Should the Contractor fail to do so, any additional aeration required to restore the area to its previous condition must be done at no expense to the Owner.

2-11.3(2) COMPACTION CONTROL TESTS

Maximum density and optimum moisture content for materials placed are determined by one of the following methods:

1. Materials less than 30 percent retained on the 3/4 inch sieve are determined by ASTM D 1557 (AASHTO T 180 Method D).
2. Materials with 30 percent or more retained on the 3/4 inch sieve may be determined by rolling pattern using in-place density, determined using ASTM D6938 (AASHTO T 310).

The Engineer will determine which test procedure to use.

The Contractor must provide the Engineer a minimum 2 Working Days advance notification when field soil or Mineral Aggregate density reading or compaction testing is required.

The Contractor must re-establish the compaction procedure if routine in-place densities show the specified compaction is not being attained. In no case will placement of Material be allowed to proceed until the specified compaction is attained.

Water settling is not allowed as a method for compaction.

2-11.4 MEASUREMENT

Compaction will not be measured.

2-11.5 PAYMENT

When the Engineer directs a change in construction, the Owner will not increase the Bid Item price, but will increase the Bid Item quantity at the Bid Item prices for the Bid Items that apply, as specified in Section 1-04.5.

Density testing by Owner forces will be performed at no charge to the Contractor for the first test series at each Engineer designated location. If these tests indicate a failure to achieve required densities, re-testing must take place after recompaction. Engineer expenses related to retesting will be charged to the Contractor as specified in Section 1-05.7.

All costs and expenses involved in drying Materials with whatever method is appropriate are considered incidental to the various Bid Item prices and at no additional cost to the Owner.

See Divisions 7 and 8 for payment information associated with excavation, backfill and compaction of utility trenches.

SECTION 2-12 WATERING

2-12.1 DESCRIPTION

Section 2-12 describes furnishing, hauling, and applying water for settling, constructing subgrade, placing of crushed surfacing, dust control, flushing, and testing as the Contract requires.

2-12.2 RESERVED

2-12.3 CONSTRUCTION REQUIREMENTS

2-12.3(1) GENERAL

The Contractor must apply water to streets using tank trucks equipped with spray bars. Spray controls must ensure that water is applied uniformly and at a rate of coverage for the intended purpose. When the source of water within the Work area

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is hydrants, the Contractor may, with approval of the Engineer, apply water with a hose and reduced pressure principle backflow assembly, see Section 9-30.13(5), approved by the Washington State Department of Social and Health Services (WSDSHS certification) and directly connected to the hydrant. The Contractor must have a copy of the WSDSHS certification on board the vehicle drawing water from the hydrant. Before drawing water, the Contractor must first obtain approval of the assembly and hook-up by making the advance notification specified in Section 1-07.28 item 8D. The Contractor must furnish the hose, equipment, or tank truck necessary for required watering, and strictly comply with the provisions of the permit.

2-12.3(2) SOURCE OF WATER SUPPLY, REQUESTING HYDRANT PERMIT, AND REGULATIONS PERTAINING TO HYDRANT USE

Within the SPU Water Operations direct service area, the source of water used on a project must be approved by the Engineer. When the source of water is a hydrant, a hydrant use permit must be obtained from SPU Development Services Office, and any applicable use fees paid.

The Contractor must only use water sources or hydrants approved by the Engineer, and must be in strict accordance with the requirements of City of Seattle Ordinance 65877 and the conditions of the permit.

Information on SPU hydrant use permits can be obtained at (206) 684-3333, or by visiting the 27th floor of the Seattle Municipal Tower, 700 Fifth Avenue, Seattle, WA.

Outside of the SPU Water Operations direct service area, the Contractor must comply with the requirements of that local jurisdiction.

2-12.4 MEASUREMENT

Water used in conjunction with work involving the water distribution system will not be measured.

Water used in conjunction with work except the water distribution system will be measured.

2-12.5 PAYMENT

All costs associated with obtaining a hydrant use permit and providing and applying water to Work not involving the water distribution system are considered incidental to the various Bid Items comprising the improvement and no separate or additional payment will be made. See Section 4-07.5 for an exception where the Owner will pay for water.

All costs associated with providing and applying water to Work involving the water distribution system will be borne by the Owner, including the hydrant use permit fee.

Where the Work involves both water distribution work and other work, no reimbursement of the hydrant permit fee will be made. Costs for City non-water distribution work are considered incidental to the various non-water distribution Bid Items and no separate or additional payment will be made except as specified in Section 4-07.5.

Water costs are based on the prevailing rates as listed in Seattle Public Utilities' current standard charges.

SECTION 2-13 ROCK FACING

2-13.1 DESCRIPTION

Section 2-13 describes constructing, rebuilding, and relocating rock facings used for erosion control or the containment of cuts and embankments. Work must be performed per Standard Plan 141, and as designated in the Contract. Rock facing used for fire hydrant wall requirements as shown on Standard Plan 313 must comply with the requirements of Section 2-13.3(5).

2-13.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Material	Section
Rock Facing Material	Section 9-03.15
2" to 4" Quarry Spall	Section 9-13.6
Geotextile	Section 9-37

Crushed gravel with at least 90 percent of the total required quantity having 2 or more fractured surfaces each piece and also meeting the grading requirements of quarry spalls may be used instead of ledge rock.

Where needed, the geotextile between the native soil behind the rock facing and the quarry spall backfill must comply with the requirements of a geotextile for separation on Table 3 of Section 9-37.

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2-13.3 CONSTRUCTION REQUIREMENTS

2-13.3(1) ROCK FACING

2-13.3(1)A GENERAL

Rock facings except fire hydrant wall requirements per Standard Plan 313 must be constructed, rebuilt, or relocated at the locations and to the limits shown on the Drawings. The subgrade elevation and location of the rock facing must be as shown on the Drawings or established by the Engineer.

2-13.3(1)B ROCK FACING KEYWAY

Once clearing and general Job Site preparation is complete, the Contractor must excavate a keyway for the base course of rock facing. The keyway must be 3 to 12 inches deep as shown on Standard Plan 141 extending over the entire length of the rock facing, and must incline slightly downward toward the face of the cut or fill being protected, by an approximate 4 horizontal to 1 vertical slope. The keyway width must be at least 40 percent of the height of the proposed rock facing.

2-13.3(1)C ROCK SELECTION

The Contractor must have sufficient working space so individual rock selection from a number of stockpiled rocks can satisfy the needs of the project. The stockpile area must not be placed on traffic lanes or driveways. Rocks must be of a generally cubical, tabular or rectangular shape, as opposed to rounded or tetrahedral forms, and must be placed to match as closely as possible the spaces afforded by the next lower course of rocks. One-man rocks must not be used on rock facings more than 3 feet high.

2-13.3(1)D ROCK PLACEMENT

The thickness of the rock facing, including the filter layer behind it, must be approximately 40 percent of its height. Where required in the Contract, a 6-inch subsurface drain pipe must be installed in a keyway behind the rock facing, with sufficient gradient to initiate flow, and be piped to an approved discharge point as shown on the Drawings, such as a surface, ditch, curb above inlet or CB grate, or separate CB with no roadway discharge.

The Contractor must place the first course of rock on firm, unyielding soil having a minimum load bearing capacity of 2000 pounds per square foot, at base elevations specified in Standard Plan 141. There must be full contact between the rock and soil. This may require shaping of the ground surface, or slamming or dropping the rocks into place when appropriate, so that the soil foundation conforms to the shape of the rock face bearing on it. As an alternative, it may be necessary to place and compact crushed rock into the subgrade to increase its load bearing capacity. Before placing the next level of rock facing, the Contractor must place and compact filter Material behind and to the top of the rocks previously placed.

The Contractor must use rock sizes as specified in Section 9-03.15, using the largest rocks at the bottom and progressively smaller rocks toward the top. The rocks must be placed so there are no continuous joint planes in either the vertical or lateral direction. Each rock must bear on at least 2 rocks below it, must have at least 3 contact surfaces, and must be set stable with no rocking.

Rocks must be placed so there is some bearing between flat rock faces rather than on joints. Horizontal joints between rock courses must slope downward towards the embankment being protected.

The batter of the rock facing must be 1 horizontal to 4 vertical and must be uniformly the same throughout the length of the rock facing. The face of individual rocks may vary no more than 3 inches from the batter or slope line of the rock facing.

Where voids greater than 4 inches in dimension exist in the rock facing, they must be visually examined to determine if contact between the rocks exists within the thickness of the rock facing. If there is contact, no further action is required. If there is no rock contact within the rock facing thickness, some resetting is required. If there is a void measuring 6 inches or more near the inside face of the rock facing, use a smaller piece of rock to fill the void. This filler rock must be placed with the longest dimension perpendicular to the face.

If stability of an unprotected cut slope is a concern, the rock facing must be constructed in short lengths. The final course must have an even appearance and must be placed to minimize erosion of the protected embankment.

2-13.3(1)E FILTER MATERIAL

The Contractor must place a drainage filter of 2-inch to 4-inch quarry spall between the face of the embankment and the rear of the rock facing. The drainage filter must be a minimum 6 inches in thickness.

2-13.3(1)F GEOTEXTILE

If surface water or groundwater seeping from the slope could cause erosion of the native soil during the life of the rock facing, a separation geotextile meeting the requirements in Table 3 of Section 9-37 must be placed between the filter material and the native soil.

2-13.3(1)G SLOPE ABOVE ROCK FACING

The slope of the terrain above the rock facing must be no steeper than 3 horizontal to 1 vertical to minimize an earth surcharge on the rock facing. Additional surcharge such as a building, parking area, other traffic area, and other loading above the rock facing, requires a rock facing design by a licensed civil engineer as specified in Section 1-05.3, which must be submitted to the Engineer. Hydroseed the unimproved area above the rock facing for erosion control.

2-13.3(2) REBUILD ROCK FACING

This work consists of dismantling an existing rock facing and reconstructing the facing in the same location. Reconstruction work must be conducted as specified in the requirements of Section 2-13.3(1). Rock dismantled from the existing facing may be used in reconstructing the rebuilt rock facing if the rock is approved by the Engineer as meeting the rock quality requirements of Section 9-03.15. Additional rock required by the Engineer to complete the facing must be furnished by the Contractor, and must meet the requirements of Section 2-13.2. Existing drainage rock behind the existing rock facing must be replaced with 2-inch to 4-inch quarry spall for the rebuilt rock facing.

The Contractor must sequence the removal and rebuild to limit the length of exposed slope. Each Working Day, a length of up to twice the height of the existing rock facing may be removed. Each Working Day, rebuilding the rock facing must proceed in a manner providing the shortest length of unfinished rock facing full height. The removal and rebuild must be coordinated to limit the exposure of un-rocked embankment.

2-13.3(3) RELOCATE ROCK FACING

This work consists of dismantling an existing rock facing and rebuilding a similar rock facing in a different location using the rock obtained from the dismantled facing. Work must be conducted as specified in the requirements of Sections 2-13.3(1) and 2-13.3(2). The Contractor must furnish additional rock as directed by the Engineer to complete the facing. New rock must meet the requirements of Section 2-13.2. Existing drainage rock behind the existing rock facing must be replaced with 2-inch to 4-inch quarry spall for the relocated rock facing.

2-13.3(4) CONTRACTOR REQUIRED EXPERIENCE

The rock facing Contractor or Subcontractor must furnish written evidence of at least 5 rock facing constructions within the 2 years preceding the date of Advertisement for Bids and must invite inspection of at least 2 of these rock facings that are similar to the proposed rock facings in the Contract, as determined by the Engineer.

2-13.3(5) ROCK FACING FOR HYDRANTS

Where rock facings are required as wall requirements for fire hydrants, as shown on Standard Plan 313, the rock facing construction must be conducted as specified in Section 2-13.3(1), with the following exceptions:

1. The depth of the keyway must be 1 foot minimum;
2. The filter Material behind the rock facing must be Mineral Aggregate Type 2 with a minimum thickness of 6 inches.
3. The maximum height of rock facing must not exceed 5 feet as measured from finished grade to top of rock facing.
4. The sizes of rock facing must comply with the requirements of the table listed on Standard Plan 141, with "h" measured from finished grade to top of rock facing.
5. The maximum slope behind the rock facing must not be steeper than 2 horizontal to 1 vertical.
6. Finished grade in front of the rock facing must be within a minimum 6-inch compacted depth of Mineral Aggregate Type 2.
7. No weep holes and no subsurface drain are required behind the rock facing.
8. Each rock facing rock must bear on at least 3 points without rocking. Voids greater than 4 inches on either the outside face or inside face must be filled with a smaller rock ensuring stability of the rock facing.

2-13.4 MEASUREMENT

"Rock Facing" and for "Relocate Rock Facing" is measured by the square foot of rock face for the new rock facing or for the relocated rock facing.

"Rebuild Rock Facing" is measured by the square foot based on measurement of the finished rock facing.

Measurement will include the entire front face of the constructed rock facing including the keyway.

Measurement for quarry spall drainage Material is by the ton.

Measurement for filter Material except quarry spall is by the cubic yard, as specified in Section 4-01.4.

2-13.5 PAYMENT

1. **"Rock Facing"**, per square foot.

The Bid Item price for "Rock Facing" includes all costs for the work required to furnish and place the rock and geotextile, excavation of keyway and of embankment.

Payment for drainpipe, when called for in the Contract, will be paid as "Subsurface Drain" as specified in Section 7-01.

2. **"Rebuild Rock Facing"**, per square foot.
3. **"Relocate Rock Facing"**, per square foot.

The Bid Item prices for "Rebuild Rock Facing" and for "Relocate Rock Facing" include all costs for the work required to dismantle and reconstruct the rock facing as specified using the existing rock. It also includes temporary stockpiling of the rock, excavation as may be necessary to rebuild or relocate the rock facing, disposal of existing rock or drainage aggregate, and furnishing additional drainage aggregate and geotextile as necessary.

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Costs required to import and place additional rock, or replace existing rock to rebuild or relocate rock facing are addressed in Section 1-09.4.

4. **Other payment information**

Payment for quarry spall or other filter Material specified for drainage filter Material will be as specified in Section 8-15.

SECTION 2-14 TRIMMING AND CLEANUP

2-14.1 DESCRIPTION

Section 2-14 describes dressing and trimming the roadways specified in the Contract, including frontage roads, connecting ramps, auxiliary lanes, and approach roads. This work extends to shoulders and ditches.

2-14.2 RESERVED

2-14.3 CONSTRUCTION REQUIREMENTS

The Contractor must:

1. Trim shoulders and ditches to produce smooth surfaces and uniform cross-sections that conform to the grades set by the Engineer.
2. Open and clean all channels, ditches, and gutters to ensure proper drainage.
3. Dress the back slope of any ditch or borrow pit that will remain adjacent to the roadway. Round off the top of the back slope and distribute the Material evenly along its base.
4. Remove and dispose of all weeds, brush, refuse, and debris that lay on the roadbed, shoulders, ditches, and slopes.
5. Remove all loose rocks and gravel from paved shoulders.

Distribute evenly along the embankment any Material not needed to bring the shoulders to the required cross-section.

Restoration must be conducted as shown on the Drawings and the requirements in Section 8-02.

The Contractor must not use heavy equipment (tractors, graders) to trim the shoulders of an existing or new bituminous surface, or drag, push, or scrape shoulder Material across completed surfacing or pavement.

When the Contract requires rebuilding part of a roadway, only the rebuilt areas must be trimmed and cleaned up.

Trimming and cleanup in ditches and channels over 4 feet deep requires safety systems, as specified in Section 2-07.

2-14.4 MEASUREMENT

Work specified in Section 2-14 will not be measured.

Measurement for safety systems related to cleanup of ditches and channels over 4 feet deep is specified in Section 2-07.4.

2-14.5 PAYMENT

Payment for safety systems related to ditch and channel cleanup will be as specified in Section 2-07.5.

SECTION 2-15 CONSTRUCTION GEOTEXTILE

2-15.1 DESCRIPTION

Section 2-15 describes furnishing and placing construction geotextile as specified in the Contract.

2-15.2 MATERIALS

Construction Geotextile must comply with the requirements of Section 9-37.

Geotextile roll identification, storage, and handling must comply with ASTM D 4873. During periods of shipment and storage, the geotextile must be stored off the ground. The geotextile must be covered at all times during shipment and storage to fully protect it from ultraviolet radiation including sunlight, Job Site construction damage, precipitation, chemicals including strong acids or strong bases, flames including welding sparks, temperatures in excess of 160 °F, and any other environmental condition that may damage the physical properties of the geotextile.

Geotextile required for underground drainage must be “Moderate Survivability” and “Drainage Class C” and geotextile for permanent erosion control must be “High Survivability” and “Drainage Class C.”

2-15.3 CONSTRUCTION REQUIREMENTS

2-15.3(1) GENERAL

The area to be covered by the geotextile must be graded to a smooth, uniform condition free from ruts, potholes, and protruding objects such as rocks or sticks. The geotextile must be spread immediately ahead of the covering operation. Do not leave the geotextile exposed to sunlight during installation for more than 14 Calendar Days. The geotextile must be laid smooth without excessive wrinkles. The geotextile must not be dragged through mud or over sharp objects which could cause damage. The cover material must be placed on the geotextile so that the minimum required initial lift thickness remains

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between the equipment tires or tracks and the geotextile at all times. Construction vehicles on the first lift above the geotextile are not permitted.

Soil piles or the manufacturer's recommended method can be used as needed to hold the geotextile in place until the specified cover material is placed.

Should the geotextile be torn, punctured, or the overlaps or sewn joints disturbed, as evidenced by visible geotextile damage, subgrade pumping, intrusion, or roadbed distortion, the backfill around the damaged or displaced area must be removed and the damaged area repaired or replaced by the Contractor at no expense to the Owner. The repair must consist of a patch of the same type of geotextile, placed over the damaged area by the minimum required overlap for the application.

If geotextile seams will be sewn, whether in the field or at the factory, the seams must consist of 1 row of stitching unless the geotextile does not have a selvage edge where the seam would be sewn. If a selvage edge is not present, the seams must consist of 2 parallel rows of stitching, or a J-seam, Type SSn-1, using a single row of stitching. The 2 rows of stitching must be 1 inch apart with a tolerance of ±1/2 inch and must not cross except for re-stitching. The stitching must be a lock-type stitch. The minimum seam allowance (the minimum distance from the geotextile edge to the stitch line nearest to that edge) must be 1-1/2 inches if a flat or prayer seam, Type SSa-2, is used. The minimum seam allowance for all other seam types must be 1 inch. The seam, stitch type, and the equipment used to perform the stitching must be as recommended by the manufacturer of the geotextile and as approved by the Engineer.

The seams must be sewn in a manner that the seam can be inspected readily by the Engineer or a representative. The seam strength will be tested and must comply with the requirements stated here.

2-15.3(2) UNDERGROUND DRAINAGE

See Section 7-01.2 and 7-01.3(2) for geotextile type and construction requirement for subsurface drain pipe.

Trench walls must be smooth and stable. The geotextile must be placed in a manner that ensures intimate contact between the soil and the geotextile (no voids, folds, or wrinkles).

The geotextile must either be overlapped a minimum of 12 inches at all longitudinal and transverse joints, or the geotextile joints must be sewn for moderate survivability drainage applications. In those cases where the trench width is less than 12 inches, the minimum overlap is the trench width.

In moderate survivability geotextile underdrain applications, the minimum overlap is 12 inches, or the geotextile joints must be sewn, except where the geotextile is used in area drains. An area drain is defined as a geotextile layer placed over or under a horizontal to moderately sloping layer of drainage aggregate. For area drains, the geotextile must be overlapped a minimum of 2 feet at all longitudinal and transverse joints, or the geotextile joints must be sewn together. The minimum initial lift thickness over the geotextile in the area drain is 12 inches.

In all cases, the upstream geotextile sheet must overlap the next downstream sheet.

2-15.3(3) SEPARATION

For separation, the geotextile must either be overlapped a minimum of 2 feet at all longitudinal and transverse joints, or the joints must be sewn together. The initial lift thickness must be 6 inches or more.

2-15.3(4) SOIL STABILIZATION

For soil stabilization, the geotextile must either be overlapped a minimum of 2 feet at all longitudinal and transverse joints, or the joints must be sewn together. The initial lift thickness must be 12 inches or more. Compaction of the first lift above the geotextile must be by Method A (Section 2-11.3). No vibratory compaction is allowed on the first lift.

2-15.3(5) PERMANENT EROSION CONTROL AND DITCH LINING

Unless otherwise specified in the Contract, the geotextile must either be overlapped a minimum of 2 feet at all longitudinal and transverse joints, or the joints must be sewn together. If overlapped, the geotextile must be placed so the upstream strip of geotextile overlaps the next downstream strip. When placed on slopes, each strip must overlap the next downhill strip.

Placement of aggregate and riprap or other cover material on the geotextile must start at the toe of the slope and proceed upwards. The geotextile must be keyed at the top and the toe of the slope as shown on the Drawings. The geotextile must be secured to the slope, but loosely enough so the geotextile does not tear when the riprap or other cover material is placed on the geotextile. The geotextile must not be keyed at the top of the slope until the riprap or other cover material is in place to the top of the slope.

All voids in the riprap or other material through which the geotextile is visible must be backfilled with quarry spalls or filter material as designated in the Contract, so the geotextile is completely covered. When an aggregate cushion between the geotextile and the riprap or other cover material is required, it must have a minimum thickness of 12 inches.

An aggregate cushion must be placed on the geotextile when hand placed riprap or sack riprap is specified.

Grading of slopes after placement of the riprap or other cover Material is not allowed if grading results in stone movement directly on the geotextile. Never allow stones with a weight of more than 100 pounds to roll downslope. Stones must not be dropped from a height greater than 3 feet above the geotextile surface if an aggregate cushion is present, or 1 foot if an aggregate cushion is not present. Lower drop heights may be required if geotextile damage from stones is evident, as

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determined by the Engineer. If the geotextile is placed on slopes steeper than 2 horizontal to 1 vertical, the stones must be placed on the slope without free-fall for moderate survivability, high survivability, and ditch lining geotextiles.

2-15.3(6) TEMPORARY SILT FENCES

See Section 8-01.3(10).

2-15.4 MEASUREMENT

Measurement for construction geotextile, with the exception of temporary silt fence geotextile and underground drainage geotextile used in trench drains, is measured by the square yard for the ground surface area actually covered. No additional measurement will be made for overlap.

Measurement for underground drainage geotextile used in trench drains is measured by the square yard for the perimeter of drain actually covered. No additional measurement will be made for overlap.

2-15.5 PAYMENT

1. **"Construction Geotextile for Underground Drainage"**, per square yard.
2. **"Construction Geotextile for Separation"**, per square yard.
3. **"Construction Geotextile for Soil Stabilization"**, per square yard.
4. **"Construction Geotextile for Permanent Erosion Control"**, per square yard.
5. **"Construction Geotextile for Ditch Lining"**, per square yard.

The Bid Item prices for "Construction Geotextile (Use)" include all costs for the work required to furnish, install, maintain, and remove the geotextile for the use as specified.

Additional geotextile required by the Engineer will be addressed as specified in Section 1-04.3.

SECTION 2-16 DIRECTIONAL DRILLING

2-16.1 GENERAL

For auger boring trenchless construction, see Section 2-17. For underground construction or trenchless construction except horizontal directional drilling and auger boring, see Section 7-17.3(2)H.

Horizontal directional drilling (HDD) is a trenchless excavation method used for the installation of pipe, conduit and cable. A drill rig sits on the ground surface and advances a steerable pilot bore to a design profile, typically in an arc-shaped bore. Excavation takes place with fluid assisted cutting from a drilling tool that is connected to the drill rig by a series of drill pipe that are pushed forward by the drilling rig. The lead drill pipe attached to the drilling tool, commonly known as the down-hole assembly (DHA), contains a shallow angle allowing steering to take place by the positioning of the DHA. Steering only takes place during the pilot bore stage of the drill. The bore is then enlarged by subsequent reaming passes. Once the final size required for product pipe installation is achieved, the pipe, conduit, or cable is pulled into the fluid-stabilized bore. The pilot bore is tracked using a survey tool within the lead drilling pipe with a transmitter that is monitored with a surface tracking device. A walk-over locator is typically used for surface tracking.

The Contractor must furnish all labor, equipment, and materials necessary to complete the work in accordance with these specifications at locations designated for HDD installation and with material dimensions shown on the Drawings.

Where used in this Section, the following terms and phrases must be understood as defined below:

1. Active interference: Signals generating a magnetic field which interfere with HDD tracking equipment by increasing the baseline readings of a walkover locating system and competing with the signal sent transmitted from the DHA.
2. Circulation: The movement of the excavated cuttings and/or drilling fluid to the entry or exit location for removal of spoils.
3. Drilling fluid: A mixture of water, bentonite, polymers, and other additives continuously pumped to the drilling tool to facilitate the removal of cuttings, stabilize the bore, and cool the drilling tool.
4. Drilling tool/ downhole assembly (DHA): A tool or system of tools that excavate at the face of the bore.
5. Inadvertent returns: When drilling fluid emerges at the ground surface or in any other locations other than the entry or exit location of the design bore profile.
6. Passive interference: Interference of HDD tracking equipment by features which block, absorb, or distort a magnetic field.
7. Physical location: as it relates to existing underground facilities, determination of depth and lateral position of a facility via potholing or other means of excavation, as a means to confirm or compare with the facility's location as shown on the Drawings or any other source.
8. Product pipe: the pipe, conduit, or cable that is pulled into the prepared borehole to complete the HDD installation.
9. Pullback load: The tensile load applied to a drill string and product pipe during the pullback process.
10. Underground facility: all underground features including pipe networks, underground structures, piles, and footings.
11. Underground utility: existing pipelines, conduits, and cables.

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12. Visual verification during drilling: as it relates to underground facilities, exposure of the underground facility via potholing or other means of excavation while the leading edge of the DHA crosses the facility so the locator can confirm visually that the auger bore alignment does not conflict with the existing facility.

2-16.2 MATERIALS

The product pipe be as specified in the Contract. The tensile strength of product pipe joints must be of sufficient strength to withstand installation stresses and frictional resistance for the size, length, and curvature of the bore.

2-16.3 CONSTRUCTION REQUIREMENTS

2-16.3(1) EXPERIENCE

See Section 2-16.3(5)A for submittal requirements.

In addition to requirements specified elsewhere in the Contract, the directional drilling crew, whether Contractor or Subcontractor, must demonstrate experience with HDD projects of the size and length shown on the Drawings. The HDD operator must have completed a minimum of 5 HDD installations the past 3 years installing product pipes with HDD of the diameter and length shown on the Drawings or greater. The HDD Operator must demonstrate experience on the equipment proposed for use.

The HDD locator must have a minimum of 5 projects completed in the past 3 years tracking the installation for product pipes of the size and length shown on the Drawings or greater. The HDD locator must demonstrate experience with the tracking equipment proposed for use.

2-16.3(2) DRILLING EQUIPMENT

All drilling equipment, whether direct or supporting, must be maintained according to the manufacturer recommendations. Hoses and hose connectors must have no flaws, and must be connected per the manufacturer's recommendations. Flow meters and pressure reading gauges must be calibrated per manufacturer's recommendations.

The Contractor must match the drill equipment and supplies to the soils and Project Site conditions. Drilling equipment must be capable of advancing through the site conditions and the DHA must be steerable and provide necessary cutting surface and drilling fluid jets. The torque and thrust capacity of the drilling rig must be capable of advancing through the site conditions at all phases of the HDD process.

The drilling Contractor or Subcontractor must be qualified to perform necessary and reliable equipment operation and inspection including the reliability of the DHA locating system, and must be qualified or have ready access to qualified expertise to maintain and repair the equipment as may be necessary.

2-16.3(3) UNDERGROUND FACILITIES – INVESTIGATION AND DOCUMENTATION

2-16.3(3)A GENERAL

Before any directional drilling activity starts, the Contractor must make preparatory measures to confirm that the proposed bore path does not conflict with existing underground facilities as applicable and as specified in this Section.

2-16.3(3)B EXISTING UNDERGROUND FACILITIES

The plan and profile locations of known existing underground facilities, appurtenances, and other underground features and improvements including existing utilities, anchor systems, and service laterals, along and near the proposed bore path are shown on the Drawings. The Contractor must physically locate underground facilities within the limits specified in Section 2-16.3(3)D and where shown on the Drawings. The Contractor must expose and visually verify existing facility clearance from the drill path during drilling when underground facilities are within the limits specified Section 2-16.3(3)E and where shown on the Drawings.

When preparing drilling bore path alignment and profile, the Contractor must compare the underground facility locations, depths, dimensions, and appurtenances, as specified in the Contract, with the actual facility locations, depths, dimensions, and appurtenances, and with the proposed bore path alignment and profile. Where conflict is indicated, such conflict must be resolved before drilling can start.

2-16.3(3)C ONE NUMBER LOCATOR SERVICE – ADDITIONAL REQUIREMENTS

In addition to the requirements of Section 1-07.17, the Contractor must provide the following information when notifying One Call Locator Service:

1. The type of excavation is directional drilling
2. A brief description of the proposed bore path location, full length, including its start and finish locations
3. The range of proposed bore depths
4. Indicate the proposed bore path will be adequately surface-marked its entire length to aid One Call Locator Service utility locators
5. Request "marking" of all service laterals and appurtenances within 10-feet of the proposed bore path

Before notifying One Call Locator Service, surface mark the proposed bore path at regular and frequent intervals unless surface features require increasing or decreasing interval spacing. These surface markings must be per the APWA Uniform

Color Code. In areas where surface markings are not allowed, stakes must be used and the Contractor must alert One Call Locator Service of staking.

2-16.3(3)D PHYSICAL LOCATION OF EXISTING UNDERGROUND FACILITIES

Contractor must physically locate and identify the type, size, and depth of underground facilities, including service laterals, along the proposed bore path, if the location and depth of a facility is indicated as within 10 feet the proposed bore path. Physical location of existing underground facilities must be performed before approval of the proposed bore path. For unlocatable underground facilities, the Contractor must request the best available information from the facility owner. The Contractor must provide advance notification and coordination with public and private underground facility owners prior to physically locating facilities and prior to crossing underground facilities with the drilling head.

2-16.3(3)E VISUAL VERIFICATION OF EXISTING UNDERGROUND FACILITIES

When the proposed bore path is within 36 inches of an existing underground facility or service lateral, or where shown on the Drawings, the Contractor must visually verify that the DHA safely clears an underground facility and that the underground facility is isolated from drilling fluid. Visual verification consists of exposing the underground facility while the DHA advances to allow visual observation that the DHA does not disturb the underground facility. The exposure and visual verification locations must be in alignment with the proposed bore path or advancing DHA.

2-16.3(3)F SELECT UNDERGROUND FACILITIES – SPECIAL REQUIREMENTS

Some utilities may have special requirements when being crossed by an HDD installation. The Contractor must coordinate with utility owner to ensure that all special requirements specified in the Contract are met.

The Contract may specify clearances, notifications, and other requirements for other underground facilities not listed above. The Contractor must promptly notify the Engineer if the utility owner has additional requirements that are not addressed in the Contract.

2-16.3(4) ACTIVE AND PASSIVE INTERFERENCES AND DRILLING EQUIPMENT

In preparing for drilling, the Contractor must walk the proposed bore path with locating equipment as it relates to tracking the DHA and must identify areas of active interferences and passive interferences that impact location readings of the DHA by the Contractor's locating equipment.

Interference areas must be identified on the proposed bore path alignment and profile Shop Drawing. The Contractor must use a walkover locator receiver that is capable of being calibrated to account for interferences along the proposed bore path. The Contractor's locator must locate the DHA in all indicated interference areas and must record the readings in the daily log and as-built drawings.

2-16.3(5) SUBMITTAL

2-16.3(5)A SUBMITTAL – EXPERIENCE

The Contractor must submit the following information to the Engineer at least 10 Working Days before starting HDD operations:

1. Directional drilling crew qualifications, including operator, locator, and drilling fluid "engineer" if applicable.
2. A project list of the 5 most recent directional drilling projects which satisfy the requirements specified in Section 2-16.3(1) for each crew member listed above.

The project list must show each project's name and total price paid by the project owner for the horizontal directional drilling, the project owner, an owner contact person knowledgeable of the drilling, the type and size of pipe installed, and the maximum depth of the bore.

2-16.3(5)B SUBMITTALS REQUIRED BEFORE STARTING DRILLING

The Contractor must submit the following information to the Engineer, at least 10 Working Days before starting HDD operations:

1. Shop Drawings of the proposed HDD bore path alignment and profile, full length, showing all existing underground facilities within 10 feet of the alignment. Include all known required clearances, locations of any launch and receiving locations, equipment setup areas, the location of all equipment, staging areas, and the safe working zone. Include any areas of active or passive interferences based upon the calibration of the HDD locator receiver.
2. A list and description of equipment and Supplies as they relate to HDD, including the following:
   a. Manufacturer literature, make, model, and year purchased for the HDD machine, and its parts if not of the same manufacturer;
   b. The HDD equipment manufacturer's recommended maintenance and repair program;
   c. Drilling rig thrust and torque capacity;
   d. Drilling fluid pump flow rates and pressures;
   e. Drilling fluid mixing tank volumes;

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f. Photos or Shop Drawings of proposed drilling tools and all downhole tools including reamers and pull head assembly;
g. Spill containment and cleanup tools and environmental controls; and
h. Manufacturer's literature and details of the tracking equipment.

3. Descriptions of all methods, equipment, and materials to be used for the product pipe installation. Method descriptions must be chronological and include details of mobilization activities, utility potholing and physical location, pavement removal, pilot bore, reaming, pipe pullback, spoils disposal, product pipe mandrel testing, tracer wire installation, temporary capping of the product pipe, backfill, and restoration activities.
4. Description of how the locator will guide the drill and steps that will be taken to accurately track the bore. In areas of active and passive interference, explain how these interferences impact locating the DHA, where the DHA is going, what the attitude of the DHA is, the degree of uncertainty, and explain how the Contractor intends to compensate for these interferences and uncertainty ensuring the DHA follows the proposed bore path alignment and profile.
5. List of all underground facilities' owners where notification, coordination, and uncovering arrangements are required, including the contact persons, how contact is made, and any pre-arranged requests of these owners.
6. Description of the drilling fluid and component parts, with manufacturers' specifications and data, including the following:
   a. The planned mix design
   b. Procedures during drilling including anticipated pumping rate, pressure and volumes of drilling fluids
   c. Details of the associated containment, control, collection, transport and disposal of drilling fluids and spoils with estimated volumes for each bore.
7. Proposed disposal site and a letter from the disposal site indicating willingness and legal authority to accept the described and anticipated waste products.
8. Details of the soils separation plant if planned, including mixing and storage tank volumes, pump capacity and how to adjust the drilling fluid for filter cake and gel strength needs as the DHA advances and drilling fluid conditions fluctuate. Provide details for obtaining and transportation of drilling fluid makeup water including estimated volumes required for each bore.
9. Provide a description of controls to maintain safe working conditions and safe conditions where the public will be at risk, such as at the launch and receiving locations.
10. SDS for all Supplies and materials that will be used.
11. Copies of all permits required and obtained for the drilling operation if not required by other Specifications.
12. A detailed and legible schedule of work, in addition to the requirements of Section 1-08.3, which must include the following:
    a. Mobilization;
    b. One call utility locates requests and physical location of crossing and parallel utilities;
    c. Site preparation and excavation;
    d. Pilot boring;
    e. Reaming;
    f. Installation of tracer wire (if applicable);
    g. Product pipe pullback;
    h. Cleaning and site restoration;
    i. Pipe testing;
    j. Temporary capping (if applicable); and
    k. Demobilization.

No drilling is allowed until the Engineer has reviewed and approved this submittal.

2-16.3(5)C SUBMITTALS REQUIRED DURING AND AFTER COMPLETION OF DRILLING

The Contractor must submit daily logs of the drilling by noon on the day following the drilling activities. See Section 2-16.3(15)B.

Within 5 Working Days of completing the installation of product pipe in the bore, the Contractor must submit a copy of the daily log and as-built Drawing as specified in Section 2-16.3(15)C.

2-16.3(6) PRE-DRILL MEETING AND OTHER MEETINGS

Before starting directional drilling, the Contractor must hold a pre-drill meeting with the drill operator, locator, and the Engineer. The pre-drilling meeting must be held within 48-hours of initiation of the pilot bore.

The meeting agenda must include a walk-through of all elements of the proposed bore path and drilling operation including:

1. Required notifications and coordination;
2. Location-specific controls and monitoring;
3. Open communication channels between the driller, Contractor, and Engineer;
4. Required entries to the daily log and updating of the as-built drawings; and
5. Ensuring the drilling is conducted safely and is within the design tolerance.

2-16.3(7) MONITORING THE BORE

The Contractor must verify that the bore path of the drill follows the proposed bore path in both alignment and profile, that the indicated readings of depth and location of the DHA by the Contractor's locator match the actual location and depth of the DHA as verified by exploratory or other type excavation, and that all underground facilities are identified, their locations confirmed, and the bore path indicates clearances with all underground facilities.

The Contractor must perform surface locate readings to track the DHA at least every 20 feet, or more frequently as required, and log the time, station, and depth of the DHA.

All Contractor located DHA location and depth readings, and visually verified depth and location readings, must be shown on the plan and profile Shop Drawing as it relates to the proposed bore path, and must be recorded in the daily log.

2-16.3(8) LOCATE TRACKING SYSTEM

The DHA locate system must be of the strength and type for tracking the DHA at the designed bore path, including providing readings in areas of indicated active and passive interferences. The batteries in the transmitter and receiver must be fresh, and of the strength and type required for the conditions expected to be encountered along the bore path and Project Site conditions. The transmitter at the DHA must be adequately calibrated with the receiver to overcome indicated interferences including obtaining readings that will be required on either side of the bore path where such information increases confidence of the readings.

Tracking and locating equipment must be calibrated at the start of each shift, and at the start of each Day.

Locator readings, exploratory and other type excavation verification, and the status of batteries and locating equipment, including any repair, must be recorded in the daily log and on the as-built drawings, as applicable, see Section 2-16.3(15).

2-16.3(9) LAUNCH AND RECEIVING LOCATIONS AND PITS

The Contractor must select the locations of the launch and the receiving locations best suited for the directional drilling operation. Such entry and exit locations may be pits or excavations. If and where necessary, such locations must include the following:

1. Adjacent area for safe working zone, see Section 2-16.3(14)
2. Support, staging, and related needs
3. Considerations for the pipe bend radius, see Section 2-16.3(10)
4. Adequate space to provide a bore path alignment and profile that provides adequate clearances with existing underground infrastructure, see Section 2-16.3(3)
5. Location to provide the necessary entry and exit angles and meet the design entry and exit pipe elevation
6. Containment of drill waste (spoils), and groundwater treatment and discharge

2-16.3(10) BEND RADIUS

Bend radius must be taken into consideration in proposing the bore path alignment and profile, including expected directional adjustments along bore path. The allowable bend radius, per the manufacturers recommended tolerances, of product pipe, of drill string, and of drill equipment must be compatible and must not present a condition for overstressing pipe, joint, drill string, or equipment.

2-16.3(11) REAMING

Reaming may be necessary to incrementally enlarge a pilot bore to a size to accommodate acceptable product pipe installation. Enlargement of the bore hole through reaming must allow for minimizing frictional resistance during installation of the product pipe, and for allowing removal of spoils while installing the product pipe. Pipe material and joints must have sufficient strength in tension, bending, and hoop strength to allow installation of the pipeline without damage to the pipeline.

2-16.3(12) DRILLING FLUID

The Contractor must maintain a drilling fluid system that is compatible with the site conditions. Drilling fluid must be developed to be used with fluid-assisted cutting, have a filter cake and gel strength to stabilize the borehole, and have viscosity and gel strength to carry excavated material from the borehole. The Contractor must maintain equipment and supplies in-place to clean drilling fluid for re-use, adjust drilling fluid with additives to improve drilling characteristics, and maintain adequate quantity of drilling fluid as the bore progresses. The Contractor must continuously monitor drilling fluid quality and spoils content as they relate to filter caking and gel strength.

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If drilling fluid circulation is lost during drilling, the Contractor must stop drilling and adjust the equipment or drilling practices to regain circulation. The location and depth where circulation was lost must be recorded on the daily log, as well as indications of procedures to regain circulation.

The Contractor must identify locations of inadvertent returns along the bore path as they are indicated. This information must be entered into the daily log and must include location of DHA, depth of DHA, time of day, date, estimated quantity of lost drilling fluid, and methods of containment and cleanup. Any inadvertent fluid return location must be allowed to heal prior to re-pressurizing.

2-16.3(13) ENVIRONMANTAL CONTROL

The Contractor must use environmental controls in containing and handling spoils, drilling fluid, waste, additives, and other pollutants of any kind, that are in compliance with law, code, regulation, and as may be required in the Contract.

Containment Supplies that absorb and contain drilling fluid and other material associated with the HDD installation must be kept on site. See Section 1-07.5 for required environmental controls.

2-16.3(14) SAFE WORKING ZONE

The area surrounding the launch location and the receiving location must be secured as a safe working area to protect the public from potential hazards associated with directional drilling.

2-16.3(15) DAILY LOG AND AS-BUILT DRAWINGS

2-16.3(15)A GENERAL

The Contractor must keep daily written records of all daily progress and events, and a copy of the proposed bore path updated to reflect the actual bore path in the as-built drawings. The daily log must be coordinated with and must reference the as-built drawings, and the as-built drawings must reference entries in the daily log where appropriate. The daily log and as-built drawings must be kept at the Project Site and must be made available to the Engineer upon request.

See Section 2-16.3(5)C for submittal requirements.

2-16.3(15)B DAILY LOG

Entries to appear in the daily log must be recorded as they occur, or if unable, a brief entry in the diary must be made stating that additional explanation will be provided at end of Working Day. Typical entries to the daily log must reference entries on the as-built drawings as applicable and must include:

1. All notifications made to utility owners including date notified and a summary of any requirement made by the utility owner beyond a simple notification, including communications with by Utility Owners, and any site visits by Utility Owners including name of individuals, phone and email contact information, date, time of visit, and a summary of any requirement and observation made by the utility owner.
2. Results of any exploratory or other type excavation used to verify location and depth of DHA.
3. Description of areas of active or passive interference including description of the interference, locator method used, and locator calibration procedures or channels used to account for interference.
4. Description of daily progress including start and stop times and the length drilled each hour. Record time when drill begins and reaches exit locations. Record the time of any events listed this Section.
5. For as-built drawings showing exploratory and other type excavation's location and depth as performed in the field. Describe the purpose of the excavation and statement of findings. Reference the as-built drawings where exploratory or other type excavation was used or was required to verify DHA clearance with underground facility, and state results including identifying which underground facility.
6. Description of drilling fluid status, including changes in or adjustments to drilling fluid content or quality, and reasons for adjustment. State the location of the DHA relative to the Drawing where drilling fluid adjustment were required. Record location and time where any inadvertent return occurred.
7. Description of reaming and installation of product pipe. If casing was used, include this in the description, and include a description of annular space filler and how installed, if applicable.

2-16.3(15)C AS-BUILT DRAWINGS

The as-built drawing must include the location of the bore as well as the design of the pipeline and show existing underground facilities, including their dimension, depth, any appurtenance, and proposed and required clearances.

As-built drawings must be full sized Shop Drawings as specified in Section 1-05.3(11).

As the bore progresses, the following must be clearly shown on the as-built Drawing, as applicable:

1. Entrance and exit locations, and details of pits, if used. Identify safe working zones, locations of equipment and Supplies, see Section 2-16.3(9)
2. Tracking locations of the DHA and the indicated depth of DHA at that location
3. Locations of active and passive interference, if applicable. Show locations and depth of exploratory or other type excavations verifying locator DHA reading.

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4. Locations of underground infrastructure including depth to facility, dimension of facility, special bedding if any, and appurtenances associated with a facility. Clearly identify exploratory or other type excavation locations and depths as specified in Section 2-16.3(3).
5. Exploratory or other type excavation locations and depths that were performed during the drilling. Reference the entry in the daily log, including "pipeline" and "pipeline system."
6. Proposed bore path alignment and profile, see Section 2-16.3(5)C, and actual bore path alignment and profile. Show entry location and exit location angles for product pipe installation including pipe size and invert elevations at entrance and exit locations.

If the actual bore path alignment or profile or both differ from as specified in the Contract or as proposed, see Section 2-16.3(5)C, the Contractor must show both actual and proposed bore paths and must clearly identify and label each.

2-16.3(16) TESTING

The Contractor must test the installed pipe or product pipe as specified in the Contract for the type and size of pipe installed.

2-16.4 MEASUREMENT

Measurement for "Pipe, (Material), (Class), (Size), and (Directional Drilling)" is by linear foot of pipe actually installed and tested. Measurement is from end of pipe to end of pipe whether a pipe end is within a structure or not. No measurement is made for pit whether an entry pit or an exit pit.

"Exploratory Or Other Type Excavation, (Directional Drilling)" is per lump sum for all exploratory and other type excavation directly related to directional drilling.

2-16.5 PAYMENT

1. **"Directional Drilling Preparatory Work"**, per lump sum

The Bid Item price for "Directional Drilling Preparatory Work" includes all costs for the work necessary to perform investigatory requirements including necessary exploratory and other types of excavation.

2. **"Pipe Installation, (Material), (Class), (Size), Directional Drilling"**, per linear foot

The Bid Item price for "Pipe Installation, (Material), (Class), (Size), Directional Drilling", per linear foot, includes all costs for the work required to directional drill as specified in this Section except for other Bid Items in this Section.

3. **Other payment information**

Payment for all cost for the Electrical Safety Observer will be as specified in Section 1-05.2(2).

Payment for all cost for backfilling exploratory or other type excavations within paved areas of the Right of Way that are associated with directional drilling are considered incidental to the various Bid Items and no additional or separate payment will be made.

Payment for all costs for surface restorations associated with directional drilling will be per the various Bid Items in the Contract.

SECTION 2-17 AUGER BORING

2-17.1 DESCRIPTION

For horizontal directional drilling trenchless construction, see Section 2-16. For underground construction or trenchless construction except auger boring and directional drilling, see Section 7-17.3(2)H.

Auger boring is a pipe jacking technique for installing a steel casing from a launch shaft to a reception shaft. Excavation is accomplished by means of a rotating cutting head that is driven by helically wound auger flights rotating within the steel casing. Soil is removed from the face of the auger through the auger flights to the launch shaft. Auger boring is for use above the groundwater or in a dewatered environment. The location, depth, and dimension of existing underground facilities within 10 feet of the proposed auger bore path are identified and located, including appurtenances as may exist, and the auger bore path alignment in relation to these underground utilities is planned. The auger boring equipment is set up to allow the location and depth of the steel casing to follow the design bore path and grade is monitored at all times with a water level. Notifications and coordination with others whose underground facilities exist along the auger bore path are prearranged and timely.

The Contractor must furnish all labor, equipment, and materials necessary to complete the work in accordance with these specifications at locations designated for auger boring installation and with material dimensions shown on the Drawings.

Where used in this Section, the following terms and phrases must be understood as defined below:

1. Annular space: The space between the inside diameter of the casing pipe and the outside diameter of the carrier pipe.
2. Casing pipe: Pipe specifically designed to be installed using auger boring.
3. Carrier pipe: Pipe installed within the casing pipe after auger boring is completed.
4. Launch shaft: An excavation from which trenchless technology equipment is advanced.

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5. Lubrication: A bentonite slurry or polymer mixture injected into the space between the outer diameter of the casing pipe and the soil to reduce friction between the casing pipe and the in-situ soil during the auger boring operations.
6. Lubrication/grout port: A port within the casing pipe fitted with a one-way valve for injection of lubrication material or grout into the annular space between the pipe and the ground.
7. Obstruction: An object or feature that stops forward progress of the auger boring machine.
8. Physical location: as it relates to existing underground facilities, determination of depth and lateral position of a facility via potholing or other means of excavation, as a means to confirm or compare with the facility's location as shown on the Drawings or any other source.
9. Receiving shaft: An excavation into which trenchless technology equipment is recovered following the installation of the casing.
10. Underground facility: all underground features including pipe networks, underground structures, piles, and footings.
11. Underground utility: existing pipelines, conduits, and cables
12. Visual verification during auger boring: as it relates to underground facilities, exposure of the underground facility via potholing or other means of excavation while the leading edge of the auger bore crosses the facility so the operator can confirm visually that the auger bore alignment does not conflict with the existing facility.

2-17.2 MATERIALS

Casing pipe, and carrier pipe when required, must be as specified in the Contract. The casing pipe must be of sufficient strength to withstand installation stresses for the size, length, and depth of the auger bore.

2-17.3 CONSTRUCTION REQUIREMENTS

2-17.3(1) EXPERIENCE

See Section 2-17.3(5)A for submittal requirements.

In addition to requirements specified elsewhere in the Contract, the auger boring crew, whether Contractor or Subcontractor, must demonstrate experience with the use of the auger boring equipment proposed for use on the project. The auger boring superintendent and machine operator must have completed 5 auger bores with a minimum diameter equal to or greater than the diameter shown on the Drawings and with a minimum length equal to or greater than that shown on the Drawings, with 3 of the auger bores in soil similar to the soil anticipated on the auger bores shown on the Drawings. The operator must demonstrate experience on the equipment proposed for use.

2-17.3(2) AUGER BORING EQUIPMENT

The Contractor must match the auger boring equipment and supplies to the soils and Project Site conditions. All auger boring equipment, whether direct or supporting, must be maintained in accordance with the manufacturer's recommendations for machine maintenance. Hoses and hose connectors must be maintained per the manufacturer's recommendations and have no flaws, with hose connections recommended by the manufacturer. Flow meters and pressure reading gauges must be calibrated per manufacturer's recommendations.

All gages and monitoring equipment must be maintained per the manufacturer's recommendations and must provide legible readings for the operator or inspector observations. Any broken gages will be repaired prior to using the auger boring equipment.

The auger flights must be full diameter augers for the specified casing size. All auger flights must be inspected to verify they are structurally sound with no cracks, no excessive wear, continuous threads, and no flaws before incorporating for use in the auger boring operation. Defective auger flights are not allowed and will be considered unauthorized work.

Use a jacking system that is capable of continuously monitoring the jacking pressure.

2-17.3(3) AUGER BORE ALIGNMENT - PREPARATORY REQUIREMENTS

2-17.3(3)A GENERAL

Before any auger boring activity starts, the Contractor must make preparatory measures as applicable and as specified in Section 2-17.3(3), and as specified in the Contract.

2-17.3(3)B EXISTING UNDERGROUND FACILITIES

The plan and profile locations of known existing underground facilities, appurtenances, and other underground features and improvements including existing utilities, anchor systems, and service laterals, along and near the proposed bore path are shown on the Drawings. The Contractor must physically locate all underground facilities within the limits specified in Section 2-17.3(3)D and where shown on the Drawings. The Contractor must expose and visually verify clearances between the auger bore alignment and existing facilities within the limits specified in Section 2-17.3(3)E and where shown on the Drawings during auger bore operations.

When preparing auger bore path alignment and profile, the Contractor must compare the underground facility locations, depths, dimensions, and appurtenances, as specified in the Contract, with the actual facility locations, depths, dimensions, and appurtenances, and with the proposed auger bore path alignment and profile. Where conflict is indicated, such conflict must be resolved before auger boring can start.

2-17.3(3)C ONE CALL LOCATOR SERVICE

In addition to the requirements of Section 1-07.17, the Contractor must provide the following information when notifying One Call Locator Service:

1. The type of excavation is auger boring
2. A brief description of the proposed auger bore path, location, full length, including its start and finish locations, and the maximum proposed depth
3. Indicate the proposed auger bore path will be adequately surface-marked its entire length, to aid One Call Locator Service utility locators
4. Request "marking" of all service laterals and appurtenances within 10-feet of the proposed bore path

Before notifying One Call Locator Service, surface mark the proposed bore path at regular and frequent intervals unless surface features require increasing or decreasing interval spacing. These surface markings must be per the APWA Uniform Color Code. In areas where surface markings are not allowed, stakes must be used and the Contractor must alert One Call Locator Service of staking.

2-17.3(3)D PHYSICAL LOCATION OF EXISTING UNDERGROUND FACILITIES

Contractor must physically locate and identify the type, size, and depth of underground facilities, including service laterals, along the proposed bore path, if the location and depth of a facility is indicated as within 10 feet of the proposed bore path. Physical location of existing underground facilities must be performed before approval of the proposed bore path. For unlocatable underground facilities, the Contractor must request the best available information from the facility owner. The Contractor must provide advance notification and coordination with public and private underground facility owners prior to physically locating facilities and prior to crossing underground facilities with the casing.

2-17.3(3)E VISUAL VERIFICATION OF EXISTING UNDERGROUND FACILITIES

When the proposed auger bore alignment is within 24 inches of an existing underground facility or service lateral, or where shown on the Drawings, the Contractor must visually verify that the leading edge of the casing safely clears the underground facility by exposing the underground facility while the leading edge advances. These exposure and visual verification locations must be in alignment with the proposed auger bore path and advancing casing.

2-17.3(3)F SELECT UNDERGROUND UTILITIES – SPECIAL REQUIREMENTS

Some utilities have special requirements for auger boring. The Contractor must coordinate with utility owner to ensure that all special requirements specified in the Contract are met.

The Contract may specify clearances, notifications, and other requirements for other underground facilities not listed above. The Contractor must promptly notify the Engineer if the utility owner has additional requirements that are not addressed in the Contract.

2-17.3(4) GRADE MEASUREMENT AND RECORDING

In preparing for auger boring, the Contractor must set up all equipment to construct the auger bore to the line and grade shown on the Drawings. The auger bore rails and jacking equipment must be surveyed to ensure they are set to the design bore alignment.

The Contractor must use a method for monitoring grade of the alignment, such as a water level or approved equal. Grade will be monitored during auger boring and recorded at a minimum of once per pipe segment during auger boring operations and shown on the daily logs and as-built drawings.

2-17.3(5) SUBMITTAL

2-17.3(5)A SUBMITTAL – EXPERIENCE

The Contractor must submit the following information to the Engineer at least 10 Working Days before starting auger boring operations:

1. Auger boring crew qualifications, including superintendent and machine operator.
2. A project list of the 5 most recent auger bore projects which satisfy the experience requirements specified in Section 2-17.3(1) for each crew member listed above.

The project list must show each project's name and total price paid by the owner for auger boring, the project owner, an owner contact person knowledgeable of the project, casing size and wall thickness, type and size of carrier pipe installed within the casing, length and depth of the auger bore, soil and groundwater conditions at the auger bore site, and any environmental constraints on the project.

2-17.3(5)B SUBMITTALS REQUIRED BEFORE STARTING AUGER BORING

The Contractor must submit the following information to the Engineer at least 10 Working Days before the start of auger boring operations:

1. Shop Drawing of the proposed auger bore alignment in plan and profile views showing all existing underground utilities within 10 feet of the alignment as they relate to the auger boring including any known appurtenances,

clearances as required, locations of launch and receiving locations or pits, equipment setup areas, the location of all equipment, staging areas, and safe working zone.

2. List and description of equipment, materials, and supplies as they relate to the auger boring, including the following:
   a. Manufacturer literature, make, model, and year purchased for the auger boring machine, and its parts if not of the same manufacturer;
   b. Auger boring equipment manufacturer's recommended maintenance and repair program;
   c. Details of the auger boring equipment, complete with jacking capacity and torque. These details must demonstrate that the estimated jacking force to complete the installation does not exceed the available capacity of the equipment, with a factor of safety of 2.0. Submit the SDS for all materials and supplies.
3. Description of methods, equipment and procedures to be utilized in completing the auger boring Work, including:
   a. Method and capabilities for controlling ground conditions at the excavation face and preventing loss of ground in front of, above, and surrounding the operation at all times, including during shutdown periods.
   b. Operational practices of the auger boring equipment to ensure that the casing will pass beneath utilities without damage.
4. Calculations of the anticipated jacking force required to complete the installation, providing details of the calculation method and assumptions used to determine anticipated forces, including the following:
   a. Calculations on the thrust resistance wall within the jacking shaft illustrating sufficient capacity to resist the jacking force with a safety factor of 1.5.
   b. Calculations demonstrating that the pipe selected has been designed to support the maximum earth loads and superimposed live loads, both static and dynamic, which will be imposed on the pipe. This calculation must include the maximum allowable jacking force that can be applied to the pipe during installation with a minimum factor of safety of 2.0.
   c. All calculations must be signed and stamped by a registered professional engineer in the State of Washington.
5. Schedule for auger boring working identifying all major construction activities as independent items, including:
   a. Jacking shaft construction
   b. Reception shaft construction
   c. Casing installation
   d. Carrier pipe installation
   e. Advance notifications required for any utilities or railroads
6. A spoils removal plan, including all equipment necessary to remove the spoils from the shaft for transportation and the location and details of the disposal site.
7. An obstruction removal plan, including methods for removal of an obstruction beneath any critical features or utilities the auger bore will pass beneath.
8. Dewatering procedures and groundwater control details, including launch and receiving seals where shown on the Drawings. Describe proposed methods for testing groundwater and discharge locations. Provide a copy of any permit necessary for groundwater discharge.
9. Description of controls to prevent environmental pollution, to stay within environmental constraints where specified in the Contract, and the proposed approach to containing excavation spoils in the launch and receiving locations or pits.
10. An auger boring safety plan including description of controls to maintain safe working conditions and safe conditions where the public may be at risk, such as at the launch and receiving locations.
11. Material specifications and shop drawings of casing pipe showing the following:
    a. Pipe wall thickness meeting the minimum thickness shown on the Drawings
    b. Steel grade and the maximum allowable jacking force
    c. Yield strength and end preparation
    d. Manufacturing tolerances of the pipe supplier
    e. Pipe certification of compliance
12. Submit details on the casing spacers that will be used for the installation of the carrier pipe within the steel casing pipe installed by auger boring. Provide manufacturer's literature, planned location of the casing spacers, and procedures for installation of the pipe with the casing spacers.
13. Facility protection plan including all utilities, description and locations of permanent ground support systems, underpinnings, and dead-man systems, and how these facilities are to be protected during auger boring operations.
14. Copies of all permits required and obtained for the auger boring operation if not provided in the Specifications.
15. Contingency Plan describing the Contractor's approach for dealing with the following during construction:
    a. Obstructions halting the forward advancement of the casing.
    b. Voids created in front of or above the casing,

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c. Casing installed outside of the specified tolerances.

No auger boring is allowed until the Engineer has reviewed and approved this submittal.

2-17.3(5)C SUBMITTALS REQUIRED DURING AND AFTER COMPLETION OF CASING INSTALLATION

The Contractor must submit daily logs of the auger boring by noon on the day following the auger boring activities. See Section 2-17.3(15)B.

Within 5 Working Days of completing the installation of carrier pipe in the casing, the Contractor must submit a copy of all daily logs and as-built Drawings as specified in Section 2-17.3(15)C.

2-17.3(6) PRE-AUGER BORING MEETING

Before the Contractor starts auger boring the Contractor must hold a pre-auger boring meeting with the superintendent, auger boring operator, the Engineer, and the engineer of record. Such meeting may include the briefing/tailgate conference with the Electrical Safety Observer as specified in Section 1-05.2(2), and may include other utility owners.

The intent of the meeting is to review all elements of the proposed auger boring operation including:

1. Notifications and coordination.
2. Verify the rails have been surveyed to the design elevation and slope.
3. Communication protocols between the auger boring operator, Contractor, and Engineer.
4. Required entries to the daily log and updating the as-built drawings.
5. Ensuring the auger boring is conducted safely and is conducted within the specified tolerances.
6. Methods for confirming the as-built casing alignment and profile is within the tolerance of the design auger bore alignment and profile.

2-17.3(7) CASING INSTALLATION

Jack each pipe section forward as the excavation progresses to provide complete and continuous ground support at the face of the excavation. Provide a jacking frame capable of developing a uniform distribution of jacking forces around the periphery of the pipe. Design and construct the thrust reaction backstop that is square to the alignment and evenly distributes the jacking reaction forces to the shaft and soil mass behind the back wall of the jacking shaft. The thrust wall must be designed to support the jacking capacity of the auger bore machine.

If the location of the casing installation exceeds the specified tolerances, the Contractor must correct the installation. All corrective Work must be performed as described in the accepted Contingency Plan or a detailed alternative corrective action plan should the Contingency Plan not suit the situation. All work will be conducted at no additional cost to the Owner.

The Contractor must use benchmarks to maintain line and grade to establish the location of the casing pipe and the pipe guide rails in the shaft to ensure they are aligned to the line and grade shown on the Drawings. Submit to the Engineer all copies of field notes used to establish all lines and grades.

If the location marker or the equipment for determining the alignment is damaged or compromised in any way, the Contractor must re-establish the position prior to determining the as-built location of the Auger Bore.

Steel casing must have welded joints. Steel casing must be square cut with beveled ends using a full-penetration butt weld. Welding procedures must be per the requirements of AWS and AWWA C2016 and the joints must be welded by AWS certified welder. If a casing section is damaged during the installation, the Contractor must repair the casing to a state that allows installation of the carrier pipe without disturbance of the surrounding soil in a method accepted by the Engineer. All voids resulting from damaged casing repair to be filled to the satisfaction of the Engineer.

Provide dewatering or groundwater control as required for proper execution of the Work, including the use of launch and reception shaft seals as needed.

If the soil at the face of the machine is not stable and subject to flowing or fast raveling conditions, the Contractor must recess their augers inside the casing or use some alternate method to ensure that the face is controlled, and soil does not freely flow into the augers or the casing.

Transport and dispose of all excavated spoils in accordance with the submitted disposal plan. Only use the disposal sites identified in accepted submittals.

In the event the Contractor encounters a problem during the Work and the situation is not covered by the Contractor's Contingency Plan, the Contractor must propose alternative solutions to the Engineer for acceptance.

After completing Work, provide the Engineer with access to both pipe ends for visual inspection. The installed casing is subject to visual inspection by the Engineer.

The Contractor must remove all construction debris, spoil, slurry, oil, grease, and other materials from the installed casing.

2-17.3(8) INSTALLATION OF CARRIER PIPE IN CASING

The Contractor must install the carrier pipe in the casing pipe using casing spacers. Casing spacers must be used per the manufacturer's recommendations, using a minimum of two spacers per pipe joint length. Place spacers a maximum of 2 feet from the ends of the pipe.

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Protect carrier pipe coating from damage during installation. Any pipe with coating damaged during installation must be replaced at the Contractor's sole expense.

The carrier pipe must be anchored against flotation and air release ports must be installed as required to facilitate filling annular space. Install full sticks of carrier pipe except as necessary to match the designed length of installation.

2-17.3(9) LAUNCH AND RECEIVING LOCATIONS AND SHAFTS

The Contractor must locate the launch and the receiving shafts best suited for the auger boring operation while remaining in the construction limits shown on the Drawings. Such entry and exit locations must be shafts or excavations in accordance with the Drawings. If and where necessary, such locations must include:

1. Adjacent area for safe working zone, see Section 2-17.3(14)
2. Support, staging, and related needs
3. Auger bore path alignment, profile, and clearances with existing underground infrastructure, see Section 2-17.3(3)
4. Depth of the launch shaft and the receiving shaft to allow for casing depth and slope shown on the Drawings
5. Containment of excavation spoils and groundwater treatment and discharge

2-17.3(10) OBSTRUCTIONS DURING INSTALLATION

Notify the Engineer immediately in writing upon encountering an obstruction. The Contractor must provide the Engineer visual access to verify objects. Upon written authorization by the Engineer, proceed with removal of the obstruction in accordance with the Contractor's submitted obstruction removal plan or modify and submit an obstruction removal plan that is tailored for the specific situation.

Take all necessary steps to safely remove any obstruction or otherwise permit the resumption of casing installation. All obstructions less than or equal to 30% of the casing inner diameter in the longest dimension are the responsibility of the Contractor and will not be considered for additional payment.

2-17.3(11) TOLERANCES

The auger bore casing installation must remain within the tolerances shown on the Drawings at all locations along the alignment. If no tolerances are indicated on the drawings, the maximum vertical deviation must be no greater than 1 percent of length and the maximum horizontal deviation must be no greater than 1 percent of length. The Contractor must notify the Engineer if the vertical grade deviation is at or exceeds the specified maximum vertical deviation. The carrier pipe must be installed at the grade and tolerance as shown on the Drawings.

2-17.3(12) ENVIRONMENTAL CONTROL

The Contractor must use environmental controls that comply with law, code, and regulation to contain and handle tunnel spoils, waste, and other pollutants of any.

Supplies that absorb and contain oil and grease and other material associated with construction must be readily available. Also see Section 1-07.5 for required environmental controls.

2-17.3(13) PERSONAL PROTECTIVE EQUIPMENT (PPE)

The Contractor must comply with all applicable safety rules developed by OSHA and WSHA for pipe jacking from within a confined space. The Contractor must comply with all measures outlined in their site-specific safety plan.

2-17.3(14) SAFE WORKING ZONE

The area surrounding the launch shaft and the receiving shaft must be secured as a safe working area to protect the public from potential hazards associated with auger boring.

2-17.3(15) DAILY LOG AND AS-BUILT DRAWING

2-17.3(15)A GENERAL

The Contractor must keep written daily records of all daily progress and events, and a copy of the proposed auger bore path updated to reflect the actual line and grade in the as-built Drawings. The daily log must reference and be coordinated with the as-built drawings, and the as-built drawings must reference entries in the daily log where appropriate. The daily log and as-built drawings must be kept at the Project Site and must be made available to the Engineer upon request. See Section 2-17.3(5)C for submittal requirements.

2-17.3(15)B DAILY LOG

Entries to appear in the daily log must be recorded as they occur, or if unable, a brief entry in the diary must be made stating that additional explanation will be provided at end of Working Day. Typical entries to the daily log must reference entries on the as-built drawings as applicable and must include:

1. Notifications made to utility owners including date notified and a summary of any requirement made by the utility owner beyond a simple notification.

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2. Utility owners' on-site visits including name of individuals, phone and email contact information, date, time of visit, and a summary of any requirement and observation made by the utility owner.
3. Communications made by utility owners to the Contractor beyond those in items 1 and 2, and a summary of any request made by the utility owner.
4. Results of any exploratory or other type excavation used to verify location and depth of casing, for locations shown on the as-built Drawings, see Sections 2-17.3(7) and 2-17.3(8).
5. Inclination, jacking pressure, and start and stop time of each auger casing segment.
6. Pipe lubricant used, in gallons, and location along the alignment where the lubrication was pumped.
7. Problems encountered or reasons for stopping the auger boring process.
8. As-built Drawings showing exploratory and other type excavation's location and depth not addressed in preceding item 4: description of the purpose of the excavation and statement of findings. Reference the as-built drawings where exploratory or other type excavation was used or was required to verify casing clearance with underground facility, and state results including identifying which underground facility.
9. Description of daily progress made, including the time of day that auger boring starts, how far the casing advanced at each succeeding hour, time of day of casing reaching exit location, and the time of day for items 1, 2, 3, 4, 5, and as applicable, 6, 9, and 10 of this Section.
10. Description of groundwater flowing into any launch or receiving location or pit, and any resulting dewatering, method of treatment, and discharge or disposal. See Section 2-17.3(9).

2-17.3(15)C AS-BUILT DRAWINGS

The as-built drawing must be the as-constructed auger bore path alignment and profile and must show existing underground facilities, including their dimension, depth, any appurtenance, and proposed and required clearances.

As-built drawings must be full sized Shop Drawings as specified in Section 1-05.3(11).

As the auger bore progresses, the following must be clearly shown on the as-built drawing, as applicable:

1. Entrance and exit locations, and details of pits, if used. Identify safe working zones, locations of equipment and Supplies, see Section 2-17.3(11).
2. Locations and depth of casing. If exploratory or other excavation was used to verify casing location, show the location of the exploratory or other type of excavation performed in advance of the verification reading. Reference the daily log entry as to status of visual verification.
3. Locations of underground infrastructure including depth to facility, dimension of facility, special bedding if any, and appurtenances associated with a facility. Clearly identify exploratory or other type excavation locations and depths as required by Section 2-17.3(3).
4. Exploratory or other type excavation locations and depths that were performed during the auger boring. Reference the entry in the daily log, including "pipeline" and "pipeline system."
5. As constructed auger bore path alignment and profile. Show entry location and exit location horizontally and vertically for carrier pipe installation including size and pipe invert elevations at entrance and exit locations.

2-17.3(16) TESTING

The Contractor must test the installed pipe or product pipe as specified in the Contract for the type and size of pipe installed.

2-17.4 MEASUREMENT

Measurements for "Casing Pipe, (Material), (Class), (Size), Auger Boring", and for "Pipe, (Material), (Class), (Size), Auger Boring" is by the linear foot of pipe and casing pipe actually installed and tested. Measurement is from end of pipe to end of pipe whether a pipe end is within a structure or not. No measurement is made for pit whether an entry pit or an exit pit.

"Exploratory Excavation, Auger Boring" is per lump sum for all exploratory and other type excavation directly related to auger boring.

2-17.5 PAYMENT

1. **"Exploratory Excavation, Auger Boring"**, per lump sum.

The Bid Item price for "Exploratory Excavation, Auger Boring" includes all costs for the work necessary to perform investigatory requirements including necessary exploratory and other type excavation.

2. **"Casing Pipe, (Material), (Class), (Size), Auger Boring"**, per linear foot.

The Bid Item price for "Casing Pipe, (Material), (Class), (Size), Auger Boring", per linear foot, includes all costs for the work required to furnish and install casing pipe. All cost for filling the annular space when specified in the Contract are considered incidental to this Bid Item and no separate or additional payment will be made.

3. **"Carrier Pipe, (Material), (Class), (Size), Auger Boring"**, per linear foot.

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The Bid Item price for “Carrier Pipe, (Material), (Class), (Size), Auger Boring”, per linear foot, includes all costs for the work required to install carrier pipe as specified in this Section.

4. **“Shaft Construction”**, per each

The Bid Item price for “Shaft Construction” includes all costs for the work necessary to excavate, shore, and dewater the launch and reception shafts as specified in this Section.

5. **Other payment information**

Payment for all cost for the Electrical Safety Observer will be as specified in Section 1-05.2(2).

Payment for all cost for backfilling exploratory or other type excavations within paved areas of the Right of Way that are associated with auger boring are considered incidental to the various Bid Items and no additional or separate payment will be made.

Payment for all costs for surface restorations associated with auger boring will be per the various Bid Items in the Contract.

All costs for daily log will be included in the various Bid Items and no separate or additional payment will be made.

All cost for submittals are specified in Section 1-05.3

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DIVISION 3 PRODUCTION FROM QUARRY AND PIT SITES AND STOCKPILING

SECTION 3-01 PRODUCTION FROM QUARRY AND PIT SITES

3-01.1 DESCRIPTION

Section 3-01 describes Work consisting of manufacturing and producing crushed and screened aggregates including pit run aggregates of the kind, quality, and grading specified for use in the construction of Portland cement concrete, asphalt concrete, asphalt treated base, crushed surfacing, maintenance rock, ballast, gravel base, gravel backfill, gravel borrow, riprap, and bituminous surface treatments of all descriptions.

These requirements apply whether the source is ledge rock, talus, gravel, sand, or any combination thereof.

3-01.2 MATERIALS

3-01.2(1) GENERAL SOURCE

3-01.2(1)A APPROVAL OF SOURCE

Material sources must be approved in advance of use in the Work as specified in the requirements of Section 1-06.

3-01.2(1)B STRIPPING QUARRIES AND PITS

Stripping of quarries and pits consists of the removal, after clearing and grubbing, of the surface material and overburden which is unsuitable for the kind of Material to be borrowed or produced for use. Stripped Materials to be used later, as provided on the Job Site reclamation plan specified in Section 3-03, must be deposited within the quarry or pit site at such a location as not to interfere with future development within the site.

3-01.2(1)C PREPARATION OF SITE

The portion of the quarry or pit site to be used must be cleared and grubbed, and the area from which Materials are to be taken stripped of overburden as specified in Section 3-01.2(1)B. Dispose of all combustible debris resulting from these operations as acceptable to the Engineer.

3-01.2(1)D PRODUCTION REQUIREMENTS

Use all oversize stones, rock fragments, or boulders occurring in the source, up to and including those measuring 18 inches in the greatest dimension, in the manufacture of crushed Material.

If the grading or quality of raw material in sources used for the manufacture of products covered by this Section is such that the fracture, grading, or quality of the product specified cannot be obtained by using the natural Material, fine portions of the raw material will be rejected to the extent necessary to produce products meeting all requirements of these Specifications. Failure of the Owner to include a scalping requirement in the Contract does not relieve the Contractor of the responsibility for rejecting fine portions of the Material if such becomes necessary to produce products meeting all requirements of these Specifications. Perform scalping after the pit run or quarry run Material has passed through the primary crusher.

When scalping over a screen of a specified size is required in the Contract, the scalping screen must be of a size and capacity that it removes enough of the fine material to produce Material as specified.

Washing and reclaiming of the reject Material and subsequent addition of this Material to any finished products is not allowed unless specifically authorized in writing by the Engineer.

Surplus screenings accumulated during the crushing and screening of specified roadway Materials will be considered separate and distinct from reject Material resulting from scalping operations.

Both fine and coarse concrete aggregates must be thoroughly washed to remove clay, loam, alkali, bark, sticks, organic castings, or other deleterious matter. Washing is also required in the production of other Materials if necessary to produce products meeting all quality requirements of these Specifications.

When producing screened gravel or sand Materials, remove all oversize Material by screening at the pit site. The Contractor's operations in the pit must be conducted so that the grading of individual loads will be reasonably uniform. In general, use the most suitable Materials available and make as many moves of the loading equipment as may be necessary to fulfill these requirements.

Where pit run Materials comply with the requirements of the Specifications, screening or processing is not required.

3-01.2(1)E FINAL CLEANUP

Upon completion of the Contractor's operation, clear the quarry or pit of all rubbish, temporary structures, and equipment, leaving it in a neat and presentable condition. The pit or quarry must be reclaimed per the approved site reclamation plan specified in Section 3-03.

3-01.2(2) CONTRACTOR FURNISHED MATERIAL SOURCE

If the Contractor chooses to provide a source of Materials, or if the Contractor elects to use Materials from other private sources, the Contractor must, at no expense to the Owner, make all necessary arrangements for obtaining the Material and provide evidence that the needed quantity of suitable Material satisfying the requirements of Section 1-06 is available. Use of

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Materials from such sources is not permitted until representative samples taken by the Engineer have been tested, the source approved, and authority granted for the use. Before the samples are taken by the Engineer, the Contractor must, at no expense to the Owner, have done enough testing of the proposed site to enable the Engineer to obtain a sample that is representative of the Materials in the source.

Approval of a Contractor's source is contingent on the Material being of equal quality, and no additional costs will accrue to the Owner as a result of such approval. Equivalency of quality will be based on those test values listed in the Contract as being representative of Material in the Owner pre-approved source. If no such values are listed, the minimum specification requirements will apply.

Notify the Washington State Departments of Ecology, Fish and Wildlife and Natural Resources, in writing, of the intent to furnish the source, and at no expense to the Owner, make all necessary arrangements with these agencies for the determinations of regulations which might be imposed on the Contractor during removal of Materials from the source. When the Contractor intends to operate a source under the Owner's blanket surface mining permit, the Contractor must submit a reclamation plan at least 10 Working Days in advance. No work is allowed to start in the pit or quarry before the reclamation plan is approved by the Engineer.

The source must be selected so that, after the Materials have been removed, the pit drains to a natural drainage course and no ponding can result. Should the source selected by the Contractor not drain as outlined, the Contractor must obtain written permission from the governing body of the city or county to remove Materials from the pit or quarry, and provide a copy to the Engineer.

The Contractor must not operate a pit or a quarry site visible from any State highway unless it can be demonstrated to the complete satisfaction of the Engineer that no unsightly condition will result from or remain as a result of the Contractor's operations. If, in the opinion of the Engineer, unsightly conditions exist after removal of Materials from the site, correct such unsightly conditions as specified.

Following removal of Materials from the pit, the entire site must be cleared of all rubbish, temporary structures, and equipment which have resulted from the Contractor's occupancy and operations. Obliterate or screen to the satisfaction of the Engineer any unsightly conditions that remain. Obtain a written release from the permitter upon fulfillment of these requirements. All costs for cleaning up the pit site and for the installation or erection of screening or for other work required to correct unsightly conditions are at the Contractor's sole expense. The requirements of this paragraph do not apply to commercially operated pits.

All costs in connection with acquiring the rights to take Materials from the source, for exploring and developing the site, for complying with the regulations of the State agencies, for preparing the Job Site as provided in Section 3-01.2(1)C and Section 3-03, for cleaning up the site, and for correcting unsightly conditions, are included in the Bid Item prices for the various Bid Items of Work involved.

The grading and quality of Material must comply with the requirements of Section 9-03 unless the Contract specifies otherwise.

3-01.3 RESERVED

3-01.4 MEASUREMENT

All crushed, screened, or other quarry Materials will be measured by the tonnage of total weight of Material source minus water which is in excess of naturally occurring amounts.

For payment purposes, all crushed, screened, or naturally occurring Materials that are to be paid for by the ton, dependent on their grading, will be limited to the following water contents naturally occurring in the Material source:

% By Weight Passing U.S. No. 4	Maximum Water Content % By Weight
Less than 20%	4%
20% or more	8%

3-01.5 PAYMENT

Unless otherwise specified in the Contract, all costs in connection with the production of Materials meeting the quality requirements of these Specifications are included in the Bid Item prices of the various Bid Items involved and no separate or additional payment will be made.

Payment for the particular Materials or aggregates to be produced will be as specified in the appropriate Sections of the Specifications.

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SECTION 3-02 RESERVED

SECTION 3-03 SITE RECLAMATION

3-03.1 DESCRIPTION

Section 3-03 describes Work consisting of reclaiming land used for borrowing Material, mining for aggregates, sorting or wasting Materials as specified in the Contract.

3-03.2 GENERAL REQUIREMENTS

3-03.2(1) SITES

3-03.2(1)A CONTRACTOR PROVIDED SITES

All borrow, quarry, and pit sites larger than 3 acres in size of disturbed land, or resulting in pit walls more than thirty feet high and steeper than a 1 horizontal to 1 vertical slope which are owned or furnished by the Contractor, must be reclaimed per the conditions and requirements of an approved operating permit acquired from the Department of Natural Resources. When Material is acquired exclusively for use on this Contract, approval of reclamation plans may be allowed by the Surface Mined Land Reclamation Act of Washington and the rules and regulations adopted by the Department of Natural Resources.

When the Contractor obtains an operating permit from the Department of Natural Resources, provide evidence of such approval to the Engineer at least 3 Working Days before any work within the site.

Ultimate reclamation plans are not normally required for borrow, quarry, or pit sites not meeting the above criteria or for stockpile waste sites. However, all such sites must be reclaimed to the extent necessary to control erosion and provide satisfactory appearance consistent with anticipated future use.

Compliance with the State Environmental Policy Act (SEPA) is required for sites involving more than 100 cubic yards of excavation, or fill, throughout the lifetime of the Job Site unless the local agency in which the project is located establishes a greater amount. Sites involving more than 500 cubic yards of excavation or landfill throughout the lifetime of the Job Site always require compliance with SEPA. Prepare and submit reclamation plans as specified.

Under no circumstance will the Contractor be allowed to waste Material within a wetland as defined in Section 1-07.5(8).

3-03.2(1)B OUT OF STATE SITES

All out of State borrow, quarry or pit, stockpile, and waste sites which are furnished by the Contractor exclusively for use on this Contract must be reclaimed per an approved reclamation plan that is in compliance with local area restrictions.

3-03.2(2) RECLAMATION PLANS

3-03.2(2)A PLANS FOR CONTRACTOR PROVIDED SITES

A plan is not required except on specific request for those sources of Material for which the Contractor has obtained a valid surface mining operating permit issued by the Department of Natural Resources and has paid all required fees.

If the Contractor elects to apply for an approved reclamation plan, the following requirements apply:

1. The Contractor must prepare its own plan.
2. Reclamation plans must be approved in advance of any work within the site.
3. The Contract will include a list of minimum design requirements which must be considered in preparing reclamation plans. Meet or exceed these minimum requirements for the various types of sites described in the Contract. The Owner may accept or reject reclamation plans.
4. All Drawings required by the plan must be on reproducible sheets 22” or 24” wide x 36” long in overall dimensions.
5. The Contractor must submit to the Engineer for approval 6 copies of the reclamation plan, which includes:
    a. Site boundaries and pertinent topographic features.
    b. Location of the site. The plan must provide sufficient information to allow the Job Site to be located on quadrangle or county maps.
    c. Proposed finished ground contours or cross-sections and all final slopes;
    d. Site drainage; restoration of stream beds.
    e. Methods by which contaminants are controlled.
    f. Planned lakes, ponds or other bodies of water which would be beneficial for residential, recreational, game or wildlife purposes.
    g. Local zoning and planning, if any.
    h. Type of vegetative cover.
    i. Proposed stockpiles or buildings.
    j. Any proposed development of the Job Site which will be affected within 2 years after depletion or abandonment of the site.

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k. A statement of the proposed subsequent use of the land after reclamation and satisfactory evidence that all owners of a possessory interest in the land concur with this proposed use.

l. Any other feature which contributes to the final appearance of the land after restoration measures.

6. Together with the reclamation plan, submit completed forms SM 2 and SM 6 issued by the Department of Natural Resources.

7. After approval, submit the original tracing of the plan or a reproducible of the plan for all borrow, quarry, and pit sites within 10 Working Days of receipt of approval. If the plan is approved as noted, it must be modified by the Contractor before submission of the plan to the Engineer.

8. When the reclamation plan is approved by the Engineer for sites involving more than 3 acres of disturbed land, or resulting in pit walls more than 30 feet high and steeper than a 1 horizontal to 1 vertical slope, the Contractor will be allowed to operate under an operating permit subject to continuing approval and inspection by the Engineer and the Department of Natural Resources.

9. Complete form SM 3 and forward to the Department of Natural Resources through the Engineer upon completion of all seeding and planting.

   Complete form SM 7 and forward to the Department of Natural Resources through the Engineer immediately upon completion of mining operations and Job Site reclamation.

   Forms SM 3 and SM 7 are not required on-sites of 3 acres or less of disturbed land and resulting in pit walls 30 feet high or less and a 1 horizontal to 1 vertical or flatter slope.

10. The Engineer will notify the Contractor if environmental requirements must be satisfied. To comply with the requirements, the Contractor must furnish a completed environmental checklist in the SEPA guidelines. The SEPA checklist will then be reviewed under existing procedures. Any landfill or excavation of 100 cubic yards or less is exempt from SEPA requirements.

3-03.3 CONSTRUCTION REQUIREMENTS

3-03.3(1) EROSION CONTROL

All sites owned or furnished by the Contractor, if specified on a reclamation plan approved by the Engineer, require erosion control as specified in Section 8-01 or landscaping as specified in Section 8-02.

3-03.3(2) DEVIATIONS FROM APPROVED RECLAMATION PLANS

Reclamation of any site which deviates from the approved reclamation plan is not permitted without first revising the approved reclamation plan and obtaining the approval of the Engineer. Allow 5 Working Days review time by the Engineer.

3-03.4 RESERVED

3-03.5 PAYMENT

For Contractor provided sites, all costs involved in complying with the requirements of an operating permit acquired from the Department of Natural Resources, complying with the requirements of a reclamation plan approved by the Engineer, or with reclaiming sites to the full extent required by the Contract will be included in the costs of other Bid Items of work involved in the Work.

END OF DIVISION

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DIVISION 4 BASES

SECTION 4-01 MINERAL AGGREGATES

4-01.1 DESCRIPTION

Section 4-01 addresses Mineral Aggregate. This Work consists of constructing 1 or more layers of Mineral Aggregates on a prepared subgrade per these Specifications and in conformity with the lines, grades, depth, and typical cross-section shown on the Drawings or as established by the Engineer.

4-01.2 MATERIALS

Mineral Aggregate Types must comply with the requirements of Section 9-03. If the Contract allows and if the Contractor proposes to use Mineral Aggregates with recycled aggregates, see Section 4-02.

4-01.3 CONSTRUCTION REQUIREMENTS

Mineral Aggregates must be uniformly spread on the prepared subgrade to the depth, width, and cross-section shown on the Drawings. Unless addressed elsewhere in the Contract, construction methods used must comply with the applicable requirements of Sections 4-04.3

4-01.4 MEASUREMENT

Bid Items of Work completed under the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for in the Contract or here within.

4-01.5 PAYMENT

1. **"Mineral Aggregate**, **(Type)"**, per ton.
2. **"Mineral Aggregate**, **(Type)"**, per cubic yard

The Bid Item price for "Mineral Aggregate, (Type)" includes all costs for the work required of furnishing, hauling, stockpiling, placing, grading, and compacting the Mineral Aggregate or accepted crushed substitute.

3. **Other payment information**

Unless included in other Bid Items for payment, the Bid Item price for "Mineral Aggregate, (Type)" for backfill for walls and utility trenches includes all costs for the work required by the cubic yard in place as determined by the neat lines shown on the Drawings or Standard Plans less the volume of pipes and Structures greater than 6 inches outside diameter or other minor Structures greater than 1 cubic yard .

Unless included in other Bid Items for payment, the Bid Item price for "Mineral Aggregate, (Type)" backfill for foundations and drains, except behind a wall, includes all costs for the work required by the cubic yard in place as determined by the neat lines shown on the Drawings or the Standard Plans. Payment for minor and local quantities of backfill for drains surrounding weep holes of 1 cubic yard or less will be included in the Bid Item price for concrete in place per Section 6-02.5 and no separate or additional payment will be made.

Unless included in other Bid Items for payment, payment for drainage filter layer behind rock facings will be by the Bid Item "Mineral Aggregate, (Type)" by the ton, see Section 2-13.5.

Payment for approved changes in the Type of Mineral Aggregate from that specified will be as specified in Section1-04.3.

SECTION 4-02 MINERAL AGGREGATES WITH RECYCLED MATERIAL

4-02.1 DESCRIPTION

Section 4-02 addresses all Mineral Aggregate with recycled Material and the substitution request for full or partial inclusion of recycled Material. If Mineral Aggregate with recycled Material are not specified per the Contract, the Contractor may submit written request for substitutions per Sections 1-06.1 and 1-05.3. See 4-02.2(2) for substitutions of Mineral Aggregates with recycled Material request requirements.

4-02.2 MATERIALS

Materials must comply with the requirements of the following section:

Material	Section
Aggregates	Section 9-03
Recycled material	Section 9-03.16

4-02.2(1) MATERIALS – WITH RECYCLED AGGREGATES

Mineral Aggregates with recycled Material including recycled Portland cement concrete and recycled asphalt concrete must comply with the submittal requirements of Sections 1-05.3, 1-06.1, and 9-03.16(1).

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If Mineral Aggregate Type 1R or Type 2R is used as base course under asphalt concrete pavement or other non-rigid pavement, then the Mineral Aggregate must have a minimum California Bearing Ratio of 70 per AASHTO T 193 (ASTM D1883).

4-02.2(2) MATERIAL – RECYCLED AGGREGATES SUBSTITUTION REQUEST

The Contractor may submit written request for substitutions per Sections 1-06.1 and 1-05.3. The Contractor may request substitutions of Mineral Aggregates with recycled Material including recycled Portland cement concrete and recycled asphalt concrete meeting the requirements of Section 9-03.16 for Mineral Aggregate (Type) with the exceptions noted for each recycled Material, see Section 4-02.2(1).

4-02.2(2)A SUBMITTAL REQUIREMENTS

See Section 9-03.16(1).

4-02.3 CONSTRUCTION REQUIREMENTS

See Section 4-01.3.

4-02.4 MEASUREMENT

See Section 4-01.4.

4-02.5 PAYMENT

See Section 4-01.5.

SECTION 4-03 RESERVED

SECTION 4-04 BALLASTING AND CRUSHED SURFACING

4-04.1 DESCRIPTION

Section 4-04 describes Work consisting of constructing 1 or more courses of crushed aggregate Material on an existing roadway surface, or on a subgrade prepared as specified in the provisions of Section 2-09 in conformity with the lines, grades, depth, and typical cross-sections shown on the Drawings or Standard Plans, as established by the Engineer .

This Work also consists of constructing 1 or more layers of gravel base on a prepared subgrade in conformity with the lines, grades, depth, and typical cross-section indicated on the Standard Plans.

4-04.2 MATERIALS

Materials must comply with the requirements in the following Sections:

Material		Section
Dust Palliative	Dust Palliative Oil CMS-2	Section 9-02
Roadway Ballast	Mineral Aggregate Types 2 and 14	Section 9-03
Shoulder Ballast	Mineral Aggregate Type 13	Section 9-03
Base Course	Mineral Aggregate Type 2	Section 9-03
Crushed Surfacing	Mineral Aggregate Type 1	Section 9-03
Maintenance Rock	Mineral Aggregate Type 3	Section 9-03
Sand Filler	Mineral Aggregate Type 11	Section 9-03
Dust Palliative Sand	Mineral Aggregate Type 6	Section 9-03
Gravel Base	Mineral Aggregate Type 17	Section 9-03
Permeable Ballast	Mineral Aggregate Type 13	Section 9-03
Aggregate Discharge Subbase	Mineral Aggregate Type 24	Section 9-03
Geotextile	Geotextile for Separation	Section 9-03

The application of dust palliative with or without crushed surfacing is considered an oil mat treatment (Section 4-04). See Section 5-02 for bituminous surface treatment.

Crushed gravel may only be used instead of Crushed Rock, Mineral Aggregates Type 1 and Type 2 as a surface ballast course under the following conditions:

1. Only when specified in the Contract for specific locations or uses; and
2. Meets the requirements of Section 4-01.

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Recycled concrete crushed to the requirements of Section 9-03 and proposed for pavement base or subbase where wet conditions do not exist, will be permitted as a substitute for gravel base when approved by the Engineer, and must comply with the requirements of Section 4-01.

See Section 5-06 for separation geotextile for pervious concrete pavement.

4-04.3 CONSTRUCTION REQUIREMENTS

4-04.3(1) EQUIPMENT

All equipment necessary for acceptable performance of this construction must be on the Project Site and approved by the Engineer before starting Work. If central mix plant methods are used, the central mixing plant must comply with the following requirements:

1. The cold aggregate feeder must be mechanically operated and adjustable to the extent necessary to provide a uniform and continuous flow of Materials. These Materials must be deposited in an approved mixer with a sufficient amount of water being added to obtain the required density when spread and compacted. The water must be weighed or metered, and dispensed through a device providing uniform dispersion across the mixer.
2. The mixing plant must be provided with weighing or calibrating devices, feeders, provisions for sampling, and other devices and equipment so designed, coordinated, and operated to produce a uniform mixture, and to allow the sampling of the Materials before and after mixing. The mixer must be kept in good condition, and mixing blades or paddles be of proper size, adjustment, and clearance to provide a positive and uniform mixture at all times.
3. The capacity of the plant and equipment furnished for the Work must be adequate at all times to provide for efficient and continuous operations as far as practical.

The minimum amount and type of heavy equipment considered necessary for the proper execution of this Work must comply with or exceed the following:

a. One heavy-duty self-propelled grader, of an approved type, equipped with scarifier, broom, and an adjustable blade not less than 8 feet long capable of conforming to the indicated grade.
b. One 10 ton self-propelled 3-wheel roller, 1 vibratory roller, or 1 pneumatic tired roller. Roller wheels may be weighted if necessary to secure specified weight per linear inch of tire width. Vibratory rollers must comply with the requirements of Section 5-04.3(3)C.

Other combinations and types of equipment may be substituted for the above if approved by the Engineer. Additional equipment must be supplied if required by the Engineer. Such equipment includes, but is not limited to, bottom dump hauling equipment with transfer spreading facilities, self-propelled spreading and leveling machines, and spreader boxes equipped with wheels or so constructed as to preclude any damage to the subgrade or underlying courses.

The equipment used for the Work is subject to the Engineer's approval.

4-04.3(2) SUBGRADE

The subgrade must be prepared as specified in Section 2-09 and be approved by the Engineer before placing ballast or surfacing Materials.

Where shown on the Drawings for pervious concrete pavement section, separation geotextile must be as specified in Section 9-37 and must be placed as shown on the Drawings prior to placement of permeable ballast or aggregate discharge subbase.

Gravel base must be uniformly spread on the prepared subgrade to the depth, width, and cross-section shown on the Drawings.

4-04.3(3) MIXING

Unless otherwise specified in the Contract, the Contractor may use either, or both, of the following described methods:

1. Central Plant Mix Method: The surfacing Material and water must be mixed in an approved mixing plant as described in Section 4-04.3(1). The completed mixture must be a thoroughly mixed combination of proportioned Materials and water, uniform in distribution of particle sizes and moisture content. A mixture containing water in excess of the proportion established by the Engineer will not be accepted.
2. Road Mix Method: After Material for each layer of surfacing has been placed, the Material must be mixed until uniform throughout by motor graders or other equipment approved by the Engineer. Add water to facilitate mixing and compacting, in amounts acceptable to the Engineer.

4-04.3(4) PLACING AND SPREADING

On street areas to be paved with asphalt concrete pavement, place crushed surfacing to a compacted depth of 6 inches.

Start spreading of the first course of surfacing or ballasting at points nearest to the point of loading and start successive courses at points farthest from the point of loading. Each course must be constructed continuously from the starting point of the course. The first course of surfacing or ballasting Material must be placed on the entire available subgrade before placing the succeeding course. If the Engineer deems it necessary, a succeeding course must be placed over a section of a previously placed course before the final completion (Physical Completion Date) of that course.

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Crushed surfacing, base course, and top course must be constructed in layers not to exceed 4 inches in depth. Ballast must be constructed in layers with each layer not to exceed 6 inches in depth.

Each layer of surfacing and ballasting Material must be placed and spread by equipment approved for use by the Engineer. The surfacing and ballasting must be spread by any method that results in an even distribution of these Materials on the roadway without perceptible separation in gradation. Spread and screed the Material to a depth and surface uniformity which permits compaction to a reasonably true line, grade, depth, course, and cross-section without further shaping.

Should there occur during any stage of the placing and spreading operation a separation of the coarser from the finer Materials, causing, in the opinion of the Engineer, serious lack of uniformity in the grading, the Contractor must immediately change the method of handling the Material to prevent separation.

There must be a distance of not less than 1 block nor more than 1/2 mile between the construction of any 2 courses of surfacing or ballast. Use uniform gradations of Mineral Aggregates for surfacing on roadways.

Before placing any layer, the preceding layer must be properly bound, and all floating or loose stone removed from the surface.

Regardless of method used, if a pervious pavement is to be constructed, neither vehicles nor equipment are allowed to operate on the prepared subgrade or separation geotextile unless the first layer, or full depth, of aggregate discharge subbase or permeable ballast has been placed.

4-04.3(5) SHAPING AND COMPACTION

4-04.3(5)A SHAPING AND COMPACTION FOR NON-PERVIOUS PAVEMENT CONSTRUCTION

Following spreading and shaping of each layer, the layer must be compacted to a minimum 95 percent of the maximum density as specified in Section 2-11 before the next succeeding layer of surfacing or pavement is placed.

When necessary, apply a mist or spray of water to replace moisture lost by evaporation should the Engineer determine inadequate moisture is evident. Each completed layer must have a smooth, bound, uniform surface true to the line, grade, and cross-section indicated on the Drawings, or as established by the Engineer.

4-04.3(5)B SHAPING AND COMPACTION FOR PERVIOUS PAVEMENT CONSTRUCTION

Immediately following spreading and final shaping, each layer of surfacing must be compacted as follows:

1. Aggregate discharge subbase must be compacted by mechanical means until the surface is smooth, stable, and to the satisfaction of the Engineer. Equipment used for compacting subbase will be subject to approval by the Engineer. Compactive effort must not be applied to the extent that it breaks down or degrades the aggregates.
2. Permeable ballast must be compacted by mechanical means until the surface is smooth, stable, and to the satisfaction of the Engineer. Equipment used for compacting permeable ballast will be subject to approval by the Engineer. Compactive effort must not be applied to the extent that it breaks down or degrades the aggregates.

The Engineer will determine the number of compaction passes required for the particular compaction equipment available, such as rollers or vibratory compactors. A mist spray of water must be applied as needed to replace moisture lost by evaporation. The completed layer must have a smooth, tight, uniform surface true to the line, grade, and cross-section shown on the Drawings, or as staked.

4-04.3(6) MISCELLANEOUS REQUIREMENTS

The surface of each layer of surfacing Material must be maintained true to line, grade, and cross-section by blading, watering or aerating as required, and rolling until placing the next succeeding course or the final paving surface. The first course of surfacing Material must be placed on all available subgrade before placing the next overlay course. There must be at least 100 feet between the construction of any 2 courses of surfacing or ballast.

Should irregularities develop in any layer surface during or after compaction, they must be remedied by loosening the surface and correcting the defects. Then the entire area, including the surrounding surface, must be thoroughly recompacted. The completed surface must be true to line, grade, and crown before proceeding with the surfacing or final paving.

4-04.3(7) WEATHER LIMITATIONS

When, in the opinion of the Engineer, the weather is such that acceptable results cannot be obtained, the Contractor must suspend operations until the weather is favorable. Surfacing materials must not be placed in snow or on a soft, muddy, or frozen subgrade.

4-04.3(8) HAULING

4-04.3(8)A HAULING FOR NON-PERVIOUS PAVEMENT CONSTRUCTION

Route hauling equipment over the roadway as to be most effective in the compacting of the surfacing. Hauling over any of the surfacing in the process of construction is not permitted when, in the opinion of the Engineer, hauling adversely impacts the roadway.

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4-04.3(8)B HAULING FOR PERVIOUS PAVEMENT CONSTRUCTION

Hauling equipment must not be routed over permeable ballast and aggregate discharge subbase except when necessary for the construction of the pervious pavement section. Hauling over any of the surfacing during construction is not permitted unless approved by the Engineer.

4-04.3(9) HOURS OF WORK

See Section 1-08.1(4).

4-04.3(10) SHOULDER BALLAST

The Contractor must not place shoulder ballast until the abutting pavement has been completed. Place shoulder ballast through a spreader box in 1 lift. Processing of the shoulder ballast course on the roadway is not permitted. Compact the aggregate by making a minimum of 3 passes with a vibratory compactor of a type acceptable to the Engineer. The density requirements of Section 4-04.3(5) do not apply.

4-04.3(11) APPLICATION OF DUST PALLIATIVE

Dust palliative must not be applied to materials used for pervious concrete pavement section.

Completed crushed rock surfacing courses must be given 2 or more applications of dust palliative oil. Dust palliative oil must be CMS 2 and be uniformly applied by an approved pressure type distributor at the rate of 0.3 gallons of oil per square yard of surface to be treated. Do not apply succeeding applications of dust palliative oil until the preceding application has thoroughly dried.

Do not apply dust palliative oil on a wet surface nor when the temperature is below 60 °F.

Provide and place Mineral Aggregate Type 6 sand on newly oiled streets to prevent tracking of oil onto adjacent surfaces. Apply additional sand as necessary to areas where oil remains on the surface due to poor surface penetration.

4-04.3(12) RESURFACING OF OIL MAT AND GRAVEL STREETS

The surface of existing oil mat and graveled streets must be scarified and bladed to a minimum width of 21 feet, unless indicated otherwise in the Contract, until it has a uniform grade and cross-section with a 3-inch to 5-inch crown at the center line. Do not attempt to apply oil to the street surface disturbed by construction operations without first scarifying and blading the entire roadway. Preparation work on the street surface must produce a smooth, crowned surface, without residual ripples, ridges, or irregularities as determined by the Engineer. All stones, lumps, broken concrete or asphalt, bricks, or other deleterious material that will not pass a 3-inch standard sieve size must be removed. All wood, peat, organic matter, or other deleterious matter must also be removed before the application of the crushed surfacing. In shaping the existing surfacing, all Material that may have been displaced by traffic, or by other means, must be bladed into the newly formed surfacing section.

Apply crushed surfacing, Mineral Aggregate Type 1 only after the newly prepared street surface has been approved by the Engineer. Spread crushed surfacing to a minimum depth of 2 inches by any method that results in an even distribution of the Material on the roadway without perceptible separation in gradation. Where separation does occur, it must be corrected as specified in Section 4-04.3(4). During or after spreading operations, shape the newly spread crushed surfacing by blading to conform to the depth, line, grade, and cross-section indicated on the Drawings. The Contractor must comply with the requirements of Section 1-07.5 regarding the control of dust and pollutants.

After final grading has been completed and approved by the Engineer, apply dust palliative oil as specified in Section 4-04.3(11). Before opening the newly oiled streets to traffic, place warning signs at locations on all routes leading to the freshly oiled roadways, saying “Caution Fresh Oil.” Signs must be of a size and Material with adequately sized lettering and bordering meeting the requirements for Warning Signs in the City of Seattle Traffic Control Manual for In Street Work. Signs must remain at the locations until the oiled roadway is accepted by the Engineer. No Parking signs, if used, must be removed at the end of day where areas have been covered with rock, see Section 1-07.23 and Section 1-10.

4-04.3(13) PERMEABLE BALLAST AND AGGREGATE DISCHARGE SUBBASE

Permeable ballast or aggregate discharge subbase must not be placed until the subgrade and separation geotextile has been accepted by the Engineer. Permeable ballast or aggregate discharge subbase must be placed in lifts not to exceed the maximum allowed in Section 4-04.3(4). Processing of the permeable ballast or aggregate discharge subbase course on the subgrade is not permitted.

Completed permeable ballast or aggregate discharge subbase must be protected from contamination by traffic, sediment, organic material, or other deleterious substances. Permeable ballast or aggregate discharge subbase that has become contaminated in the opinion of the Engineer will be rejected. Contaminated permeable ballast or aggregate discharge subbase must be removed and replaced to limits as determined by the Engineer. The permeable ballast or aggregate discharge subbase must be inspected and accepted by the Engineer prior to placing the pervious concrete on the permeable ballast or aggregate discharge subbase.

4-04.4 MEASUREMENT

Crushed rock surfacing, top course and base course; ballast; and gravel base will be measured by the ton.

“Mineral Aggregate, (Type)” for gravel base will be measured by the ton.

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4-04.5 PAYMENT

1. **"Dust Palliative"**, per gallon

The Bid Item price for "Dust Palliative" includes all costs for the work required to furnish and place dust palliative.

2. **Other payment information**

Payment for Mineral Aggregate of the Type specified is as specified in Section 4-01.5.

If the Engineer directs the Contractor to change the Type of Mineral Aggregate from that specified, then any change in payment resulting from the change will be as specified in Section 1-09.4. Additional payment for Contractor requested changes in Mineral Aggregate Type which are approved by the Engineer will not be made.

SECTION 4-05 FULL DEPTH ASPHALT PAVEMENT RECYCLING

4-05.1 DESCRIPTION

Section 4-05 describes Work consisting of recycling existing pavement by a technique in which existing full depth asphalt pavement and a predetermined portion of the underlying Materials are pulverized, blended, mixed, and compacted resulting in a uniformly mixed base course. Increased stabilization is obtained by mixing with additives. A final wearing surface of asphalt concrete follows, as specified in Section 5-04.

4-05.1(1) SUBMITTAL

At least 10 Working Days before intended use, the Contractor must submit a mix design to the Engineer as specified in Section 1-05.3. This mix design must indicate the amount of each additive applied per square yard of pulverized surface area to obtain the desired mix proportion with the pulverized Materials to the depth indicated on the Drawings. Laboratory analyses and the locations of sample borings in the area to be treated will be provided in the Contract.

4-05.2 MATERIALS

Materials must comply with the requirements of the following sections:

Material	Section
Portland Cement	Section 9-01
Asphalt Emulsion	Section 9-02
Mineral Aggregate	Section 9-03
Water	Section 9-25

Lime must be a hydrated (not agricultural) lime.

4-05.3 CONSTRUCTION REQUIREMENTS

4-05.3(1) EQUIPMENT

The Contractor has the option to use whatever equipment can effectively pulverize and blend the Materials. The equipment must be capable of introducing liquid additives uniformly and accurately.

The mixing equipment must be equipped with a foot per minute indicator which is integral with the variable speed pump controller ensuring that asphalt emulsion can be added only when the machine is moving.

The metering system must include a totalizer so that the amount of asphalt emulsion used during any given period can be read directly, and must also include a gallons per minute gauge to indicate the instantaneous flow rate during the mixing operation.

Equipment acceptable to the Engineer for both pulverizing and mixing is the CMI RS 500 Reclaimer / Stabilizer or approved equal.

The compaction equipment must be a vibratory roller compactor weighing a minimum 15 tons.

4-05.3(2) CONSTRUCTION METHOD

4-05.3(2)A REMOVAL OF OBSTACLES

Before the asphalt pavement reclamation process starts, existing utility castings within the pavement area to be reclaimed must be temporarily removed and the opening securely covered so that the pavement reclamation process does not adversely impact the existing utility and the existing utility does not adversely impact the reclamation equipment. Existing utility castings which cover any Structure connected to the SPU water distribution or water transmission system require the notification specified in Section 1-07.28 item 8. The depth of removal must provide adequate unobstructed clearance between the top of the temporary utility cover and the existing pavement surface to accommodate the pavement reclamation operation. The temporary cover for the utility opening must have sufficient strength and be adequately secured to the exposed utility opening to withstand the stresses of the reclamation process. The location of existing utilities which have had castings

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removed and then covered must be surveyed so that after reclamation, the covered utility can be located and reinstalled to finished grade.

Remove all other obstacles identified on the Drawings as necessary.

See Sections 1-07.16(1) and 1-07.28 item 17 regarding the survey monumentation, witness monument, re-monumentation, and notifications required.

4-05.3(2)B PULVERIZATION

Pulverize and blend the existing pavement and base Material to the depth shown on the Drawings so the entire mass of Material is uniformly graded. The pulverized Material must have a minimum 95 percent passing the 1-1/2 inch sieve size. Material gradation may vary due to local aggregates and conditions; however, acceptance of the pulverized Material is based on visual inspection by the Engineer. Remove all rock larger than 3 inches and all deleterious material as defined in Section 9-03.1. The pulverizing operation must be completed before the mixing operation. If any pulverized section will be temporarily opened to traffic, first shape and compact it as approved by the Engineer.

4-05.3(2)C ADDITIVES, MIXING AND COMPACTING

If Portland cement or lime is required as an additive to the emulsion treated base, lightly dust it onto the pulverized surface at a uniform rate of application. Apply any Portland cement or lime before the application of asphalt emulsion and the mixing operation.

The emulsified asphalt must be uniformly distributed and mixed with the pulverized Material and any imported Material as specified. The mixing operation may be accomplished by using either the same equipment used for the pulverizing operation or a separate machine designed for in place continuous mixing. Regardless of which method is used, use a positive displacement variable speed pump and control system capable of metering the emulsion application rate to 1/10 of a gallon per square yard .

The application rate of the emulsified asphalt is expressed in gallons per square yard. This rate must be calculated from the designated percent of emulsion based on the dry unit weight of the unmixed in place Material as determined by the Engineer.

Completed the mixing operation in continuous segments. Each segment must be processed and compacted by the end of each Day and be ready to open to traffic.

Density of the compacted Material acceptable to the Engineer will be determined as follows:

After each pass of the vibratory roller, nuclear densometer readings of the compacted Material will be taken to the depth indicated on the Drawings. These nuclear densometer readings will be taken at several locations so as to determine a relationship indicating "Measured Density" vs. "Number of Passes" of the vibratory roller. When the change in density readings between successive passes of the roller at a given test location increases by less than 2 percent of the previous density reading at that same location then the compaction of the Material at that location is considered acceptable.

4-05.3(2)D FINAL SURFACE PREPARATION

Allow the emulsion treated base to cure for a minimum of 10 Days before the application of the wearing surface. The length of time necessary for proper curing may vary dependent on the weather and environmental conditions.

4-05.4 MEASUREMENT

Measurement for "Reset Casting for Pavement Recycling" will be per each.

Measurement for "Full Depth Pavement Recycling" will be by the square yard of existing asphalt pavement pulverized, to the depth and within the limits specified on the Drawings.

Measurement for "Portland Cement for Pavement Recycling" will be by the ton of Portland cement applied to the surface of pulverized pavement as specified.

Measurement for "Lime for Pavement Recycling" will be by the ton of hydrated lime applied to the surface of the pulverized pavement as specified.

Measurement for "Emulsified Asphalt for Pavement Recycling" will be by the ton of emulsified asphalt used during the mixing process as specified.

4-05.5 PAYMENT

1. **"Reset Casting for Pavement Recycling"**, per each

The Bid Item price for "Reset Casting for Pavement Recycling" includes all costs for the work required to temporarily remove utility casting and sufficient upper portion of collar and leveling material as necessary; securely place a temporary cover, and replace permanent casting, and collar and leveling material.

2. **"Full Depth Pavement Recycling"**, per square yard

The Bid Item price for "Full Depth Pavement Recycling" includes all costs for the work required to furnish the equipment and pulverize the existing asphalt pavement to the depth and to the limits indicated on the Drawings, to apply and mix the additives to the depth indicated an the Drawings; to grade, shape and compact; and apply fog seal. The application of water as necessary, will be considered incidental to this Bid Item and no separate payment will be made.

3. **"Portland Cement for Pavement Recycling"**, per ton

The Bid Item price for "Portland Cement for Pavement Recycling" includes all costs for the work required to furnish and apply the Portland cement to the pulverized surface.

4. **"Lime for Pavement Recycling"**, per ton

The Bid Item price for "Lime for Pavement Recycling" includes all costs for the work required to furnish and apply the lime to the pulverized surface.

5. **"Emulsified Asphalt for Pavement Recycling"**, per ton

The Bid Item price for “Emulsified Asphalt for Pavement Recycling" includes all costs for the work required to furnish and apply the emulsified asphalt.

SECTION 4-06 ASPHALT TREATED BASE

4-06.1 DESCRIPTION

4-06.1(1) GENERAL

Section 4-06 describes Work consisting of 1 or more courses of asphalt treated base placed on the subgrade per these Specifications and in conformity with the lines, grades, thickness, and typical cross-sections specified in the Contract.

4-06.1(2) DEFINITION

Asphalt Treated Base (ATB): a compacted course of base Material which has been weatherproofed and stabilized by treatment with an asphalt binder.

4-06.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Material	Section
Asphalt	Section 9-02
Anti-stripping Additive	Section 9-02
Aggregates	Section 9-03

The grade of paving asphalt must be PG 64-22 meeting the requirements of Section 9-02.1(4).

4-06.3 CONSTRUCTION REQUIREMENTS

4-06.3(1) ASPHALT MIXING PLANT

Asphalt mixing plants for asphalt treated base must comply with the following requirements:

1. Heating: The plant must be capable of heating the aggregates to the required temperature.
2. Proportioning: The mixing plant must be capable of proportioning the aggregates to comply with the specified requirements, and of producing asphalt at the rate specified by the Engineer. If the aggregates are supplied in 2 or more sizes, means must be provided for proportioning or blending the different sizes of aggregates to produce Material meeting the specified gradation and other requirements.
3. Mixing: The mixer must be capable of producing a homogeneous mixture of uniformly coated aggregates meeting the specified requirements.

4-06.3(2) PREPARATION OF AGGREGATES

Aggregates for ATB must be heated to a temperature between the limits of 350 °F and 375 °F, or as approved by the Engineer or specified in the Contract.

4-06.3(2)A MIX DESIGN

The mix design requirements for asphalt treated base must be as specified in the Contract.

4-06.3(3) HEATING OF ASPHALT MATERIAL

Heating of asphalt Material at the mixing plant must comply with Section 5-04.3(2).

Heating of asphalt binder must comply with Section 5-04.3(5).

4-06.3(4) MIXING

Mix asphalt treated base as specified in the Contract.

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4-06.3(5) HAULING EQUIPMENT

Hauling equipment for asphalt treated base must comply with Section 5-04.3(3)A.

4-06.3(6) SPREADING AND FINISHING

4-06.3(6)A GENERAL

The machine that spreads the ATB must be equipped with a stationary, vibratory, or oscillating screed or cut off device, subject to the approval of the Engineer. The Engineer's approval of the equipment will be based on a demonstration that the finished product meets all requirements specified. Automatic controls are not required.

The temperature of the mixture when compaction is achieved must be at least 185 °F.

When the total depth of ATB exceeds 3 inches, the ATB Material must be placed in 2 or more equal courses with each not to exceed 0.35 feet in thickness.

4-06.3(6)B SUBGRADE PROTECTION COURSE

Place the first course of ATB as a protection for the prepared subgrade as soon as possible after the subgrade has been completed.

The surface of the subgrade protection layer when constructed on a grading project must conform to grade and smoothness requirements that apply to the subgrade on which it is placed.

4-06.3(6)C FINISH COURSE

The final surface course of the asphalt treated base, except shoulders, must not deviate at any point more than 3/8 inch from the bottom edge of a 10-foot straight edge laid on the surface in any direction on either side of the roadway crown. Failure to comply with this requirement will require corrective measures acceptable to the Engineer to achieve the required tolerance, at no expense to the Owner.

When placing Portland cement concrete pavement on asphalt treated base, ensure a surface tolerance of the asphalt treated base such that no elevation lies above the plan grade minus the specified plan depth of Portland cement concrete pavement. Before placing the Portland cement concrete pavement, bring any such irregularities to the required tolerance by grinding or other means approved by the Engineer.

4-06.3(7) COMPACTION AND DENSITY

The method of compaction must be as specified in Section 5-04.3(9).

The density of the asphalt treated base must be at least 80 percent of the maximum theoretical density established for the mix by WSDOT Test Method 705. The frequency of these tests is at the discretion of the Engineer, but will in no case be less than 1 control lot for each normal Day's production. The use of equipment which results in damage to the Materials or produces defective work is not permitted.

4-06.3(8) ANTI STRIPPING ADDITIVE

Add an anti-stripping additive (Section 9-02.4) to the asphalt Material when directed by the Engineer.

4-06.4 MEASUREMENT

Asphalt treated base will be measured by the ton.

4-06.5 PAYMENT

1. **"Pavement Base**, **Asphalt Treated (ATB)"**, per ton

The Bid Item price for "Pavement Base, Asphalt Treated (ATB)" includes all costs for the work required in Section 4-06 and not otherwise provided for separately and necessary to furnish and construct the asphalt treated base on a prepared subgrade to the lines, grades, and cross-sections required.

2. **"Anti Stripping Additive"**, payment will be as specified in Section 1-09.4
3. **Other payment information**

Payment for roadway excavation and subgrade preparation including excavation and disposal of unsuitable Material is per applicable Sections.

SECTION 4-07 FULL DEPTH PAVEMENT RECLAMATION

4-07.1 DESCRIPTION

Section 4-07 describes Work consisting of pulverizing the existing asphalt concrete pavement and a portion of the underlying base Material to the depth and width indicated on the Drawings; grading the pulverized roadway in reasonably close conformance with the slopes and the grades indicated on the Drawings; adding Portland cement and water at the specified rates; in place mixing of the pulverized roadway Materials and additives to the depth specified; regrading per the slopes and grades indicated on the Drawings; and compacting the mixed stabilized base as specified. Do not mix a portion of the bottom section of pulverized base Material with Portland cement.

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4-07.1(1) SUBMITTAL

At least 10 Working Days before intended use, submit a mix design to the Engineer as specified in Section 1-05.3. This mix design must indicate the amount of each additive applied per square yard of pulverized surface area to obtain the desired mix proportion with the pulverized Materials to the depth indicated on the Drawings. Locations of borehole soil samples taken within the existing area of proposed pavement reclamation, and descriptions of sampled soils will be provided in the Contract.

4-07.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Material	Section
Portland Cement	Section 9-01
Aggregate	Section 9-03
Joint Filler and Sealants	Section 9-04
Curing Materials and Admixtures	Section 9-23
Water	Section 9-25

4-07.3 CONSTRUCTION REQUIREMENTS

4-07.3(1) EQUIPMENT

Equipment acceptable to the Engineer for both pulverizing and mixing is the CMI RS 500 Reclaimer / Stabilizer or approved equal. Submit information describing the equipment to be used for this Work at least 5 Working Days in advance.

The compaction equipment must be a vibratory roller compactor weighing a minimum 15 tons.

4-07.3(2) CONSTRUCTION METHOD

4-07.3(2)A PULVERIZING

Pulverize existing pavement and underlying base course Materials to the width and depth indicated on the Drawings. Make as many passes as necessary to blend all pulverized Materials to the width and depth indicated on the Drawings. The blended Material must conform to the following gradation:

Sieve Size	Percent Passing (by weight)
1-1/2 Inch Square Opening	100 - 96%

Acceptance of the gradation is based on visual inspection of the Engineer. The blended Material must be shaped and rolled to allow for temporary use of traffic as necessary. Continue shaping until a uniform roadway section is developed. The surface must be within ± 0.10 feet of the finished grade and the Materials must have a uniform and consistent gradation. Remove and dispose of all rocks larger than 3 inches and all other deleterious Material.

4-07.3(2)B DISTRIBUTING ADDITIVES

After the pulverizing and initial shaping and rolling operations are completed, place additives on the roadway surface for mixing with underlying roadway Materials to the depth indicated on the Drawings. Distribute the Portland cement onto the prepared roadway surface at a rate to obtain the approved mix design proportions. Blend the roadway surface applying water at a rate so that the mixed Material does not exceed the optimum moisture content by more than 2 percent.

Portland cement and water must not be placed so far ahead of the mixing equipment such that the soil cement pavement base cannot be mixed, graded, and compacted within 90 minutes after placement of the Portland cement and water. Traffic is not permitted on the treated surface for a minimum of 3 Days to allow for curing.

See Section 2-12 regarding watering except payment for water is as specified in Section 4-07.5.

4-07.3(2)C MIXING

The mixing operation must consist of thoroughly blending the distributed additives with the pulverized Materials to the total combined depth indicated on the Drawings. The mixing equipment must be the same equipment used for the pulverizing. Additional additives or cross mixing or both may be required, as determined by the Engineer, to localized areas to achieve a property mixed base. Remove all rocks and Material larger than 3 inches that are exposed by the mixing operation. Traffic is not permitted on the treated surface for a minimum of 3 Days to allow for curing.

4-07.3(2)D FINAL GRADING, COMPACTING, AND CURING

The mixed and stabilized roadway Material must be final graded and compacted within 90 minutes after the addition of Portland cement and water. The finished grade is shown on the Drawings.

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Density of the compacted soil cement acceptable to the Engineer is determined as follows:

After each pass of the vibratory roller, a nuclear densometer reading of the compacted Material will be taken to the depth indicated on the Drawings. These nuclear densometer readings will be taken at several locations so as to determine a relationship indicating Measured Density vs. Number of Passes of the roller. When the change in density readings between successive passes of the roller at a given test location increases by less than 2 percent of the previous density reading at that same location, then the compaction of the Material at that location is considered acceptable.

Allow the completed base course to cure for a minimum of 3 Days before allowing traffic access. Do not allow the compacted soil cement to dry. A water truck or any other method of supplying water may be used to keep the finished surface moist and prevent loss of moisture from the treated Material. Apply a tack coat as soon as practical after final compaction as specified in Section 5-04.3(4)B4. Apply the HMA Class asphalt wearing course as soon as practicable after the 3 Day curing period and before opening the treated pavement to traffic.

4-07.3(2)E PATCHING AND CORRECTION OF DEFECTS

Any areas in the completed and stabilized base which appear non-uniform in any way including: segregation of aggregates, insufficient or excessive Portland cement or water, insufficient compaction, or an improper surface tolerance must be removed and reprocessed, or replaced at the Engineer's direction.

4-07.4 MEASUREMENT

Measurement for "Full Depth Pavement Reclamation" will be by the square yard.

Measurement for "Portland Cement for Pavement Reclamation" will be by the ton.

Measurement for "Water" will be by the 1,000 gallons (Mgal).

4-07.5 PAYMENT

1. **“Full Depth Pavement Reclamation"**, per square yard

The Bid Item price for “Full Depth Pavement Reclamation" includes all costs for the work required to perform full depth Pavement reclamation, except for the cost of Portland cement and water as provided in this Section. Payment for the tack coat is considered incidental to the Bid Item “Full Depth Pavement Reclamation” and no separate or additional payment will be made.

2. **“Portland Cement for Pavement Reclamation"**, per ton

The Bid Item price for "Portland Cement for Pavement Reclamation" includes all costs for the work required to furnish and apply Portland cement as specified in Section 4-07.

3. **"Water"**, per 1,000 gallons (Mgal)

The Bid Item price for "Water" includes all costs for the work required to furnish and apply the water as specified in Section 4-07.

4. **Other payment information**

All costs associated with obtaining a hydrant use permit are considered incidental to the various Bid Items comprising the Work and no separate or additional payment will be made, see Section 2-12.5.

END OF DIVISION

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DIVISION 5 SURFACE TREATMENTS AND PAVEMENTS

SECTION 5-01 SUBSEALING

5-01.1 DESCRIPTION

Section 5-01 describes filling voids under existing cement concrete pavement and rigid base asphalt pavements by pumping a mixture of Portland cement, pozzolan, or fly ash, and water under the pavement slabs.

5-01.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Material	Section
Portland Cement and Blended Hydraulic Cement	Section 9-01
Pozzolans (Fly Ash & Ground Granulated Blast Furnace Slag)	Section 9-23.6 & 9-23.7
Water	Section 9-25

5-01.3 CONSTRUCTION REQUIREMENTS

5-01.3(1) PROPORTIONING MATERIALS

The standard mix design for subsealing is:

Portion	Material
1 part (by volume)	Portland cement Type I or II
3 parts (by volume)	Pozzolan (natural or artificial)
2.25 parts (by volume)	Water

Any deviation from the above mix design requires Engineer approval. The Contractor may vary the water content as required for local conditions.

5-01.3(2) EQUIPMENT

All equipment used in performance of subsealing is subject to Engineer approval and must be maintained in satisfactory working condition at all times.

Air compressors used for operating air hammers and blowing air into the cavities beneath the pavement must be of sufficient size and capacity for acceptable performance.

Rotary hammers or rock drills must be equipped with drills capable of cutting 1-1/2-inch diameter holes through the pavement. The equipment must be in good working condition and operated in such a manner that no non-round holes are produced.

The grout equipment must consist of a cement injection pump and a high speed colloidal mixing machine. The colloidal mixing machine must operate at a minimum speed of 1,200 rpm and must consist of a rotor operating in close proximity to a stator, creating a high shearing action and subsequent pressure release to make a homogeneous mixture.

The dry Material must be accurately measured and the water must be batched through a meter or scale with a totalizer for the day's consumption.

Provide wooden cylindrical plugs or other Engineer approved devices to temporarily plug the application holes until the Material has set. Plugs must be slightly tapered on one end for ease in driving.

5-01.3(3) CONSTRUCTION

The Contractor must not start subsealing when the pavement is wet, or when water is present under the pavement. Drill application holes through the cement concrete pavement in the approximate pattern shown on the Drawings.

Application holes must be approximately 1-1/2 inches in diameter and must be perpendicular to the pavement surface. Do not drill more holes in a day than can be filled or temporarily plugged during the same day. To prepare the cavity for injection of the subsealing mix Materials, blow compressed air through the application holes for not less than 15 seconds and not more than 60 seconds. After the application holes are blown out and the nozzle is firmly wedged into the hole, pump the subsealing mix into the application hole until all cavities are filled, or until any of the following occurs:

1. A pavement slab or portion of a slab starts to rise.
2. Subsealing mix extrudes from adjacent application holes, or along or outside the longitudinal edges of the pavement.
3. The Engineer orders application of subsealing mix stopped.

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Immediately upon removal of the nozzle, insert the plug and drive firmly into the application holes.

Following the application and after the mix has set, remove the wooden plugs and immediately fill the application holes with subsealing mix, continuing progressively through all pavement that was previously subsealed.

Do not allow traffic on any subsealed area until the subseal has hardened.

In the event the Engineer determines that continued injection at any specific location is no longer economically feasible, the Contractor must stop operations and move to a new location.

5-01.4 MEASUREMENT

Measurement for "Pavement Subseal" will be by cubic foot of dry Materials used before the addition of water or other additives.

Measurement for "Drill Hole for Subsealing" will be by each hole drilled completely through the pavement.

5-01.5 PAYMENT

1. **"Drill Hole for Subsealing"**, per each.

The Bid Item price for "Drill Hole for Subsealing" includes all costs for the work required to drill the holes.

2. **"Pavement Subseal"**, per cubic foot.

The Bid Item price for "Pavement Subseal" includes all costs for the work required to complete the subsealing.

SECTION 5-02 BITUMINOUS SURFACE TREATMENT

5-02.1 DESCRIPTION

5-02.1(1) GENERAL

Section 5-02 describes constructing a single or multiple course bituminous surface by treating existing crushed rock, screened gravel, or bituminous roadway surfaces with liquid asphalt and covering with a Mineral Aggregate thoroughly cemented to the roadway to obtain a wearing surface with good riding and nonskid qualities.

Roadway surfaces are classified as treated or untreated roadway surfaces as defined in Section 5-04.3(4)A.

Bituminous surface treatment method is Class B unless specified otherwise in the Contract.

Bituminous surface treatment is not considered "oil mat surface," see Section 4-04.

5-02.1(2) BITUMINOUS SURFACE TREATMENT CLASS A

This method of treatment requires 2 applications of asphalt and 3 applications of aggregate. The second application (tack coat) must be applied after the first application of prime coat has cured and all loose aggregate has been removed.

5-02.1(3) BITUMINOUS SURFACE TREATMENT CLASSES B, C, AND D

These methods require placing 1 application of asphalt and 1 or more sizes of aggregate, as specified, on an existing asphalt roadway to seal and rejuvenate the surface and to produce a uniform roadway surface with good nonskid characteristics.

5-02.2 MATERIALS

Materials comply with the requirements of the following Sections:

Material	Section
Asphalt	Section 9-02
Anti-Stripping Additive	Section 9-02.4
Mineral Aggregates	Section 9-03

The grade of asphalt must be Cationic Emulsified Asphalt (CRS 2) meeting the requirements of Section 9-02.1(6).

Mineral Aggregate for Bituminous Surface Treatment Class A or Class B must be Mineral Aggregate Type 24, Chip Rock, meeting the requirements of Section 9-03.

When cutback asphalts are specified for Bituminous Surface Treatment Class A, construction must not start until the need for anti-stripping additive has been determined. The Contractor must allow a minimum of 7 Working Days after the SPU Materials Laboratory has received samples of the Mineral Aggregate, asphalt, and anti-stripping additive for testing. The Engineer will require additional time to verify acceptable performance and compatibility if the Contractor has requested more than 1 source of asphalt or anti-stripping additive be approved. Take this into consideration in preparing for and meeting Contract Time.

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5-02.3 CONSTRUCTION REQUIREMENTS

5-02.3(1) EQUIPMENT

The Contractor's equipment includes scarifying, mixing, spreading, finishing, and compacting equipment; an asphalt distributor; and equipment for heating asphalt Material, all of which are subject to Engineer approval before use on the Work.

The distributor must have a minimum capacity of 1,000 gallons, and must be designed, equipped, maintained, and operated to uniformly apply asphalt Material of an even heat at the required rate. It must be equipped with a 10-foot spray bar with extensions, pressure pump and gauge, a volume gauge located where it can be easily observed from the ground, a tachometer to accurately control the speed and spread of asphalt, and 2 thermometers. 1 of the thermometers must be permanently installed in the tank to indicate asphalt temperatures at all times. Power for operating the pressure pump must be supplied by a unit that will provide a uniform spray from each nozzle across the spray bar and extensions.

Rollers must be self-propelled pneumatic tired or smooth wheeled rollers, each weighing at least 10 tons.

Spreading equipment must be self-propelled, supported on at least 4 pneumatic tires, and have an approved device for accurately metering and distributing the Mineral Aggregate uniformly over the roadway surface.

Brooms must be motorized with a positive means of controlling vertical pressure.

Other equipment necessary to acceptably perform the Work specified in this Section is subject to Engineer approval before its use on the Work.

Place additional units on the Work when the Engineer considers it necessary, to fulfill the requirements of these Specifications or to complete the Work within the time specified.

Both the asphalt distributor and the self-propelled chip spreader must be calibrated before their use, to ensure applications within the specified coverage limits. Adjust the asphalt distributor spray bar height to produce a triple lap of spray fans from bars with a 4-inch nozzle spacing, and a double lap from bars having a 6-inch nozzle spacing.

Frequently check and adjust the height of the spray bar during asphalt application as necessary to insure the height above the pavement surface does not vary by more than 1 inch as the truck load lightens.

5-02.3(2) PREPARATION OF ROADWAY SURFACE

5-02.3(2)A UNTREATED SURFACES

Refer to Section 5-04.3(4)C.

No traffic is allowed on the repaired surface until the prime coat of asphalt and Mineral Aggregate is applied.

5-02.3(2)B TREATED SURFACES

Refer to Section 5-04.3(4)B.

5-02.3(2)C SOIL RESIDUAL HERBICIDE

The use of soil residual herbicide is not allowed.

5-02.3(3) APPLICATION OF ASPHALT

The Contractor must apply Cationic Emulsified Asphalt (CRS 2) on the properly prepared roadway surface, at the rate of 0.35 to 0.40 gallon per square yard in non-shaded areas, and at 0.38 to 0.45 gallon per square yard in shaded areas. The asphalt spraying application temperature at the distributor must be between 140 °F and 185 °F. The Engineer may vary the rate of asphalt application to provide the best results.

To ensure uniform distribution of asphalt before starting the asphalt application the distributor bar must be operated over a pit or vat. To avoid gaps and ridges at transverse junctions of separate applications of asphalt, spread sufficient building paper over the treated surface to ensure that the spray jets function normally when the untreated surface is reached.

The pattern, width, and length of application of shots of asphalt Material must provide proper coverage of crushed Material within the times specified, proper widths to provide an acceptable coverage of crushed cover stone, and lapping of subsequent adjacent applications.

Apply asphalt to spandrels of intersections and driveways immediately ahead of, or immediately behind, the adjacent longitudinal street application.

Omissions (skips) by the distributor must be immediately covered by hand application with the same grade of hot asphalt.

Any 1 spread of asphalt must not cover more area than can be covered with Mineral Aggregate within 3 minutes from the time of application on any part of the spread.

Spread asphalt toward the source of Mineral Aggregate to avoid injury to the freshly treated surface. Do not spread asphalt until adequate supplies of Mineral Aggregate are on hand at the Project Site.

Where earth curbs or no curbs exist, the application of asphalt must extend 4 inches beyond the gutter line. Where concrete curb and gutter exist, the application must lap onto the gutter section, not to exceed 2 inches. Where concrete curb exists, the application must be placed as close as possible to the vertical surface without excessive splash onto the curb. Where concrete curb or curb and gutter exist, the distributor must be equipped with a splash board designed to prevent spraying thereon.

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Protect all castings by securely covering them with heavy building paper weighed down with sand or crushed Material.

Use hand sprayers to apply asphalt around castings, and to areas where coverage is insufficient.

5-02.3(4) APPLICATION METHOD OF AGGREGATES

The Contractor must correct any method of handling the Mineral Aggregate that causes segregation of the various sizes of aggregate particles, at the Engineer's request, so that a uniform product is incorporated in the Work.

After applying the asphalt uniformly over the roadway surface, uniformly apply Mineral Aggregate of the type specified to the roadway surface at a rate of 25 to 33 pounds per square yard using spreader equipment. Apply a quantity of Mineral Aggregate so that it uniformly covers the asphalt and does not pick up under traffic. Apply the Mineral Aggregate over the freshly spread asphalt by trailer type or self-propelled spreader boxes. Trucks and spreader boxes must not travel on the fresh asphalt, and the Mineral Aggregate layer must be spread in 1 operation for each application of asphalt. Cover spandrels of intersections, driveways, and bare spots by hand spreading from trucks immediately behind the box application. Spread Mineral Aggregate so as to leave an 8-inch strip of asphalt exposed to provide a lap with the next application of asphalt.

The Mineral Aggregate must be damp and free of dust and impurities when applied to the roadway. If the Mineral Aggregate is dry, dusty, or both dry and dusty, the Contractor must spray the aggregate with water to obtain a damp and dust free condition. Do not use dusty or dry Mineral Aggregate that compromises adhesion of the Mineral Aggregate to the substrate.

As soon as the aggregate has been applied to the surface, roll it with a self-propelled pneumatic tired roller. Places inaccessible to the pneumatic tired roller, such as spandrels of intersections and private driveways, must be rolled with a self-propelled smooth wheel roller.

Where excess Mineral Aggregate has been applied, it must either be removed or be drifted uniformly over the adjacent roadway, using a motor patrol grader equipped with a wire broom mold board, subject to Engineer approval. Minimize this type of brooming. Where brooming is necessary, perform it carefully to avoid disturbing the mat in any way. Correct thin or bare spots in the spread of Mineral Aggregate by hand spreading or by use of a grader as described above.

Continue rolling and brooming until the roadway is uniformly covered and the Mineral Aggregate is well compacted and set into the asphalt. Continue this operation until the asphalt has cured to the extent that it does not "pick up" under traffic. During the maintenance period following the application of the Bituminous Surface Treatment, the Contractor must perform brooming, spotting, and rolling as necessary to prevent pick up or other damage to the surface.

At any time during the progress of the Work, the Engineer may direct the use of a different Mineral Aggregate grading instead of the Mineral Aggregate specified, if they determine it will better achieve the desired results of this Specification.

5-02.3(5) ADDITIONAL ASPHALT AND MINERAL AGGREGATE

If the application of asphalt or Mineral Aggregate, or both, is insufficient or excessive for the required results, the Engineer may require the Contractor to make an additional application of 1 or both Materials per these Specifications.

5-02.3(6) PATCHING AND CORRECTION OF DEFECTS

The Contractor must immediately cover any omissions by the distributor or damage to the treated surface of any coat, using hand application with asphalt in adequate quantities. Patch any holes that develop in the surface in the same manner, as specified in Section 5-04.3(4)C2.

Defects such as raveling, lack of uniformity, or other imperfections caused by faulty workmanship must be corrected. The Contractor must repair all defects and correct application means and methods before any new work begins. All improper workmanship and defective Materials resulting from overheating, improper handling or application, must be removed from the roadway and must be replaced with approved Materials and workmanship.

If the Engineer determines a fog seal is necessary at any time during the life of the Contract, the Contractor must apply a fog seal of CSS 1 at the rate of 0.07 to 0.18 (0.02 to 0.05 residual) gallons per square yard. Dilute emulsified asphalt with water at a rate of 1 part water to 1 part emulsified asphalt.

5-02.3(7) PROGRESS OF WORK

The Contractor must organize the entire operation to ensure progression in an orderly and expeditious manner.

The sequence of operation for placing Bituminous Surface Treatments is:

1. Apply asphalt emulsion on a properly prepared roadway surface resulting in a uniform application.
2. Apply Mineral Aggregate by spreader boxes or other means resulting in a uniform application.
3. Roll with pneumatic tired and/or self-propelled smooth wheeled roller.
4. Allow a minimum of 48 hours set time.
5. Sweep with an approved road broom to pick up and remove excess Mineral Aggregate. Conduct this work in the early morning hours before the heat from the sun has warmed the pavement.
6. Maintain roadway surface for 5 Calendar Days by sweeping and patching as necessary on a daily basis, maintaining traffic signing.

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10 Calendar Days after the final application, the Contractor must make a final sweep with a mechanical broom, using the pick-up broom only, to clear off any remaining loose aggregates. Do not use gutter brooms . The Contractor must dispose of the excess Mineral Aggregates.

5-02.3(8) PROTECTION OF STRUCTURES

Protect all handrails, guardrails, curbs, road signs, and other facilities from splashing and overspray.

5-02.3(9) UNFAVORABLE WEATHER

Do not apply asphalt to excessively wet Material. Do not apply asphalt during rainfall, sand, or dust storms, or before any imminent storms that might adversely impact construction. The Engineer will determine whether the surface and Materials are acceptable for construction in inclement weather.

The application of any asphalt to the roadway is restricted to the following conditions:

1. The roadway surface temperature is at least 60 °F and the air temperature at least 60 °F and either holding or rising; and
2. The air temperature is at least 70 °F when falling and the wind is less than 10 miles per hour as estimated by the Engineer.

Do not apply any asphalt that cannot be covered 1 hour before darkness. The Engineer may require the Contractor to delay application of asphalt until the atmospheric and roadway conditions are within the limits listed above.

No construction of bituminous surface treatments on any traveled way is allowed before May 15 or after September 1 of any year except with written approval from the Engineer.

5-02.3(10) ANTI STRIPPING ADDITIVE

When directed by the Engineer, add an anti-stripping additive to the asphalt Material, see Section 9-02.4.

5-02.3(11) UNTREATED ROADWAY SURFACES

Existing crushed rock, gravel, and oil mat streets must be restored with Mineral Aggregate Type 1, to a compacted depth of 4 inches. Construct final surfacing as specified in Section 5-04.3(4)C2.

5-02.4 MEASUREMENT

Measurement for “Asphalt, (Grade)” will be made by the gallon or ton before dilution.

Measurement for “Mineral Aggregate, (Type)” will be by the ton.

Measurement for roadway preparation will be as specified in Section 5-04.4

5-02.5 PAYMENT

1. **“Asphalt, (Grade)”**, per gallon or ton.

The Bid Item price for “Asphalt, (Grade)” includes all costs for the work required to construct a single or multiple course bituminous surface treatment.

2. **Other payment information**.

Payment for “Mineral Aggregate, (Type)” will be made as specified in Section 4-01.5.

Change in Mineral Aggregate type, or in grade of asphalt, or in Engineer directed application of fog seal will be addressed as specified in Section 1-04.1(2).

All costs for the work required to coat omissions or to patch defects must be included in the Bid Item price for the applicable Bid Item.

All costs for splashing and overspray protection must be included in the Bid Item price for the applicable Bid Item.

All costs for roadway preparation will be paid as specified in Section 5-04.5.

All costs for water will be paid as specified in Section 2-12.5.

SECTION 5-03 RESERVED

SECTION 5-04 HOT MIX ASPHALT (HMA) AND WARM MIX ASPHALT (WMA) PAVEMENT

5-04.1 DESCRIPTION

Section 5-04 describes providing and placing 1 or more layers of plant-mixed hot mix asphalt (HMA), warm mix asphalt (WMA), or both on a prepared foundation or base per these Specifications and the lines, grades, thicknesses, and typical cross-sections shown on the Drawings.

HMA is composed of asphalt binder and Mineral Aggregate as specified, mixed in the proportions specified to provide a homogeneous, stable, workable, and compactable mixture.

WMA is a technology that allows conventional HMA asphalt concrete mixtures to be produced and placed at reduced temperatures. The reduced temperatures of WMA are achieved using water-based foaming processes.

The Contractor may submit other WMA technologies, including organic or chemical additives, for approval.

5-04.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Material	Section
Bituminous Materials	Section 9-02
Mineral Aggregates	Section 9-03
Temporary Pavement Marking	Section 9-29

The Contract specifies the grade of asphalt binder required.

5-04.2(1) USE OF SUBSTITUTE MATERIALS

Any proposed substitutions or Alternate Materials in the production of HMA from those specified in the Contract must be included in the submittal as specified in Section 5-04.3(6), and requires Engineer approval.

Unless the Contract specifies otherwise, the Contractor may propose using recycled asphalt pavement, as specified in Section 9-03.6(3)B. Recycled asphalt pavement must not exceed 20 percent of the total weight of aggregate in the HMA mix. Recycled asphalt pavement is not allowed for asphalt binders with grades of PG58V-22 or higher.

Grade of asphalt binder: Unless the Contract specifies otherwise, the Contractor may propose a substitute grade of asphalt binder. The substitute grade of asphalt binder must:

1. Comply with the requirements of Section 9-02.1(4).
2. Have a maximum pavement design temperature equal to or greater than the specified binder.
3. Have a minimum pavement design temperature equal to or lower than the specified binder.

The Engineer-approved substituted grade of asphalt binder must be used only in HMA of the same class with the Contract-specified grade of asphalt binder. Blending of asphalt binder, whether different manufacturers and/or Suppliers and/or different grades, is not permitted.

5-04.3 CONSTRUCTION REQUIREMENTS

5-04.3(1) TERMS RELATED TO HMA

In Section 5-04, Section 9-02, Section 9-03.5, and Section 9-03.6, terms and phrases used, such as “design aggregate structure,” “nominal maximum aggregate size,” “air voids,” “maximum aggregate size,” and “binder content,” and abbreviations such as “JMF” for “job mix formula,” “Va,” “Ndesign,” and “Gsb,” are consistent with and can be found in WSDOT Standard Operating Procedure (SOP) 732 Volumetric Design for Hot-Mix Asphalt (HMA), as well as other documents incorporated by reference within WSDOT SOP 732.

These documents are available in the current edition of the Washington State Department of Transportation’s Materials Manual M 46-01.

5-04.3(1)A WMA REQUIREMENTS

When provided for in the Contract, the Contractor must use WMA technologies for paving the wearing course. Submit a WMA mix design conforming to the requirements for HMA mix design, including a description of the WMA technology proposed. The description of the technology must include:

1. Manufacturer's recommended mixing and placement temperatures;
2. Description of all variances from the standard hot mix asphalt (HMA) requirements as defined in Section 5-04; and
3. Targeted temperature reduction (production and placement).

Provide copies of all manufacturers’ literature related to the production, mixing, conveying, and placement of the WMA. Comply with all manufacturers’ recommendations for mixing, conveyance, and placement of WMA.

WMA use is subject to Engineer approval of the mix design.

5-04.3(2) MIXING PLANT

In addition to the requirements of Section 1-06, the Contractor must allow the Engineer safe access to stockpiles for sampling and allow an adequate and convenient space for the Engineer to temporarily store and test samples.

Plants used for the preparation of HMA must conform to these requirements:

1. Equipment for Preparation of Asphalt Binder: Tanks for the storage of asphalt binder must be equipped to heat and hold the binder at the required temperatures. The heating must be accomplished by steam coils, electricity, or other approved means so that no flame comes in contact with the storage tank. The circulating system for the asphalt binder must ensure proper and continuous circulation during the operating period. Provide a valve for sampling the

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binder either in the storage tank or in the supply line to the mixer. Also see Section 5-04.3(5) for additional requirements for heating asphalt binder.

2. Thermometric Equipment: An armored thermometer capable of detecting temperature ranges expected in the HMA mix must be fixed in the asphalt feed line near the charging valve at the mixer unit. The thermometer location must be convenient and safe for observation.

   The plant must be equipped with an approved dial-scale thermometer, a mercury actuated thermometer, an electric pyrometer, or another approved thermometric instrument placed at the discharge chute of the dryer, to automatically register or indicate the temperature of the heated aggregates. This device must be in full view of the facility operator and must be convenient to observation.

3. Sampling and Testing of Mineral Aggregates: The HMA plant must be equipped with a mechanical sampler for sampling the Mineral Aggregates, see Sections 1-06.1 and 1-06.2.

5-04.3(3) PAVING AND RELATED EQUIPMENT

5-04.3(3)A HAULING EQUIPMENT

Trucks used for hauling HMA must have a tight, clean, smooth metal bed with a retractable cover securely attached to the truck, made of canvas or other suitable material and of sufficient size to completely protect the mixture from adverse weather.

Whenever weather conditions during the workshift include, or are forecast to include, precipitation or an air temperature less than 45º F, protect the HMA with the retractable cover.

To prevent the HMA mixture from adhering to the hauling equipment, spray truck beds with an environmentally benign release agent. Drain any excess release agent before filling with HMA. For hopper trucks, the conveyer must be in operation during the process of applying the release agent.

5-04.3(3)B PAVING EQUIPMENT

5-04.3(3)B1 GENERAL

As specified in Section 1-05.9, the Contractor must replace equipment producing defective work.

When requested by the Engineer, the Contractor must provide HMA and related equipment manufacturer's written operating instructions and maintenance manual.

5-04.3(3)B2 HMA PAVERS

HMA pavers must be self-contained, power-propelled units, provided with an internally-heated vibratory screed or strike-off assembly, and must be capable of spreading and finishing courses of HMA plant mix material in lane widths specified on the Drawings.

The screed or strike-off assembly must effectively produce a finished surface of the required evenness and texture without tearing, shoving, segregating, or gouging the HMA. Extensions are allowed provided they produce the same results, including ride, density, and surface texture, as obtained by the primary screed or strike off assembly. Do not use extensions without augers, vibration, and heated screeds to pave the traveled way.

The paver must be equipped with automatic screed controls with sensors for either or both sides of the paver. The controls must be capable of sensing grade from an outside reference line, sensing the transverse slope of the screed, and providing automatic signals that operate the screed to maintain the desired grade and transverse slope. The sensor must be constructed to operate from a reference line or a mat referencing device.

The Contractor must furnish and install all pins, brackets, tensioning devices, wire, and accessories necessary for satisfactory operation of the automatic control equipment and must provide samples of the above items before installation when requested by the Engineer.

The transverse slope controller must be capable of maintaining the screed at the desired slope within ± 0.1 percent. The paver must be equipped with automatic feeder controls, properly adjusted to maintain a uniform depth of material ahead of the screed.

5-04.3(3)B3 MATERIAL TRANSFER VEHICLES (MTV)

A material transfer vehicle (MTV) must not be used on any paving operation without the prior written approval of the Engineer.

5-04.3(3)C ROLLERS

Rollers must be steel wheel, vibratory or pneumatic tire types, in good condition and capable of reversing without backlash. Rollers must be operated per the manufacturer's recommendations. The number and weight of rollers must be sufficient to compact the mixture as specified in Section 5-04.3(9). The use of equipment that results in crushing of the aggregate is not permitted. The Engineer will reject rollers producing pickup, washboard, uneven compaction of the surface, displacement of the mixture, or other defective work, see Section 1-05.7, as specified in Section 1-05.9.

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5-04.3(3)D PLANING BITUMINOUS PAVEMENT AND REQUIRED PRE-PLANING METAL DETECTION

5-04.3(3)D1 GENERAL

Before planing, the Contractor must meet with the Engineer to discuss the planing operations as specified in Section 5-04.3(13).

5-04.3(3)D2 PLANING BITUMINOUS PAVEMENT

Use the cold planning method for planing bituminous pavement. Equipment must have operated successfully on work comparable to that in the Contract, and is subject to Engineer approval before use. Maintain equipment in good working condition while in use.

Cold planers must be milling type equipment capable of cutting at least a 5-foot chord to a depth of up to 4 inches in 1 pass. For required planing depths in excess of 4 inches, and as the total depth requires, the first pass and all succeeding passes must not exceed 4 inches per pass, until the final depth is reached. Smaller planers may be used for cutting around castings and other metal objects to remain, and for making taper cuts for butt joints.

Where metal is not visible on the surface but is detected below the surface, the Contractor must use methods of pavement removal that do not damage the detected metal if it is to remain, and is beyond the 4-inch maximum depth of planing, to avoid damage to Contractor equipment. Where irregularities or unavoidable obstacles make the use of mechanical planing equipment impractical, use other equipment or methods as approved by the Engineer.

For mainline cold planing operations, the equipment must have automatic controls with sensor for either or both sides of the equipment capable of sensing the proper grade from an outside reference line. The automatic controls must also be capable of maintaining the desired transverse slope. The sensor must be constructed to operate from a reference line or multi footed ski-like arrangement. The transverse slope controller must be capable of maintaining the desired slope within ± 0.1 percent.

5-04.3(3)D3 REQUIRED PRE-PLANING METAL DETECTION

Metal is buried beneath the existing asphalt surface of many Seattle streets. Such metal may be rail track associated with Seattle's former street car system, or castings buried under asphalt overlay, or other similar metallic items.

Before planing, adequately sweep the entire area of asphalt to be planed to detect buried metal.

If such metal is detected and is not specified in the Contract, surface mark such detected metal and notify the Engineer before planing, as specified in Section 1-04.6.

Where the Drawings indicate the existence of metal not visible on the existing pavement surface, remove such surface pavement material and verify the depth to metal before planing. If the depth to metal is beyond the required depth of planing, note this and avoid planing contact with such metal. If the depth to metal is within the depth range of required planing, then 1 of these 2 outcomes is required:

1. If a metal casting, treat as specified in Section 7-20.
2. If a metal object except a casting, the Engineer may require removal. If removal is not addressed in the Contract, this portion of work may be addressed as extra work, see Section 1-04.6.

Metal detection equipment must have adequate sensitivity to detect metal hidden beneath existing pavement surface to a depth of at least 4 inches. Where planing is indicated to a depth greater than 4 inches, must make multiple planing passes with each pass not exceeding the 4-inch depth. Before each planing pass of 4 inches or less, must resweep the same area of asphalt to detect metal.

Where the Engineer directs additional depth planing beyond that required in the Contract, must sweep for metal before such additional depth planing, as described in this Specification.

The Contractor is solely responsible for any damage to Contractor planing equipment from metal buried within asphalt.

5-04.3(4) PREPARATION OF STREET SURFACES

5-04.3(4)A PREPARATION CLASSIFICATION DESCRIPTIONS

In preparing surfaces, the following surface classifications apply:

1. Treated surfaces: cement concrete, asphalt concrete, brick, seal coat or other bituminous surface treatments
2. Untreated surfaces: crushed rock, gravel, native subgrade, or oil mat surfaces. Bituminous surface treatments are addressed in Section 5-02, and oil mat surfaces are addressed in Section 4-05.

The work of preparing existing surfaces for asphalt concrete or other bituminous Material overlay is classified as follows:

"Surface preparation" applies only to treated surfaces, and "roadway preparation" applies only to untreated surfaces.

5-04.3(4)B SURFACE PREPARATION – TREATED SURFACES

5-04.3(4)B1 GENERAL

When an existing treated surface is used as a base for 1 or more courses of new asphalt concrete, or other surfacing, see Section 4-04 and Section 5-02, the treated surface must first be swept, cleaned, and patched:

1. Sweep treated surfaces with a power broom until free from dirt and other foreign matter. Use hand brooms to clean omissions of the power broom. Remove fatty asphalt patches, grease drippings, and other objectionable Material from the existing pavement.
2. Completely remove excess asphalt joint filler and remove premolded joint filler to at least 1/2 inch below the surface of the existing pavement.
3. Obtain a sound base with a uniform grade and cross-section. Correct irregularities in the existing treated surface before placing a new asphalt wearing course or other bituminous surface treatment. Corrections must be made by planing, preleveling, grinding, patching, or placing new base pavement.

5-04.3(4)B2 PRELEVELING

When a surface of the existing pavement or old base is irregular, the Contractor must bring it to a uniform grade and cross-section by planing, spot grinding or preleveling. Existing surfaces not requiring planing, but requiring other repair or requiring preleveling, will be addressed in the Contract. If existing asphalt overlay is planed and the surface to remain requires preleveling, the Engineer will direct preleveling before HMA wearing course placement as specified in Section 5-04.3(8). As soon as the existing surface has been thoroughly cleaned, repair holes and discontinuities in the surface and edges and edge breaks as specified in the Contract. Patching must be accomplished before preleveling or installation of the first asphalt course, whichever is applicable.

Preleveling Materials must be the same HMA class of asphalt concrete as the wearing course or an approved alternate. If the Contract does not require a finish HMA wearing course, prelevel uneven or broken surfaces by placing asphalt concrete of the class specified with a motor patrol grader, by hand-raking, by Miller box, or by another approved method.

After placement, thoroughly compact the preleveling Material with a pneumatic tire roller, unless alternate equipment is approved by the Engineer.

When planing is not a Bid Item in the Contract, the Contractor must spot grind occasional high areas, such as those caused by rutting, to allow for a uniform application of preleveling.

5-04.3(4)B3 PLANING BITUMINOUS PAVEMENT

5-04.3(4)B3A PRE-PLANING METAL DETECTION CHECK

Before starting planing of pavements, and before any additional depth planing required by the Engineer, the Contractor must conduct a physical survey of existing pavement to be planed with equipment that can identify hidden metal objects.

Should such metal be identified, promptly notify the Engineer.

See Section 1-07.16(1) regarding the protection of survey monumentation that may be hidden in pavement.

The Contractor is solely responsible for any damage to equipment resulting from the Contractor's failure to conduct a pre-planing metal detection survey, or from the Contractor's failure to notify the Engineer of any hidden metal that is detected.

5-04.3(4)B3B PLANING

See Section 5-04.3(13) regarding a planing plan, and pre-planing briefing before starting planing.

Locations of existing surfacing to be planed as shown in the Drawings.

Where planing an existing pavement is specified in the Contract, the Contractor must remove existing surfacing material and to reshape the surface to remove irregularities. The finished product must be a prepared surface acceptable for receiving an HMA overlay.

Use the cold milling method for planing unless otherwise specified in the Contract. Do not use the planer on the final wearing course of new HMA.

Conduct planing operations in a manner that does not tear, break, burn, or otherwise damage the surface which is to remain. The finished planed surface must be slightly grooved or roughened and must be free from gouges, deep grooves, ridges, or other imperfections. The Contractor must repair any damage to the surface by the Contractor's planing equipment, using an Engineer approved method.

Repair or replace any metal castings and other surface improvements damaged by planing, as determined by the Engineer.

A tapered wedge cut must be planed longitudinally along curb lines sufficient to provide a minimum of 4 inches of curb reveal after placement and compaction of the final wearing course. The dimensions of the wedge must be as shown on the Drawings or as specified by the Engineer.

A tapered wedge cut must also be made at transitions to adjoining pavement surfaces (meet lines) where butt joints are shown on the Drawings. Cut butt joints in a straight line with vertical faces 2 inches or more in height, producing a smooth transition to the existing adjoining pavement.

After planing is complete, planed surfaces must be swept, cleaned, and if required by the Contract, patched and preleveled.

The Engineer may direct additional depth planing. Before performing this additional depth planing, the Contractor must conduct a hidden metal in pavement detection survey as specified in Section 5-04.3(4)B3A.

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5-04.3(4)B4 TACK COAT AND DISTRIBUTOR EQUIPMENT REQUIREMENTS

5-04.3(4)B4A TACK COAT REQUIREMENT

Tack coat must be CSS-1, CSS-1h, or STE-1 emulsified asphalt. The CSS-1 and CSS-1h emulsified asphalt may be diluted with water at a rate not to exceed 1 part water to 1 part emulsified asphalt. The emulsified asphalt must not exceed the maximum temperature recommended by the emulsified asphalt manufacturer.

Apply a tack coat of asphalt at the rate of 0.02 to 0.08 gallons per square yard of retained asphalt to all paved surfaces on which any course of HMA will be placed or abutted. The tack coat must cover the existing pavement uniformly with a residual asphalt film, free of streaks and bare spots. Apply the tack coat only to surfaces that are dry and free from moisture. Do not apply the tack coat under the imminent threat of rain, as determined by the Engineer.

The Contractor must make arrangements with the Engineer to demonstrate tack coat application at the start of such application. Once the Engineer approves the tack coat application method and rate of application, the Contractor must continue with such application without exception.

Where the new asphalt concrete abuts a curb or gutter, cold pavement joint, trimmed meet line, or any metal surface, apply a tack coat of asphalt on the vertical face of the abutting surface. The application on the contact surfaces must be uniform to avoid an accumulation of excess asphalt. Immediately remove any excess tack coat. Do not apply the tack coat on vertical contact surfaces above the finished height of the asphalt concrete being placed.

Apply tack coat only to surfaces receiving tack coat treatment. Do not apply tack coat to any other surface. Tack coat applied to surfaces that will not be coated be removed immediately, including thorough cleaning of the surface area as necessary to leave no residue.

Do not operate equipment on tacked surfaces until the tack has broken and cured. The Contractor must repair any damages to the tack coat from Contractor operations before placement of the HMA. For surfaces open to traffic, limit the application of tack coat to surfaces that will be paved during the same work shift.

5-04.3(4)B4B DISTRIBUTOR EQUIPMENT REQUIREMENT

The distributor equipment must be capable of distributing a uniform tack coat in controlled quantities.

The distributor must have a capacity of at least 1,000 gallons, and must be designed, equipped, maintained, and operated to uniformly apply asphalt Material of an even heat at the required rate.

Power for operating the pressure pump must be supplied by a unit that provides a uniform spray from each of the nozzles across the spray bar and extensions.

In addition, the distributor must be equipped with:

1. A thermometer to indicate the temperature of the tack coat material;
2. A thermometer installed permanently in the tank to indicate temperatures at all times;
3. Hand operated spray equipment for use only on inaccessible and irregularly shaped areas;
4. A 10-foot spray bar with extensions;
5. Pressure pump and gauge, and volume gauge located where it is easily observed from the ground; and
6. A tachometer to accurately control the speed and spread of asphalt

The Engineer may allow hand operated spray equipment separate from the distributor equipment for inaccessible and irregularly shaped areas if the Contractor can demonstrate acceptable tack coat application.

5-04.3(4)C SURFACE PREPARATION OF UNTREATED SURFACES

5-04.3(4)C1 GENERAL

The Contractor must shape untreated roadway surfaces, including intersections and side roadway approaches that will receive asphalt concrete pavement, or other surfacing, see Section 4-04 and Section 5-02, to a uniform grade and cross-section, conforming as nearly as possible to the existing surface, except:

1. Where new lines and grades are specified in the Contract or established by the Engineer.

   The basis for establishing final line and grade in such cases is curbs, curbs and gutters, existing pavement, or pavement edges or other existing street improvements. Grade existing driveways as necessary to provide a smooth transition to the final grade of the new pavement surface, including any grading necessary to allow driveway adjustment.

2. Where no curbs or curbs and gutters exist and where none are required by Contract, extend subgrade preparation 1 foot on each side of the roadway beyond the final asphalt paving width shown on the Drawings. The Engineer may require the Contractor to extend this subgrade preparation to greater width to accommodate local conditions such as intersections.

Shape the grade so that all frame castings for maintenance holes, monument boxes, gate valve boxes, and catch basins, within the roadway section to be treated, extend above the prepared surface. All such castings must be flush with the final wearing course. Where existing asphalt or Portland cement concrete pavement is being met with new asphalt surfacing,

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remove sufficient existing untreated surfacing to allow the forming of a butt joint. The completed finish surface, including castings and transitions with existing treated surfaces, must be smooth as specified in Section 5-04.3(11).

Those areas and surfaces being prepared for the placement of asphalt concrete pavement or other surfacing are considered subgrade for the new construction. See Section 2-09 for subgrade preparation requirements. Excess native material deemed suitable by the Engineer is considered selected Material per Section 2-10 and must be stockpiled or bladed to the roadway edge and used as needed for fill or shoulder restoration under completion of the paving. Use the selected Material to the fullest extent possible as sub-base Material before placing new crushed rock.

Water must be available on the Job Site and must be applied as necessary to comply with compaction requirements and to alleviate dust.

Dispose of excess material.

5-04.3(4)C2 PRIME COAT TREATMENT

Where required in the Contract, apply a prime coat treatment of asphalt complying with the requirements of Section 5-02.3(3) for existing gravel, crushed rock, or oil mat streets before paving with asphalt concrete. Apply the prime coat over the entire area of proposed asphalt pavement construction. Following the application of the prime coat, do not place HMA until the prime coat has cured.

In the event the surface receiving the prime coat has the gradation and relative density to resist penetration of the prime coat, loosen no more than the upper 1/2 inch of surface and regrade it without compaction, immediately before applying the prime coat.

Maintain the completed prime coat by blading or brooming until the asphalt concrete is placed. Patch or repair any holes, breaks, or irregularities that develop in the roadway surface after the prime coat has been applied, as specified in Section 5-04.3(4)C1, immediately in advance of placing the asphalt concrete pavement.

Immediately before placing the HMA, sweep the surface of the prime coat clean of all dirt, dust, and other foreign matter.

5-04.3(4)D CRACK SEALING

Where the Contract requires Crack Sealing, clean all cracks and joints with a stiff-bristled broom and compressed air. Remove and dispose of any loose pieces.

After cleaning, fill all cracks less than 1/4 inch in width with straight CSS-1 emulsified asphalt and top with sand.

After cleaning, fill all cracks and joints 1/4 inch or greater in width with sand slurry.

Use rubberized asphalt where specified in the Contract.

The Contractor may request substitution of rubberized asphalt for sand slurry; however, such request requires written approval from the Engineer before use. Do not use rubberized asphalt to seal cracks greater than 1-1/2 inches in width.

Application of sand slurry or rubberized asphalt:

1. Sand slurry must consist of 20 percent CSS-1 emulsified asphalt, 2 percent Portland cement, sufficient water for workability, and the remainder clean U.S. No. 4-0 paving sand. Thoroughly mix the components and pour into the cracks and joints until full. The following day, top off any cracks or joints that are not completely filled with additional sand slurry. After the sand slurry is placed, strike the filler off flush with the existing pavement surface and allow to cure. Do not place the HMA overlay until the slurry has fully cured.
2. Rubberized asphalt sealant Material must comply with the requirements of Section 9-04.9 and must be applied per the sealant manufacturer's recommendations. Submit these recommendations to the Engineer before starting this type of construction, including recommended heating time and temperature, allowable storage time and temperatures after initial heating, allowable reheating criteria, and application temperature range. Cracks must be completely dry before being filled with rubberized asphalt. Control filling to confine the Material within the crack or joint. Where the sealed cracks will be overlaid with asphalt, the sealant must be recessed 3/8 inch below the surface. The method of sealant application must confine the sealant to the crack or joint and must not result in any spillage on the pavement surface.

Should spillage occur, the Contractor must have Supplies readily available to quickly and effectively remove all spilled material.

5-04.3(5) HEATING OF ASPHALT BINDER

The temperature of the asphalt binder must not fall below the minimum or exceed the asphalt binder manufacturer's recommended maximum temperatures at any time. The asphalt binder must be heated in a manner that prevents local variations in heating. The heating method must provide a continuous supply of asphalt binder to the mixer at a uniform average temperature with no individual variations exceeding 25 °F. See Section 5-04.3(2) regarding HMA mixing plant requirements.

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5-04.3(6) HMA MIX DESIGN AND SUBMITTAL REQUIREMENTS

5-04.3(6)A PREPARATION OF AGGREGATES

Provide sufficient storage space for each size of aggregate. Remove the aggregates from stockpile in a manner that minimizes segregation when being moved to the HMA plant for processing into the final mixture. Keep different aggregate sizes separated until they have been delivered to the HMA plant.

5-04.3(6)B MIX DESIGN

5-04.3(6)B1 GENERAL

From the stockpiled aggregates that will be used to produce the HMA, the Contractor must determine a design aggregate structure and asphalt binder content per WSDOT SOP 732, Volumetric Design for Hot-Mix Asphalt (HMA), available in the current edition of the Washington State Department of Transportation's Materials Manual M 46-01. The Contract specifies the grade of asphalt binder, also see Section 5-04.2(1) where binder substitution is allowed. The Contract also specifies the nominal maximum aggregate size and design ESALs. The Engineer will determine the quantity of anti-stripping additive to be added to the mix, based on the Contractor's proposed design and submittal per this Section and Section 9-02.4.

Once the Contractor has determined the aggregate structure and binder content, the Contractor's submittal must provide data demonstrating that the proposed HMA design meets the requirements of Sections 9-03.6(2) and 9-03.6(6). The Engineer's determination of anti-stripping agent requirements must be made before HMA paving can start.

5-04.3(6)B2 APPLICATION DEFINITIONS

Unless the Contract specifies otherwise, use the following definitions regarding HMA Cl mix designs and HMA submittals:

1. Structural application – major quantity: A HMA Cl mix used for travel way or surfaces for vehicular traffic where the project specifies more than 400 tons of HMA. See Section 5-04.3(6)C for submittal requirements.
2. Structural application - minor quantity: A HMA Cl mix used for vehicular traffic where the project specifies less than 400 tons of HMA. See Section 5-04.3(6)D for submittal requirements.
3. Non-structural application: An HMA Cl mix used for sidewalks, ditches, slopes, paths, trails, gores and other non-vehicular traffic application. See Section 5-04.3(6)E for submittal requirements.

For any quantity structural application, vehicular traffic includes roadways of any kind, alleys, driveways, and other surfaces as specified in the Contract.

5-04.3(6)C SUBMITTAL – STRUCTURAL APPLICATION – MAJOR QUANTITY

5-04.3(6)C1 GENERAL

As a convenience to accommodate accelerated submittals for future uses of an approved HMA Cl mix design major quantity structural application, an approved HMA Cl major quantity structural application mix design remains approved for use on all future projects with a Bid Opening Date within 365 consecutive Calendar Days from the date of approval of that specific HMA Cl mix. The SPU Materials Laboratory will specify the approval date on the returned submittal, and will maintain records on such. The Contractor must contact the SPU Materials Laboratory at (206) 386-1236 to find out if and when a specific major quantity structural application mix design was approved.

5-04.3(6)C2 MIX DESIGN AND SAMPLE SUBMITTAL REQUIREMENTS

For HMA Cl mix designs not pre-approved as specified in Section 5-04.3(6)C1, the Contractor's HMA Cl submittal requires 20 Working Days and requires both the Contractor mix design and samples.

Submit the following mix design information for each HMA class:

1. Project name and PW#
2. HMA class designation and HMA Supplier
3. Contractor's mix design number, or other designating identification (designation)
4. Design equivalent single axle loads (design ESALs)
5. Aggregate source, see Section 1-06
6. Aggregate gradations, including blending ratio
7. Percent (by weight of final mix) of RAP used
8. Target gradation of final HMA mix
9. 0.45 power plot of target gradation showing aggregate gradation control points zone
10. Binder source and performance grade (e.g. PG xx-yy)
11. Temperature – Viscosity curve of the binder
12. Recommended binder compaction temperature range
13. Recommended binder mixing temperature range
14. Maximum allowable binder temperature

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15. Type and brand of anti-stripping additive
16. Binder content of RAP (percent by weight of RAP)
17. Percent (by weight of final mix) of binder in final mix (Pb)
18. Effective Binder Content (Pbe)
19. HMA compaction temperature for the gyratory compactor
20. Relative density of the final mix at Ndesign gyrations
21. Number of design (Ndesign) gyrations used (Nini; Ndes; Nmax)
22. Voids in Mineral Aggregate (VMA)
23. Voids filled with asphalt (VFA)
24. Air voids in the compacted mixture (Va)
25. Dust/Asphalt Ratio
26. Sand Equivalent of the aggregate fraction passing U.S. No. 4 sieve
27. Percent of flat and elongated particles retained on the U.S. No. 4 sieve
28. Theoretical maximum density of the mix (Gmm)
29. Percent of Gmm for extruded specimens at Nini, Ndes and Nmax
30. Bulk specific gravity of the extruded specimen at Ndesign gyrations (Gmb)
31. Bulk specific gravity of the combined aggregates in the mix (Gsb)
32. Effective specific gravity of the combined aggregates in the mix (Gse)
33. Bulk specific gravity of the aggregate fraction passing the 3/8" sieve
34. Bulk specific gravity of the aggregate fraction retained on the 3/8" sieve
35. Specific gravity of the binder (Gb)

Samples: The mix design submittal must be accompanied by the following samples and sizes.

Mix Design Samples and Sizes

Sample	Minimum Sample Size
The HMA class mix (if RAP is proposed, the mix must contain the RAP)	75 pounds
Asphalt binders	1 quart
Recycled asphalt pavement component (RAP), if used	25 pounds
Anti-stripping agent	1 quart

Any adjustment to an approved HMA class JMF requires a submittal, see Section 1-05.3(5), and Engineer approval as specified in Section 9-03.6(7).

The Engineer may waive submittal of items 2 through 4 above if the Contractor submits a valid and current WSDOT mix design of the same class of HMA using the same constituents from the same sources as the proposed mix design, including anti-stripping agent.

The Contractor may propose an asphalt binder from a secondary source in the same submittal as the primary binder source, and include this in the submittal, see items 10., 11., 12., 13., 16., 17., 18., and the Mix Design Samples and Sizes table above.

Based on the Contractor's submittal the Engineer will determine the anti-stripping additive requirement, and make this information known on the returned submittal.

If the Engineer determines the submitted mix design is defective, the Engineer will provide written notice identifying such defect.

The Contractor must not start production of any HMA class until that HMA JMF mix design has been established and approved by the Engineer.

Any change in supply source for any of the constituents of an approved HMA class JMF requires submittal of a new mix design, which must be accepted before use as specified in this Section.

If the verification testing results of the submitted sample Materials and proposed mix design comply with Sections 9-02.1(4) and 9-03.6, the submittal is considered accepted. The accepted mix design is the initial job mix formula for the specified HMA class of mix and an Engineer approval date will be assigned.

To aid the Contractor in preparing the HMA mix design submittal, the Contract will contain an HMA Mix Design Submittal form located in the Appendix of the Project Manual.

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5-04.3(6)C3 ACCELERATED SUBMITTAL

When an approved HMA Cl mix design for major quantity structural application is specified in the Contract and this HMA mix is within the 365 Calendar Day window before the Bid Opening Date, the Contractor must submit, at least 5 Working Days in advance, a manufacturer's certificate of compliance stating:

1. For each HMA class specified in the Contract, the name and location of each Supplier providing the approved HMA class mix and component parts.
2. Supplier's HMA Cl mix design number, or other designating identification (designation) consistent with the approved HMA class mix.

5-04.3(6)C4 CERTIFICATION TO ACCOMPANY HMA DELIVERY

For any HMA class major quantity structural application mix, each delivery of HMA Cl to the Project Site must be accompanied by a certification stating:

1. HMA mix being delivered is an approved HMA mix;
2. Name and location of HMA Cl Supplier;
3. Supplier's HMA Cl mix identification number;
4. Date and time of load out;
5. Class of HMA;
6. Grade of binder;
7. Percent (by weight of binder) of anti-stripping agent; and
8. Tonnage of HMA in the hauling vehicle.

5-04.3(6)D STRUCTURAL APPLICATION - MINOR QUANTITY

For HMA Cl minor quantity structural application mixes, the Contractor must submit, at least 5 Working Days in advance of first use, a manufacturer's certificate of compliance showing items 1. through 7. below.

At the Engineer's request, the Contractor must submit the pre-approved mix design data (previously submitted and accepted as specified in Section 5-04.3(6)C2).

The Engineer may obtain samples of a previously accepted HMA Cl mix and/or its individual constituents for verification of the mix design.

In addition, every delivery of the HMA Cl mix to the Project Site must be accompanied by a certificate stating:

1. Name and location of HMA Supplier;
2. Supplier's HMA mix identification designation;
3. Date and time of load out;
4. Class of HMA;
5. Binder grade of PG58H-22;
6. Percent (by weight of binder) of anti-stripping agent including brand name and type;
7. Minimum design ESALs of 10,000,000; and
8. Tonnage in vehicle.

5-04.3(6)E NON-STRUCTURAL APPLICATIONS

For HMA Cl non-structural application mixes, the Contractor must submit, at least 5 Working Days in advance of first use, a manufacturer's certificate of compliance showing items 1. through 3. below.

At the Engineer's request, the Contractor must submit the pre-approved mix design data specified in Section 5-04.3(6)C3.

The Engineer may obtain samples of a previously accepted HMA Cl mix and/or its individual constituents for verification of the mix design.

In addition, every delivery of the HMA Cl mix to the Project Site must be accompanied by a certificate stating:

1. HMA Class 1/2 Inch;
2. Binder grade of PG58H-22 (binder grade may be substituted as specified in Section 5-04.2(1));
3. Supplier designed at any ESAL level; and
4. Tonnage in hauling vehicle.

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5-04.3(7) HMA MIXING PROCESS

5-04.3(7)A GENERAL

After the required quantities of Mineral Aggregate and asphalt binder have been placed in the mixer, mix the HMA until a complete and uniform coating of the particles and a thorough distribution of the asphalt binder throughout the Mineral Aggregates is achieved.

When discharged, the temperature of the HMA must not exceed the maximum temperature recommended by the asphalt binder manufacturer.

A maximum water content of 1 percent is allowed in the HMA at discharge, providing the water causes no problems with compaction, handling, stripping, or flushing. If the water content in the HMA causes any of these problems, the HMA is considered defective Material and the Contractor must stop production of the HMA and discontinue the placing of HMA. As specified in Section 1-05.7, the Contractor must provide an acceptable remedy for addressing the water content of the HMA. Defective Material in place must be removed and replaced with Material that meets the specified requirements.

Storing or holding HMA in approved storage facilities is permitted during the daily operation but must not be held for more than 24 hours. HMA held for more than 24 hours after mixing will be rejected. The Contractor must dispose of rejected HMA at no expense to the Owner. The storage facility must have an accessible device at the top of the cone or about the third point from the top, which indicates the quantity of material in storage. No HMA will be accepted from the storage facility when the HMA in storage is below the top of the cone, except as the storage facility is being emptied at the end of the working shift.

Where HMA has been held in approved storage and no load out has occurred for 4 continuous hours, the first 4 tons to be loaded out of the storage facility must be wasted and disposed of at the Contractor's expense.

5-04.3(7)B ACCEPTANCE SAMPLING AND TESTING – HMA MIXTURE

Acceptance of HMA is based on the following:

1. Aggregates: The acceptance criteria for aggregate properties of sand equivalent, flat and elongated, fine aggregate angularity and fracture is specified in Section 9-03.6(2).
2. Hot Mix Asphalt Mixture: The acceptance criteria for the HMA mixture is specified in Section 9-03.6(7), HMA Tolerances and Adjustments.
    a. Sampling:
        1) HMA samples must not be taken from the first or last 25 tons of HMA produced in each production shift.
        2) Samples for acceptance testing will be taken on a random basis at the point of delivery per AASHTO T168.
    b. Definition of Sampling Lot and Sublot: A lot is defined as a discrete quantity of as-constructed pavement to which an acceptance procedure is applied. For the purpose of acceptance sampling and testing, a lot is defined as the total quantity of Material or work produced for each job mix formula placed. A lot is represented by randomly selected samples that will be tested for acceptance. Only 1 lot per JMF is expected. The initial JMF is defined in Section 5-04.3(7)A, Mix Design. The Contractor may request a change in the JMF as specified in Section 9-03.6(7). If the request is approved, all Material produced up to the time of the change will be evaluated on the basis of tests on samples taken from that JMF, and a new lot will start. Sampling evaluation will be performed on a random basis at the frequency of 1 sample per sublot. Sublot size will be determined to the nearest 100 tons to provide not less than 2 uniform size sublots, based on proposal quantities, with a maximum sublot size of 400 tons. Sampling and testing will be performed on a random basis as determined by the Engineer. The quantity of material represented by the final sublot may be increased to a maximum of 2 times the sublot quantity calculated.
    c. Test Results:

        The Engineer will furnish the Contractor with a copy of the results of the acceptance testing performed in the Laboratory.

        The Contractor may challenge sublot sample test results.

        To challenge the Laboratory's test results, the Contractor must comply with the requirements of Section 1-04.4.

        Resolution of this challenge is determined by a split of the original acceptance sample, retested by the Owner's Laboratory. The split of the sample with challenged results will not be tested by the same tester that conducted the original acceptance test. The challenge sample will be tested for a complete gradation analysis, for asphalt binder content, and for percent air voids (Va). The results of the challenge sample will be compared to the original results of the acceptance sample test and evaluated according to the following criteria:

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Deviation from JMF		
Property	**Allowable Deviation**	**Standard Specification Reference**
U.S. No. 4 and larger sieves	± 4.0% for each sieve	9-03.6(6)
U.S. No. 8 sieve	± 2.0%	9-03.6(6)
U.S. No. 200 sieve	± 0.4%	9-03.6(6)
Asphalt binder content	± 0.3%	5-04.3(6)C2, item 18
Air Voids in the Compacted Mixture (Va)	± 0.7%	5-04.3(6)C2, item 24

If the results of the challenge sample testing are outside the allowable deviation established above for any of the above limits, the Contractor agrees the sublot is defective and must be removed and replaced and the cost of retesting be deducted at the rates specified in Section 1-05.7from any monies due or that may come due the Contractor under the Contract. If the results of the challenge sample testing are within all limits established above, the sublot will be accepted and the cost of retesting will be the Owner's responsibility.

d. Test Methods

1) Testing of HMA for compliance of volumetric properties (VMA, VFA Va and Dust/Asphalt Ratio) will be per WSDOT SOP 731, Method for Determining Volumetric Properties of Asphalt Concrete Pavement Class Superpave, WSDOT FOP for AASHTO T 166, Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens, and WSDOT FOP for AASHTO T 209 FOP for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures Rice Density. Testing for compliance of asphalt binder content will be per WSDOT FOP for AASHTO T 308 Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method, or WAQTC FOP TM 6, Moisture Content of Bituminous Mixtures by Oven. Testing for compliance of gradation will be per WAQTC FOP for AASHTO T 27/T 11.

e. Reject Mixture

1) Rejection by Contractor**:** The Contractor may elect to remove any defective Material before sampling and replace it with new Material. Any such new Material may be sampled, tested, and evaluated for acceptance.

2) Rejection by Engineer: Sublots found to be defective during acceptance sampling and testing must be removed and replaced. In addition, the Engineer may also isolate and reject within a sublot any Material that is determined to be defective.

If, during paving, the Engineer determines Material being placed does not comply with the Specifications, the Contractor must shut down operations and must not resume HMA placement until the Engineer is satisfied that specified Material is being supplied.

The Engineer may, without sampling, reject any batch, load, or section of HMA that appears defective in gradation, temperature or asphalt binder content. Material rejected before placement must not be incorporated into the pavement. Any rejected HMA section of roadway must be removed. The Contractor may request that the rejected Material be tested. If the Contractor elects to have the rejected Material tested, a minimum of 3 representative samples will be obtained and tested. Acceptance of rejected Material will be based on conformance with the Specifications. No payment will be made for Material that fails to comply with Specification. In addition, the cost of sampling and testing must be borne by the Contractor. If the Material meets Specification, the cost of sampling and testing is borne by the Owner and payment for the HMA will be made at the Bid Item price.

5-04.3(8) SPREADING AND FINISHING

The mixture must be laid on an approved surface, spread, and struck off to the grade and elevation established.

Unless otherwise directed by the Engineer, the nominal compacted depth of any layer of any course must conform to these limits:

Material	Maximum
HMA Class 1"	0.35 feet
HMA Class 3/4"	0.30 feet
HMA Class 1/2"	0.25 feet

When more than 1 course is necessary to meet the final paving grade, the first course must include any widening of the existing roadway and preleveling of the existing pavement surface. Construct the preleveling course or courses so that the final wearing course has a uniform compacted depth and conforms to the finished grade and cross-section elevations specified. Construction of a course on another must not proceed until the underlying course has cooled and set.

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the paving may be done with other approved equipment or by hand.

When more than 1 JMF is being used to produce HMA, the Material produced for each JMF must be placed by separate spreading and compacting equipment. The intermingling of HMA produced from more than 1 JMF is prohibited. Each strip of HMA placed during a working shift must conform to a single JMF established for the class of HMA specified unless there is a need to make an adjustment in the JMF. No adjustment to the JMF is allowed without approval of the Engineer.

When laying HMA, operate the paver at a uniform forward speed consistent with the trucking delivery rate and roller train capacity to result in a continuous operation. The auger speed and flight gate opening must be adjusted to coordinate with the operation.

During mainline paving, the wings on the receiving hopper must not be folded, and the mix level in the hopper must be maintained so that the conveyors are not exposed, unless the Engineer approves otherwise.

Manual operation of the screed will be permitted in the construction of irregularly shaped and minor areas. These areas include, but are not limited to, gore areas, road approaches, tapers, and left-turn channelizations.

When specified in the Contract, reference lines for vertical control are required. Place lines on both outer edges of the traveled way of each roadway. Horizontal control using the reference lines is permitted. The grade and slope for intermediate lanes must be controlled automatically from reference lines, or using a mat referencing device and a slope control device. When the finish of the grade prepared for paving is superior to the established tolerances and when, in the opinion of the Engineer, further improvement to the line, grade, cross-section, and smoothness can best be achieved without the use of the reference line, a mat referencing device may be substituted for the reference line. Substitution of the mat referencing device is subject to the continued approval of the Engineer. The reference line may be removed after the completion of placing the first course of HMA when approved by the Engineer. Whenever the Engineer determines that any of these methods fail to provide the necessary vertical control, the reference lines must be promptly reinstalled by the Contractor before further placement of HMA.

5-04.3(8)A UTILITY ADJUSTMENTS

Utility castings must be adjusted to finished grade before construction of the final wearing course as specified in Section 7-20.

5-04.3(9) COMPACTION

5-04.3(9)A GENERAL

Immediately after the HMA has been spread and struck off, and after surface irregularities have been adjusted, the mix must be thoroughly and uniformly compacted. The completed course must be free from ridges, ruts, humps, depressions, objectionable marks, and irregularities and must conform to the line, grade, and cross-section shown on the Drawings if necessary, the JMF may be altered as specified in Section 9-03.6(7) to achieve desired results.

Compaction must take place when the mixture is in the proper condition so that no undue displacement, cracking, or shoving occurs. All compaction equipment must be capable of producing the required compaction. Areas inaccessible to large compaction equipment must be compacted by mechanical or hand tampers. Any HMA that becomes loose, broken, contaminated, shows an excess or deficiency of asphalt, or is in any way defective, must be removed and replaced at no additional cost with fresh Material which must be immediately compacted to conform to the surrounding area.

The type of rollers used and their relative position in the compaction sequence must are generally the Contractor's option, provided Specification densities are attained. However, pneumatic tired rollers must be used between October 1st of any year and April 1st of the following year unless the Engineer directs otherwise. Coverages with a vibratory or steel wheel roller may precede pneumatic tired rolling.

Vibratory rollers must not be operated in the vibratory mode when the internal temperature of the mix is less than 175 °F. Regardless of mix temperature, a vibratory roller must not be operated in a vibratory mode when checking or cracking of the mat occurs. Vibratory rollers in the vibratory mode are prohibited on bridge decks, brick bases, and cobblestone bases.

HMA for preleveling must be thoroughly compacted to the satisfaction of the Engineer.

5-04.3(9)B CONTROL

5-04.3(9)B1 COMPACTION REQUIREMENT

For an HMA Cl having a specified compacted course thickness greater than 0.10 foot, the acceptable level of relative density is a minimum 92.0 percent of the reference maximum density. The reference maximum density is determined by the Engineer as the moving average of the most recent 3 determinations for the JMF being placed to accommodate start-up for a large placement. Where less than 3 determinations have been made, the reference maximum density will be the average of all determinations made to that time to accommodate start-up for a large placement. The actual density attained for a sublot of an HMA Cl are determined as the average of 5 nuclear density gauge tests, after completion of the finish rolling, at randomly selected locations within each density sublot. In addition to the randomly selected locations, the Engineer may select any additional locations for testing that appears deficient or in any way defective. Such additional tests are included in the calculation of the average density for that sublot. The quantity represented by each sublot for density testing will be no greater than a single day's production or 400 tons, whichever is less. For density testing of very large daily placements of HMA, the Engineer may increase the size of the final sublot to a maximum of 600 tons. A lot is defined in Section 5-04.3(7)B.

5-04.3(9)B2 TEST RESULTS

Density sublots not meeting the prescribed minimum relative density are considered defective work, and must be removed and replaced. No payment will be made for defective Material that fails to comply with the minimum relative density.

For compaction lots subject to rejection, cores may be used as an alternate to the nuclear density gauge tests. When cores are taken by the Engineer at the request of the Contractor, they must be requested before midnight of the next Working Day after receiving the test results. The cores will be taken at locations selected by the Engineer. Cores must not be located in wheel paths. On sublots that fail to attain the minimum relative density, the cost for the coring will be deducted from any monies due or that may become due the Contractor under the Contract at the rates specified in Section 1-05.7.

In addition to the randomly selected locations for relative density tests for a sublot, the Engineer may also isolate any area that is suspected of being defective in relative density. The isolated area will be evaluated as a separate representative area. Such isolated area determinations are at the sole discretion of the Engineer.

5-04.3(10) JOINTS

5-04.3(10)A LONGITUDINAL AND TRANSVERSE JOINTS

The placing of the top or wearing course must be nearly continuous, and the roller must pass over the unprotected end of the freshly laid mixture only when the laying of the course is discontinued to allow the mixture to cool. When this work is resumed, the previously compacted mixture must be sawcut back to produce a slightly beveled edge for the full thickness of the course.

Where a transverse joint is being made and pavement will be open to traffic, construct a temporary wedge of HMA at a slope of 5 horizontal to 1 vertical. The HMA in the temporary wedge must be separated from the permanent HMA by strips of heavy wrapping paper. When paving operations are renewed, remove the wrapping paper and the trim the joint to a slightly beveled edge for the full thickness of the new HMA course. Dispose of the Material that is cut away and lay new mix against the fresh cut. Use rollers or tamping irons to seal the joint.

All joints must be flush and provide a smooth transition across the meet line.

The longitudinal joint in any 1 layer must be offset from the layer immediately below by no more than 6 inches or less than 2 inches. All longitudinal joints constructed in the top layer must be at a lane line or edge line of the traveled way. Where traffic conditions, project geometry or other conditions exist that make the construction of longitudinal joints at the lane line or edge of the traveled way impractical or impossible, a longitudinal joint may be constructed at the center of the traffic lane with the Engineer's written approval.

Hot lap joints may be allowed by the Engineer provided planned grades are maintained, no surface irregularities exist and compaction requirements are met. Use 2 paving machines to construct longitudinal hot lap joints. Achieve a minimum average compacted density throughout the traffic lane as specified in 5-04.3(10). Do not operate construction equipment except rollers on any uncompacted mix.

Immediately following the compaction of the top wearing course, seal meet line joints where the new asphalt concrete abuts existing asphalt concrete pavements, or oil mats as specified in Section 5-04.3(10)B.

5-04.3(10)B NEW PAVEMENT CONNECTIONS WITH EXISTING PAVEMENTS

Where construction of new asphalt concrete pavement connects with an existing roadway surface, driveway, bridge, railway crossing, gutter, or other similar facility, the Contractor must provide a smooth riding transition between the new surface and existing surface. Such work may require modification of the existing roadway profile by burning, planing or milling to achieve the desired smooth riding transition or may require other adjustment of the new connecting surface.

Butt joints are required at the meet lines of new construction and existing surfaces. Trim the existing abutting pavement by chipping, planing, milling, or such other acceptable method to insure a minimum depth of 2 inches of compacted asphalt concrete at the point of connection. Meet lines must be trimmed straight and the edges vertical. Dispose of all waste material resulting from such trimming or chipping.

Transitions made by shimming or feathering must be accomplished when the final course is being constructed, by raking out the oversize aggregate from the HMA class being used. Do not leave the asphalt open graded when feathering and shimming down to an existing surface. If approved by the Engineer, shimming and feathering may be accomplished at a later date. In such cases, use structural HMA Class 3/8 Inch.

Tack all surfaces that will contact the new asphalt as specified in Section 5-04.3(4)B4A.

Meet lines between new and existing surfaces must be sealed while the new asphalt concrete is still warm by painting with tack coat and then immediately covering the asphalt paint strip with clean, dry paving sand (Mineral Aggregate Type 6) as specified in Section 9-03.14.

5-04.3(10)B1 GRINDING CONCRETE FOR BUTT JOINTS

Grinding concrete for butt joints must be accomplished with abrasive grinding equipment utilizing diamond cutting blades. The equipment must be self-propelled machinery specifically designed for grinding Portland cement concrete pavement. The equipment must be such that it doesn't strain or damage the underlying pavement that is to remain. The grinder must have depth control allowing for accurately cutting to specified depth and for making wedge cuts necessary for butt joints. The equipment must be capable of cutting or planing up to 3 feet in width on one pass.

Residue from grinding operations must be picked up by means of a vacuum attachment to the grinding machine and any slurry must not be allowed to flow across the pavement or left on the pavement. Pavement must be left in a washed-clean condition, free of all slipperiness from slurry. Grindings and slurry must become the property of the Contractor and disposed of in accordance with Section 1-07.3.

Grinding must not produce a smooth or polished surface. The blades utilized for grinding must provide a rough surface to achieve an acceptable bond between cement concrete and asphalt pavement.

5-04.3(11) SURFACE SMOOTHNESS

5-04.3(11)A GENERAL

The completed surface of all courses must be of uniform texture, be smooth, and have a continuous plane grade except across the crown. All surfaces must be free from defects of all kinds. The completed surface of the wearing course must not vary more than 1/8 inch from the lower edge of a 10-foot straight edge placed on the surface parallel to the centerline. The transverse slope of the completed surface of the wearing course must not vary more than 1/4 inch in 10 feet from the rate of transverse slope shown on the Drawings.

When deviations in excess of, but not more than twice, the above tolerances are found, the pavement surface must be corrected to low places, or Material removed from high places by grinding with an acceptable grinding machine. The corrected deviation must be sealed as specified in Section 5-04.3(14). Where the Engineer determines grinding or filling does not allow for an acceptable repair, removal and replacement of the wearing course of asphalt concrete is required. Correction of defects must be carried out until there are no deviations greater than the allowable tolerances.

All areas in which the surface of the completed pavement deviates more than twice the allowable tolerances described above must be removed and replaced to the extent determined by the Engineer.

If deviations are found that exceed the allowable tolerances but are not in excess of twice the allowable tolerances described above and, in the opinion of the Engineer, correction using any of the methods specified above do not produce acceptable smoothness and serviceability, the Engineer may accept the completed pavement. Under these described circumstances, the decision whether to accept the completed pavement or to require corrections as described above is vested entirely in the Engineer.

5-04.3(11)B CONCRETE OVERLAYING ASPHALT

When Portland cement concrete pavement is placed on asphalt concrete pavement, the surface tolerance of the asphalt concrete pavement must be such that no elevation lies above the proposed finished grade minus the specified depth of Portland cement concrete pavement. Before placing the Portland cement concrete pavement, any such irregularities must be brought to the required tolerance by grinding or other acceptable means.

5-04.3(12) WEATHER LIMITATIONS

Asphalt for prime coat must not be applied when the ground temperature is lower than 50 °F, without written approval of the Engineer.

Do not place HMA on any wet surface, or when the average surface temperatures are less than those specified in the following table, or when weather conditions otherwise prevent the proper handling or finishing of the bituminous mixtures.

Surface Temperature Limitations		
Compacted Thickness (Feet)	**Wearing Course**	**Other Courses**
Less than 0.10	55 °F	45 °F
0.10-0.20	45 °F	35 °F
0.21-0.35	35 °F	35 °F

5-04.3(13) PAVING AND PLANING UNDER TRAFFIC

5-04.3(13)A GENERAL

In addition the requirements of Section 1-07.23 and the traffic controls required in Section 1-10, and unless the Contract specifies otherwise or the Engineer approves, the Contractor must comply with the following:

1. Intersections:
   a. Keep intersections open to traffic at all times, except when paving or planing operations through an intersection requires closure. Such closure must be kept to the minimum time required to place and compact the HMA mixture, or plane as appropriate. For paving, schedule such closure to individual lanes or portions thereof that allows the traffic volumes and schedule of traffic volumes required in the approved traffic control plan. Schedule work so that adjacent intersections are not impacted at the same time and comply with the traffic control restrictions required by the Traffic Engineer. Each individual intersection closure or partial closure, must be addressed in the traffic control plan, which must be submitted to and accepted by the Engineer, see Section 1-10.2(5).

b. When planing or paving and related construction must occur in an intersection, consider scheduling and sequencing such work into quarters of the intersection, or half or more of an intersection with side street detours. Be prepared to sequence the work to individual lanes or portions thereof.

c. Should closure of the intersection in its entirety be necessary, and no trolley service is impacted, keep such closure to the minimum time required to place and compact the HMA mixture, plane, remove asphalt, tack coat, and as needed.

d. Any work in an intersection requires advance warning in both signage and a number of Working Days advance notice as determined by the Engineer, to alert traffic and emergency services of the intersection closure or partial closure.

e. Allow new compacted HMA asphalt to cool to ambient temperature before any traffic is allowed on it. Traffic is not allowed on newly placed asphalt until approval has been obtained from the Engineer.

2. Centerline marking, post-paving temporary marking, temporary stop bars, and maintaining temporary pavement marking must comply with Section 1-10.3(3)L.

3. Permanent pavement marking must comply with Section 8-22.3(1).

5-04.3(13)B SUBMITTALS - PLANING PLAN AND HMA PAVING PLAN

The Contractor must submit a separate planing plan and a separate paving plan to the Engineer at least 5 Working Days in advance of each operation's activity start date. These plans must show how the moving operation and traffic control are coordinated, as they will be discussed at the pre-planing briefing and pre-paving briefing. When requested by the Engineer, the Contractor must provide each operation's traffic control plan on 24 x 36 inch or larger size Shop Drawings with a scale showing both the area of operation and sufficient detail of traffic beyond the area of operation where detour traffic may be required. The scale on the Shop Drawings is 1 inch = 20 feet, which may be changed if the Engineer agrees sufficient detail is shown.

The planing operation and the paving operation include, but are not limited to, metal detection, removal of asphalt and temporary asphalt of any kind, tack coat and drying, staging of supply trucks, paving trains, rolling, scheduling, and as may be discussed at the briefing.

When intersections will be partially or totally blocked, provide adequately sized and noticeable signage alerting traffic of closures to come, a minimum 2 Working Days in advance. The traffic control plan must show where peace officers will be stationed when signalization is or may be, countermanded, and show areas where flaggers are proposed.

At a minimum, the planing and the paving plan must include:

1. A copy of the accepted traffic control plan, see Section 1-10.2(5), detailing each day's traffic control as it relates to the specific requirements of that day's planing and paving. Briefly describe the sequencing of traffic control consistent with the proposed planing and paving sequence, and scheduling of placement of temporary pavement markings and channelizing devices after each day's planing, and paving.
2. A copy of each intersection's traffic control plan (see item 2 in Section 5-04.3(13)A).
3. Haul routes from Supplier facilities, and locations of temporary parking and staging areas, including return routes. Describe the complete round trip as it relates to the sequencing of paving operations.
4. Names and locations of HMA Supplier facilities to be used.
5. List of all equipment to be used for paving.
6. List of personnel and associated job classification assigned to each piece of paving equipment.
7. Description (geometric or narrative) of the scheduled sequence of planing and of paving, and intended area of planing and of paving for each day's work, must include the directions of proposed planing and of proposed paving, sequence of adjacent lane paving, sequence of skipped lane paving, intersection planing and paving scheduling and sequencing, and proposed notifications and coordination to be timely made. The plan must show HMA joints relative to the final pavement marking lane lines.
8. Names, job titles, and contact information for field, office, and plant supervisory personnel.
9. A copy of the approved Mix Designs.
10. Tonnage of HMA to be placed each day.
11. Approximate times and days for starting and ending daily operations.

5-04.3(13)C PRE-PAVING AND PRE-PLANING BRIEFING

At least 2 Working Days before the first paving operation and the first planing operation, or as scheduled by the Engineer for future paving and planing operations to ensure the Contractor has adequately prepared for notifying and coordinating as required in the Contract, the Contractor must be prepared to discuss that day's operations as they relate to other entities and to public safety and convenience, including driveway and business access, garbage truck operations, KCM transit operations and working around energized overhead wires, school and nursing home and hospital and other accesses, other contractors who may be operating in the area, pedestrian and bicycle traffic, and emergency services. The Contractor, and Subcontractors that may be part of that day's operations, must meet with the Engineer and discuss the proposed operation as it relates to the

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submitted planing plan and paving plan, approved traffic control plan, and public convenience and safety. Such discussion includes, but is not limited to:

1. General for both Paving Plan and for Planing Plan:
    a. The actual times of starting and ending daily operations.
    b. In intersections, how break up the intersection, and address traffic control and signalization for that operation including use of peace officers.
    c. The sequencing and scheduling of paving operations and of planing operations, as applicable, as it relates to traffic control, to public convenience and safety, and to other contractors who may operate in the Project Site.
    d. Notifications required of Contractor activities, and coordinating with other entities and the public as necessary.
    e. Description of the sequencing of installation and types of temporary pavement markings as it relates to planing and to paving.
    f. Description of the sequencing of installation of, and the removal of, temporary pavement patch material around exposed castings and as may be needed.
    g. Description of procedures and equipment to identify hidden metal in the pavement, such as survey monumentation, monitoring wells, street car rail, and castings, before planning, see Section 5-04.3(4)B3A.
    h. Description of how flaggers will be coordinated with the planing, paving, and related operations.
    i. Description of sequencing of traffic controls for the process of rigid pavement base repairs.
    j. Other items the Engineer deems necessary to address.
2. Paving – additional topics:
    a. When to start applying tack and coordinating with paving.
    b. Types of equipment and numbers of each type equipment to be used. If more pieces of equipment than personnel are proposed, describe the sequencing of the personnel operating the types of equipment. Discuss the continuance of operator personnel for each type equipment as it relates to meeting Specification requirements.
    c. Number of JMFs to be placed, and if more than 1 JMF how the Contractor will ensure different JMFs are distinguished, how pavers and MTVs are distinguished if more than 1 JMF is being placed at the time, and how pavers and MTVs are cleaned so that 1 JMF does not adversely influence the other JMF.
    d. Description of contingency plans for that day's operations such as equipment breakdown, rain out, and Supplier shutdown of operations.
    e. Number of sublots to be placed, sequencing of density testing, and other sampling and testing.

5-04.3(14) SEALING OF PAVEMENT SURFACES

Any wearing course or other pavement course used for the driving surface will be evaluated by the Engineer to determine whether a fog seal is required. Determination is made when the results of nuclear or core density testing show that a seal is needed. The fog seal must be CSS 1 or CSS 1h emulsified asphalt uniformly applied to the pavement. The finished application must be free of streaks and bare spots. Dilute the emulsified asphalt at a rate of 1 part water to 1 part emulsified asphalt. Apply the diluted emulsified asphalt at the rate of 0.10 to 0.18 (0.03 to 0.05 residual) gallons per square yard. Apply the emulsified asphalt within the temperature range specified for these asphalt emulsions in Section 5-02.3(3). Unless otherwise approved by the Engineer, the fog seal must be applied before opening to traffic.

5-04.3(15) ANTI-STRIPPING ADDITIVE

Add anti-stripping additive to the HMA per the Engineer determined anti-stripping additive requirement as made known on the returned submittal, see Section 5-04.3(6)C2.

5-04.3(16) SHOULDER PAVING

Shoulders, if required, must be constructed to the lines, grades, and cross-sections specified. Material for building up shoulders must be Mineral Aggregate Type 1.

5-04.3(17) NON-STRUCTURAL HMA APPLICATIONS

5-04.3(17)A HMA SIDEWALKS

Construct asphalt walkways at the locations and to the width specified on the Drawings. Unless the Contract specifies otherwise, asphalt walkways must be constructed with a 4-inch section of compacted crushed rock Mineral Aggregate Type 2 and covered with 3 inches of compacted HMA Class 1/2 Inch.

5-04.3(17)B HMA DRIVEWAYS

Asphalt driveways must be constructed as shown on the Drawings. Unless the Contract specifies otherwise, the Contractor must provide 3 inches of compacted HMA of the class specified in the Contract over 4 inches of compacted Mineral Aggregate Type 2.

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5-04.3(18) TEMPORARY PAVEMENT PATCHING

Unless the Contract specifies an HMA CL asphalt concrete as a temporary patch Material, the temporary asphalt patch Material must comply with Section 9-02.5.

The Contractor must furnish, place and maintain a 4-inch minimum compacted thickness of temporary pavement patch Material over open cuts. Such temporary asphalt patching is required where vehicular or pedestrian traffic must be accommodated and permanent pavement patching cannot be placed immediately. Trench backfill must be compacted as specified in Section 2-10. Temporary pavement patch Material must be compacted and leveled to coincide with adjacent surfaces.

If the temporary surface subsides after the initial placement, place additional temporary pavement patch Material over the subsided Material as necessary to maintain a surface level with existing pavement. The Contractor must timely maintain such temporary patching.

Before final restoration of the pavement, remove the temporary pavement patch Material and such underlying material as may exist, clean the exposed face of the existing pavement to remain, and restore the pavement.

5-04.3(19) SPEED HUMPS AND SPEED CUSHIONS

Speed humps and speed cushions must be installed at locations shown on the Drawings per the dimensions and vertical profile shown on Standard Plan 436a and 436b. Speed hump and speed cushions must be made of HMA or WMA class 3/8 inch with PG 58H-22 binder and 3 million design ESALs.

5-04.4 MEASUREMENT

Measurement for HMA of the class specified will be by the ton whether the HMA is used for structural or non- structural applications, and whether a major quantity or a minor quantity. The net weight of HMA being delivered to the Project Site must be weighed in the transporting equipment on a certified platform scale, and with accuracy, as specified in Section 1-09.2.

Measurement of HMA of the class specified will be based on the actual quantity incorporated into the Work as determined by the Material load tickets received and accepted by the Engineer on the day the Material was delivered and incorporated into the Work. Deductions will be made for any asphaltic Material included in the measurement that is not incorporated into the Work on the day delivered.

Measurement for “Roadway Preparation” will be made by a single linear foot measurement along the centerline of the main roadway being prepared. All related intersections, side street approaches, and irregular shaped areas thereto will be incidental to this one measurement. Measurement will be to the nearest whole linear foot.

Measurement for “Surface Preparation, Plane Bituminous Pavement” will be by the square yard and will be based on the average depth shown on the Drawings plus any additional depth up to 4 inches maximum to cover removal of high spots, to cover extra thickness in existing pavement, and to cover the extra depth required to provide a 4-inch reveal along the curb line as specified in Section 5-04.3(4)B3B. Should the Drawings indicate or the Engineer direct an area be planed in excess of 4 inches, that area planed in excess of 4 inches total depth will be measured in additional square yards of surface planed for up to an additional 4 inches depth. In general, any area planed in excess of 4 inches will be measured by the square yard for each incremental depth of 4 inches. The final planed depth beyond the first 4 inches thickness will include multiples of 4 inches with the last planing pass up to 4 inches maximum. (Example: an area of pavement planed to 9.5 inches total depth will be measured as 3 times the square yardage for that area, or 4 inches + 4 inches + 1.5 inches or up to 4 inches.). Measurement also includes sweeping to detect metal hidden below the surface for each 4-inch or less depth increment of pavement to be planed.

Measurement for “Surface Preparation, Prelevel” will be by the ton of HMA class placed for preleveling surfaces based on the actual quantity incorporated into the Work as determined by the Material load tickets received and accepted by the Engineer on the day the Material was delivered and placed.

Measurement of permanent pavement patching will be by the ton for the HMA class specified.

Measurement of temporary pavement patch will be made by the ton for the initial placement only. Additional temporary pavement patch required to maintain the surface of the temporary patch level with adjacent roadway surfaces will not be measured.

Measurement of “Material Transfer Vehicle (MTV)” will be made by the ton of HMA transferred through the MTV and placed. Measurement will not be made for “Material Transfer Vehicle (MTV)” for placed HMA not transferred through the MTV.

Measurement for “Pavement, WMA (Class)” will be by the ton in the same manner as measurement for HMA.

Measurement for “Speed Hump” will be per each hump installed.

Measurement for “Speed Cushion” will be per each layout of 3 or 4 humps installed.

Measurement of “Cement Concrete Grinding for Butt Joint, 0-2-inch Depth” will be by the square yard, based on the actual width and length of the grind.

5-04.5 PAYMENT

1. **“Pavement**, **HMA (Class)”**, per ton.

The Bid Item price for "Pavement, HMA (Class)"includes all costs for the work required to furnish, haul, place and compact the HMA mix, including tack coat, fog seal and sealing joints and meet lines, sand for joints and meet lines, cleaning, and such other work as may be necessary and not otherwise set forth as a separate Bid Item in the Bid Form.

2. **"Roadway Preparation"**, per linear foot.

The Bid Item price for "Roadway Preparation" includes all costs for the work required to prepare the untreated roadway, including scarifying, blading, shaping, and compacting to remove irregularities and obtain a uniform surface except prime coat treatment which will be paid as specified in Section 5-02.

3. **"Surface Preparation**, **Prelevel"**, per ton.

The Bid Item price for "Surface Preparation, Prelevel" includes all costs for the work required to prelevel uneven or broken treated surfaces by placing and compacting asphalt as specified in Section 5-04.3(4)B2.

4. **"Surface Preparation**, **Plane Bituminous Pavement"**, per square yard.

The Bid Item price for "Surface Preparation, Plane Bituminous Pavement" includes all costs for the work required to prepare the treated surface including sweeping for hidden metal, exposing metal below the pavement surface where indicated on the Drawings before planing, milling and planing and other type pavement removal as may be necessary, removing and disposing of cuttings, extra planing for butt joints, and feathering meet areas in preparation for an asphalt overlay.

5. **"Crack Sealing"**, per linear foot.

The Bid Item price for "Crack Sealing" includes all costs for the work required to clean and fill the cracks and joints.

6. **"Pavement Patch**, **Temporary"**, per ton.

The Bid Item price for "Pavement Patch, Temporary" includes all costs for the work required to install and remove the temporary patch. The costs for additional Material required to maintain temporary pavement patches after the initial installation must be at the sole expense of the Contractor.

7. **"Material Transfer Vehicle (MTV)"**, per ton.

The Bid Item price for "Material Transfer Vehicle (MTV)"includes all costs for the work required to place HMA through the MTV. All cost for the MTV not included in "Material Transfer Vehicle (MTV)"are included in other Bid Items and no separate or additional payment will be made.

8. **"Pavement**, **WMA (Class)"**, per ton.

The Bid Item price for "Pavement, WMA (Class)"includes all costs for the work required to furnish, haul, place and compact the WMA mix, including tack coat, fog seal and sealing joints and meet lines, sand for joints and meet lines, cleaning, and such other work as may be necessary and not otherwise set forth as a separate Bid Item in the Bid Form.

9. **"Speed Hump"**, per each.

10. **"Speed Cushion"**, per each.

The Bid item price for "Speed Hump" and "Speed Cushion" includes all costs for the work required to furnish, haul, place and compact the asphalt mix into the shape required, including tack coat.

11. **"Cement Concrete Grinding for Butte Joint, 0-2-inch Depth"**, per square yard.

The Bid item price for "Cement Concrete Grinding for Butt Joint, 0-2-inch Depth" is full payment for all costs to complete the work. Costs for grinding, removing and disposing of grindings and slurry and cleaning pavement of all slurry are included in the unit cost of the work.

12. **Other payment information**

Payment for Mineral Aggregate (Type) will be made as specified in Section 4-01.5.

Payment for removal will be made as specified in Section 2-02.5.

All costs for the rejection and disposal of Materials held for more than 24 hours after mixing, as specified in Section 5-04.3(8), are at the Contractor's sole expense and at no additional or separate cost to the Owner.

When cores are taken by the Engineer at the request of the Contractor, the Owner must be reimbursed for the coring expenses as specified in Section 1-05.7.

Where samples have been taken by the Engineer from the uncompressed asphalt concrete, new Material must be placed and compacted at no additional expense to the Owner.

Where the Engineer accepts area of pavement that does not comply with the smoothness requirement as specified in Section 5-04.3(11)A, the total payment for yardage of that pavement will be reduced by $500.00 for each and every increment of section of a single traffic lane of 100 feet in length. Where more than 100 feet of such pavement exists, whether in 1 or more lanes, payment will be reduced as described. Payment for the last incremental section of said pavement will be reduced by $500.00 if such last incremental section is less than 100 feet.

Where the placement of asphalt for Portland cement concrete overlay requires grinding to provide for the full thickness of concrete pavement overlay, all expense for grinding is at the Contractor's sole expense and no separate or additional payment will be made.

Payment for backfill and compaction of the subgrade is included in the Bid Item price for the particular Bid Items of Work necessitating such work.

Payment for subgrade preparation as required by Section 5-04.3(4)C1 will be as specified in Section 2-09.5.

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Payment for Material used for fog seal as specified in Section 5-04.3(14) will be paid as asphalt for tack coat, except no payment will be made for sealing pavement that has been repaired as specified in Section 5-04.3(11).

All costs for anti-stripping additive as specified in Sections 5-04.3(6) and 5-04.3(15)are incidental to and included in the applicable Bid Item prices and no separate or additional payment will be made.

All costs for temporary pavement marking and removal are incidental to and included in the applicable Bid Item prices and no separate or additional payment will be made.

All costs to repair pavement damaged by the removal of temporary marking tape specified in Section 5-04.3(13) is at the Contractor's sole expense and no additional or separate payment will be made.

All cost to repair existing pavement to remain, that is damaged by the Contractor's planing as specified in Sections 5-04.3(4)B2 and 5-04.3(4)B3,is at the sole expense of the Contractor and no separate or additional payment will be made.

If the Contractor requests and the Engineer approves a change in grade of asphalt binder as specified in Section 5-04.2(1), the Contractor accepts no change in the Bid Item price, and no separate or additional payment will be made.

All cost associated with Contractor proposed and Engineer approved use of recycled asphalt pavement, and use of substitute asphalt binder grade as specified in Section 5-04.2(1) will be at no cost to the Owner and no separate or additional payment will be made.

All cost to remove and replace newly placed pavement that is defective is at the Contractor's sole expense and no separate or additional payment will be made.

All cost related to planing equipment that is damaged by contacting metal hidden in pavement is at the Contractor's sole expense and no separate or additional payment will be made. See Sections 5-04.3(3)D and 5-04.3(4)B3.

All cost for adjusting metal castings below the existing pavement surface shown on the Drawings, and not visible on the surface, is specified in Section 7-20.5.

All cost related to addressing hidden metal found in pavement as required before starting planing, and which are not shown on the Drawings, is specified in Section 1-04.6.

SECTION 5-05 CEMENT CONCRETE FOR ROADWAY AND RELATED WORK

5-05.1 DESCRIPTION

Section 5-05 describes constructing a pavement composed of Portland cement concrete or blended hydraulic cement concrete on a prepared subgrade or base as specified in this Section and in conformity with the lines, grades, thicknesses, and typical cross-sections shown on the Drawings, Standard Plans, or established by the Engineer. Cement concrete pavement construction consists of:

1. Roadway Paving. May be full reconstruction, but typically selective reconstruction, of cement concrete roadway or cement concrete roadway base with asphalt overlay.
2. Non-Roadway. Requirements for cement concrete alleys, driveways, sidewalks, curb ramps, curbs, curb and gutters, and other cement concrete construction on prepared subgrade or base.

Extra Work for using colored or imprinted concrete including color matching joint material, when specified, is also addressed.

5-05.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Material	Section
Portland Cement and Blended Hydraulic Cement	Section 9-01
Fine Aggregate	Section 9-03
Coarse Aggregate	Section 9-03
Combined Aggregate	Section 9-03
Premolded Joint Filler	Section 9-04.1
Joint Sealants	Section 9-04.2
Deformed Steel Bars (Rebar)	Section 9-07.2
Dowel Bars	Section 9-07.5
Tie Bars	Section 9-07.6
Wire Mesh	Section 9-07.7
Concrete Patching Material	Section 9-20
Curing Materials and Admixtures	Section 9-23
Water	Section 9-25

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Material	Section
Epoxy Resins	Section 9-26

5-05.3 CONSTRUCTION REQUIREMENTS

5-05.3(1) CONCRETE MIX DESIGN

The Contractor must provide a concrete mix design for each cement concrete class specified in the Bid Form.

Use ACI 211.1 as a guide to determine proportions. The Contractor is responsible for concrete strength, placement, and workability. The maximum slumps determined per AASHTO T 119 (ASTM C 143) are 4 inches, unless otherwise accepted by the Engineer.

The specified cement concrete mix designs must comply with this Section and the parameters specified by the following cement concrete classes and table:

1. Roadway Cement Concrete, Variable Mixes: Variable mixes indicates that design parameters are broad and more than 1 mix design for this class is allowed, to provide the Contractor with more control of work. Mix designs meeting the requirements of any of the following 3 roadway cement concrete class may be provided for this class. Only 1 pay item exists; the Contractor determines the means and method of mix usage and associated costs of mixes within Contract requirements.
2. Roadway Cement Concrete, HES: HES indicates a high-early-strength cement concrete. HES and roadway cement concrete are included in the Bid Item description, as well as a time from batching to opening to traffic (3000 psi).
3. Roadway Cement Concrete: Traditional 28 day cement concrete without pozzolans. Roadway cement concrete is included in the Bid Item description.
4. Roadway Cement Concrete, W/25 percent pozzolans: W/25 percent pozzolans indicates that minimal cement content is desired and the use of pozzolans is required. W/25 percent pozzolans and Roadway are included in the Bid Item description.
5. Non-Roadway Cement Concrete, HES, High Strength: HES indicates a high-early-strength cement concrete. HES, High Strength, and non-roadway cement concrete are included in the Bid Item description, as well as a time from batching to opening to traffic (3000 psi for commercial driveways, 2500 psi for non-commercial driveways, and 2500 psi for other applications).
6. Non-Roadway Cement Concrete, High Strength: High Strength indicates a high strength non-roadway cement concrete. High Strength and non-roadway cement concrete are included in the reference.
7. Non-Roadway Cement Concrete, High Strength W/25 percent pozzolans: High Strength indicates a high strength non-roadway cement concrete. W/25 percent pozzolans indicates that minimal cement content is desired and the use of pozzolans is required. High Strength, Non-Roadway, and W/25 percent pozzolans are included in the reference.
8. Non-Roadway Cement Concrete: Traditional non-roadway cement concrete. Only non-roadway cement concrete is included in the reference.
9. Non-Roadway Cement Concrete, W/25 percent pozzolans: W/25 percent pozzolans indicates that minimal cement content is desired and the use of pozzolans is required. Non-roadway cement concrete and W/25 percent pozzolans are included in the reference.

Mix designs for the preceding classes of cement concrete must comply with the design strengths by arithmetic mean and be proportioned within the limits specified in the following table.

Cement Concrete Mix Design Strengths

Cement concrete mix class	Design Strength Parameters		Cementitious Material		Pozzolans	
	Minimum flexural strength (psi)	Minimum compressive strength (psi)	Minimum (lbs/CY)	Maximum (lbs/CY)	Minimum % of Cementitious Material	Maximum % of Cementitious Material
Roadway Cement Concrete, **Variable Mixes**	570 at 28Days[1] and 650 at 42 Days	3600 at 28 Days[2]	505	675[3]	None	10% Microsilica 30% Fly Ash 30% GGBFS 30% Combined[4]
Roadway Cement Concrete, **HES**	650 at 14Days	3600 at 28 Days[2]	564	675[3]	None	10% Microsilica 30% Fly Ash 30% GGBFS 30% Combined[4]

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Cement concrete mix class	Design Strength Parameters		Cementitious Material		Pozzolans	
	Minimum flexural strength (psi)	Minimum compressive strength (psi)	Minimum (lbs/CY)	Maximum (lbs/CY)	Minimum % of Cementitious Material	Maximum % of Cementitious Material
Roadway Cement Concrete	570 at 28Days[1] and 650 at 42 Days	3600 at 28 Days	505	587	None	10% Microsilica 30% Fly Ash 30% GGBFS 30% Combined[4]
Roadway Cement Concrete, **W/25% pozzolans**	570 at 28Days[1] and 650 at 42Days	3600 at 28 Days	505	587	25% Combined[4]	10% Microsilica 30% Fly Ash 30% GGBFS 30% Combined[4]
Non-Roadway features are alleys, driveways, sidewalks, curb ramps, curbs, curb and gutters. Mix requirements below are referenced from Specification Sections addressing those features.						
Non-Roadway Cement Concrete, **HES, High Strength**	N/A	3000 at 28 days[2]	564	675[3]	None	10% Microsilica 30% Fly Ash 30% GGBFS 30% Combined[4]
Non-Roadway Cement Concrete, **High Strength**	N/A	3000 at 28 Days	463[5]	564	None	10% Microsilica 30% Fly Ash 30% GGBFS 30% Combined[4]
Non-Roadway Cement Concrete, **W/25% pozzolans, High Strength**	N/A	3000 at 28 Days	463[5]	564	25% Combined[4]	10% Microsilica 30% Fly Ash 30% GGBFS 30% Combined[4]
Non-Roadway Cement Concrete	N/A	2500 at 28 Days	463[5]	505	None	10% Microsilica 30% Fly Ash 30% GGBFS 30% Combined[4]
Non-Roadway Cement Concrete, **W/25% pozzolans**	N/A	2500 at 28 Days	463[5]	505	25% Combined[4]	10% Microsilica 30% Fly Ash 30% GGBFS 30% Combined[4]

NOTES:

1. Mix design can be accepted based on 28 day requirement provided no single beam test is under 550 psi and quality level is not less than 80 percent per the Quality Level Calculation in this Section.
2. Mix design for high-early-strength requires 5 sets of cylinder tests at the specified time from batching for a lower compressive strength for opening to traffic as specified here (3000 psi roadway, commercial driveways, and alleys, 2500 psi for residential driveways). The quality level must not be less than 80 percent per the Quality Level Calculation in this Section.
3. Maximum for HES 24 hour or less mix is 752 pounds; a higher limit requires approval of the Engineer.
4. Combined use of Fly Ash and GGBFS; Microsilica not included.
5. 548 if 3/8" or 1/2" course aggregate used

5-05.3(1)A MATERIALS

Materials must conform to Section 5-05.2 and must comply with Section 5-05.

5-05.3(1)B ROADWAY CEMENT CONCRETE

Fine aggregate must conform to Section 9-03.1(2), Class 1. Coarse aggregate must conform to Section 9-03.1(3), AASHTO grading No. 467. An alternate combined gradation conforming to Section 9-03.1(4) may be proposed, that has a nominal maximum aggregate size equal to or greater than a 1-1/2 inch sieve.

5-05.3(1)C NON-ROADWAY CEMENT CONCRETE

Fine aggregate must conform to Section 9-03.1(2), Class 2. Coarse aggregate must conform to Section 9-03.1(3). Coarse aggregate used must be 3/4 inch to 1-1/2 inch, at the option of the Contractor, except as provided for below.

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1. An alternate combined gradation conforming to Section 9-03.1(4) may be proposed, that has a nominal maximum aggregate size equal to or greater than a 1-1/2 inch sieve.
2. The maximum size of aggregate used for extruded or slip formed curb construction or pattered cement concrete is at the option of the Contractor, but must not be larger than 1 inch or smaller than 3/8 inch.

5-05.3(1)D POZZOLANS

Fly ash, if used, must be as specified in Section 9-23.6 and must be limited to Class F with a maximum CaO content of 15 percent by weight.

Ground granulated blast furnace slag, if used, must conform to Section 9-23.7.

Blended Hydraulic Cement, if used, must comply with Section 9-01.2(3).

The water-cement ratio is calculated on the total weight of cementitious material. The following are considered cementitious materials: Portland cement, fly ash, ground granulated blast furnace slag, and microsilica.

5-05.3(1)E SUBMITTALS

The Contractor's submittal for all materials in this Section must include the mix proportions per cubic yard; test results from flexural strength of beams and roadway concrete and compressive strength of cylinders and all cement concrete: the proposed material sources: and applicable certifications for all ingredients. For roadway concrete, the mix must be capable of providing a minimum flexural strength of 650 psi. For non-roadway concrete, the mix must be capable of providing the minimum time based compressive strength.

1. Roadway Concrete: Evaluation of roadway concrete strength must be based on statistically analyzed results of 5 beam specimens made per AASHTO T 126 and tested per AASHTO T 177, which demonstrate a quality level of not less than 80 percent analyzed per the Quality Level Calculation in this Section.
2. In addition, the Contractor must fabricate, cure, and test 5 sets of cylinders, for evaluation of 28 Day strengths, per AASHTO T 22 and AASHTO T 23, using the same mix design as used in fabrication of the beams.
3. Non-Roadway Concrete: Evaluation of non-roadway concrete strength must be based on statistically analyzed results of 5 sets (10 total) cylinders specimens made per AASHTO T 22 and tested per AASHTO T 23, which demonstrate a quality level of not less than 80 percent analyzed per the Quality Level Calculation in this Section.
4. High-Early-Strength (HES) Concrete: In addition to the above, evaluation of high-early-strength concrete at specified time, for road opening strengths must be based on statistically analyzed results of 5 sets (10 total) cylinders specimens made per AASHTO T 22 and tested per AASHTO T 23, which demonstrate a quality level of not less than 80 percent analyzed per the Quality Level Calculation in this Section.

Mix designs submitted by the Contractor must provide a unique identification for each proposal and must include test data confirming that concrete made per the proposed design will comply with the requirements of this Section. Test data must be from an independent testing lab or from a commercial concrete producer's lab. If the test data is developed at a producer's lab, the Engineer or a representative may witness all testing.

Following acceptance of the Contractor's mix design as specified in Section 1-05.3, the following conformance requirements apply.

Conformance to Mix Design: Cement and coarse and fine aggregate weights must be within the following tolerances of the mix design.

Portland Cement Concrete Batch Weights, per cubic yard of Concrete		
Cement	+5%	-1%
Coarse Aggregate	+ 200 Pounds	- 200 Pounds
Fine Aggregate	+ 200 Pounds	- 200 Pounds

If the total cementitious material weight is made up of different components, these component weights must be within the following tolerances:

a. Portland cement weight plus 5 percent or minus 1 percent of that specified in the mix design.
b. Fly ash and ground granulated blast furnace slag weight ± 5 percent of that specified in the mix design.
c. Microsilica weight ± 10 percent of that specified in the mix design.

Water must not exceed the maximum water specified in the mix design.

The Contractor may initiate minor adjustments to the accepted mix proportions within the tolerances noted above without resubmitting the mix design.

Using admixtures to accelerate the set or to increase workability is permitted only when approved by the Engineer. Only non-chloride accelerating admixtures that comply with Section 9-23.4 are allowed. The Contractor must notify the Engineer in writing of any proposed modification. A new mix design will designate a new lot.

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5-05.3(1)F QUALITY LEVEL CALCULATION

The procedures for determining the quality level are as follows:

1. Determine the arithmetic mean, X
2. Compute the sample standard deviation, Sn
3. Compute the lower quality index (Ql), where L is mix design requirement.

For n = 5 sets, a Ql >= 0.88 is required for a quality level not less than 80 percent

$$Ql = (X-L) / Sn$$

5-05.3(2) CONSISTENCY

The Materials must be mixed with sufficient water to produce a stiff concrete which will hold its shape when deposited on the subgrade. Concrete placed during wet weather must be mixed with sufficient water to produce a very stiff mixture. The consistency must be such that mortar does not separate from the coarse aggregate during handling.

For Roadway Concrete: The water-cementitious material ratio, by weight, must not exceed 0.44. When slip form paving equipment is used, the Contractor must further control concrete consistency to ensure that edge slump conforms to the requirements of Section 5-05.3(11).

For Non-Roadway Concrete:

Cement		Max. W/C
Sacks	Pounds	
4.5	423	0.65
5	470	0.58
5.5	517	0.53
6	564	0.49
6.5	611	0.45
7+	658+	0.44

Interpolate between values for cement contents not listed.

5-05.3(3) EQUIPMENT

Equipment necessary for handling Materials and performing all parts of the Work must conform to the following requirements.

5-05.3(3)A BATCH PLANT AND EQUIPMENT

All concrete must be batched in a prequalified manual, semi-automatic, or automatic plant as specified in Section 6-02.3(4)A. The Engineer is not responsible for any delays to the Contractor due to problems in getting the plant certified.

5-05.3(3)B MIXING EQUIPMENT

Concrete may be mixed at a batching plant or wholly or in part in truck mixers. Each mixer must have a manufacturer's plate attached in a prominent place showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades.

Truck mixers used for mixing and hauling concrete, and truck agitators used for hauling plant-mixed concrete, must conform to the requirements of Section 6-02.3(4)A.

Bodies of non-agitating hauling equipment for concrete must be smooth, mortar-tight, metal containers must be capable of discharging the concrete at a satisfactory controlled rate without segregation. Covers must be provided when needed for protection. Plant-mixed concrete may be transported in non-agitated vehicles provided that the concrete is delivered to the Job Site and discharge is completed within 45 minutes after the introduction of mixing water to the cement and aggregates, and provided the concrete is in a workable condition when placed.

5-05.3(3)C FINISHING EQUIPMENT – ROADWAY

When and where specified in the Contract, or as desired by the Contractor and approved by the Engineer, the method of constructing concrete pavement for continuous roadway paving must be with approved slip form paving equipment designed to spread, consolidate, screed, and float-finish the freshly placed concrete in 1 complete pass of the machine, so a dense and homogeneous pavement is achieved with a minimum of hand finishing. When and where indicated, use this method for both cement concrete and cement concrete base paving.

Place cement concrete pavement with approved placement and finishing equipment using stationary side forms except where slip forms are used.

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Hand screeding and float finishing of cement concrete pavement may only be used on small irregular areas as allowed by the Engineer.

5-05.3(3)D JOINT SAWING EQUIPMENT - ROADWAY

The Contractor must provide approved power driven concrete saws for sawing joints, adequate in number of units and power to complete the sawing at the required rate. Provide at least 1 standby saw in good working order. Maintain an ample supply of saw blades at the Project Site at all times during sawing operations. Provide adequate artificial lighting facilities for night sawing. All of this equipment must be on the Job Site both before and continuously during concrete placement. Sawing equipment must be available immediately and continuously upon call by the Engineer on a 24-hour basis, including Saturdays, Sundays and Holidays.

5-05.3(3)E SMOOTHNESS TESTING EQUIPMENT – ROADWAY

The Contractor must provide a long-handle 10-foot straight edge for checking the surface smoothness, as specified in Section 5-05.3(12), on the Job Site before starting to place concrete. The straight edge must be lightweight, straight and true, and equipped with a long handle to allow for checking the smoothness of the surface in the direction of traffic and across traffic lanes.

5-05.3(4) CEMENT CONCRETE BATCHING AND ACCEPTANCE

5-05.3(4)A MEASURING, AND BATCHING MATERIALS

The batch plant site, layout, equipment, and transport of material must ensure a continuous supply of Material to the Work.

Measuring Materials:

1. The fine aggregate and each size of coarse aggregate must be measured by weighing, with the weight for the particular aggregates used being proportional to their respective bulk specific gravities. The weighing of each size of material must be a separate and distinct operation.

   Corrections must be made for variations in weight of materials due to the moisture content.

   The equipment for weighing aggregates must conform to the requirements of Section 1-09.2
2. Cement must be weighed on scales meeting the requirements of Section 1-09.2. Adequate provision must be made to prevent loss of cement between the batch box and the mixer.
3. Water may be measured either by volume or by weight. The accuracy of measuring the water must be within a range of error of 1 percent.

Batching Materials: On all projects requiring more than 2500 cubic yards of Portland cement or blended hydraulic cement concrete for paving, the batching plant must be equipped to proportion aggregates and cement by weight using automatic and interlocked proportioning devices of approved type.

5-05.3(4)B ACCEPTANCE OF PORTLAND CEMENT OR BLENDED HYDRAULIC CEMENT CONCRETE

Acceptance of cement concrete pavement per class is specified in Section 5-05.3(4)B3.

The point of acceptance is per WAQTC FOP for TM 2 or at the point of discharge when a pump is used. The concrete producer must provide a certificate of compliance for each truckload of concrete as specified in Section 6-02.3(5)B.

Acceptance testing for compliance of air content and 28Day compressive strength must be conducted from samples prepared per WAQTC FOP TM 2. Air content must be determined per WAQTC FOP for AASHTO T 152. Compressive strength must be determined per AASHTO T 23 and AASHTO T 22.

The Contractor must provide cure boxes as specified in Section 6-02.3(5)H, and protect concrete cylinders in cure boxes from excessive vibration and shock waves during the curing period as specified in Section 6-02.3(6)D.

5-05.3(4)B1 ACCEPTANCE PARAMETERS FOR ROADWAY CEMENT CONCRETE

Representative area method, see Section 5-05.3(4)B3, for acceptance applies to all other projects and cement concrete work specified in Section 5-05.

The lower limit for air content (LLAC) is 4.0 percent, and the upper limit for air content (ULAC) is 7.0 percent. The lower limit for compressive strength (LLCS) is 1200 psi less than that established in the mix design as the arithmetic mean of the 5 sets of 28Day compressive strength cylinders, or 3600 psi, whichever is higher. These compressive strength cylinders must be cast at the same time as the flexural beams used to prequalify the mix design under Section 5-05.3(1). There is no upper limit for 28 Day compressive strength.

Parameters for pavement thickness are shown on the Contract Documents. See Section 5-05.5(2).

5-05.3(4)B2 ACCEPTANCE PARAMETERS - NON-ROADWAY CEMENT CONCRETE

For non-roadway cement concrete, the LLCS is 2500 psi for standard non-roadway mix and 3000 psi for high strength non-roadway mix. The LLAC is 4.0 percent, and the ULAC is 7.0 percent.

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5-05.3(4)B3 REPRESENTATIVE AREA METHOD

Non-roadway cement concrete, and roadway cement concrete areas as determined by the Engineer, will be sampled at the discretion of the Engineer and accepted based on the representative area method.

Each representative area, including individual sublot when not included in a lot, will meet the specified acceptance requirements for compressive strength and air content when the compressive strength is equal to or greater than the LLCS, and the air content is equal to or falls between the LLAC and ULAC.

Each representative area as determined by the Engineer will be rejected if any of the following conditions occur:

1. Individual strength tests representing a representative area falls below the LLCS by more than 12 percent, or 500 psi for roadway cement concrete, 300 psi for non-roadway cement concrete, whichever is least.
2. Individual strength tests at a representative area falls below the LLAC of 4 percent by more than 1 percent.
3. Individual strength tests at a representative area falls above the ULAC of 7 percent by more than 1 percent.

Sublots not meeting the full requirements and not rejected may remain in place but are subject to a lot based Pay Adjustment disincentive as described in the following table:

	Pay Factor = 1.00	**0.90**	**0.75**	**0.50**
Cement Concrete Mix	**LLCS (28 Day Compressive Strength, psi)**	**96% of LLCS**	**92% of LLCS**	**88% of LLCS**
Non-Roadway Cement Concrete	>= 2500	>= 2400	>= 2300	>= 2200
Non-Roadway Cement Concrete, High Strength	>=3000	>= 2820	>= 2760	>= 2640
Roadway Cement Concrete	1200 psi less than mix design arithmetic mean, or 3600 psi	Calc	Calc	Calc
LLAC & ULAC % Air Content				
Non-Roadway Cement Concrete	>= 4 and <= 7	< 4.0 and >= 3.6, or > 7.0 and <= 7.4	< 3.6 and >= 3.3, or > 7.4 and <= 7.7	< 3.3 and >= 3.0, or >7.7 and <= 8.0
Non-Roadway Cement Concrete, High Strength				
Roadway Cement Concrete				

The price adjustment factor is 60 percent for compressive strength and 40 percent for air content. Thus, the composite pay factor for strength and air is the pay factor for strength by 60 percent plus the lower pay factor for air content by 40 percent. However, if either pay factor is 0, than the composite pay factor is 0 and the complete lot is rejected and no payment will be made.

5-05.3(4)B4 RE-TESTING BY CORING

When compressive strengths fail to satisfy the acceptance requirements above, the Contractor may request acceptance of in-place concrete strength based on core results. This method will not be used if the Engineer determines coring would be harmful to the integrity of the Structure. If allowed, cores must be obtained by the Contractor per AASHTO T 24 and delivered to the Owner for testing per AASHTO T 22. Do not take cores within 18 inches of joints

If the concrete in the Structure will be dry under service conditions, the core must be air-dried at a temperature between 60 °F and 80 °F and at a relative humidity less than 60 percent for 7 days before testing, and will be tested air dry.

Acceptance for each sublot or failed area by the core method requires that 3 cores be at least 85 percent of the specified LLCS with no 1 core less than 75 percent. The failing area may be subdivided to form smaller areas with each requiring 3 cores. When the Contractor requests strength analysis by coring, the results obtained will be accepted by both parties as conclusive and supersede all other strength data for the area represented. Failing sublot compressive strengths within a lot will be replaced by the new data and, if applicable, sub-sublots and sub-sublot sizes.

If the Contractor elects to core, cores must be obtained no later than 50 Days after initial concrete placement. The Engineer will concur in the locations to be cored. The Contractor is responsible for repair of cored areas. The cost incurred in coring and testing these cores, including repair of core locations, is borne by the Contractor.

5-05.3(4)C REJECTION OF CONCRETE

The Contractor may, before sampling, elect to remove any defective material and replace it with new material at no expense to the Owner. Any such new material will be sampled, tested, and evaluated for acceptance.

The Engineer may reject any load that appears defective before placement. Material rejected before placement must not be incorporated into the pavement. No payment will be made for the rejected materials unless the Contractor requests that the rejected material be tested. If the Contractor elects to have the rejected materials tested, a sample will be taken and both the

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air content and strength must be tested by the Engineer. Payment for rejected material will be based on the results of 1 sample, which was taken and tested. If the rejected material fails either test, no payment will be made for the rejected material. In addition, the cost of sampling and testing at the rate of $300.00 per sample is borne by the Contractor. If the rejected material passes both tests, the mix will be compensated for at a composite pay factor of lot or representative area and the cost of the sampling and testing is borne by the Owner.

The Engineer may reject any load that exceeds a maximum slump of 4 inches or as otherwise described in the accepted mix design. Slump is determined per AASHTO T 119 (ASTM C 143).

The Engineer may reject any concrete visually showing segregation or lack of consolidation. Acceptance based on visual bases where aesthetics are a critical feature, such as sidewalks, patterned, colored, or exposed aggregate concrete, will be at the sole discretion of the Engineer. No payment will be made for the rejected materials and the Contractor must remove and replace the material at no cost to the Owner.

The Engineer will reject any lot, sub-lot, or representative area that fails to comply with Section 5-05.3(4)B3. No payment will be made for the rejected materials and the Contractor must remove and replace the material at no cost to the Owner.

The Engineer will reject any primary unit or secondary unit that fails to comply with Sections 5-05.5(2). No payment will be made for the rejected materials and the Contractor must remove and replace the material at no cost to the Owner.

5-05.3(5) MIXING CONCRETE

The concrete may be mixed in a batching plant or in truck mixers. The mixer must be of an approved type and capacity. Mixing time is measured from the time all materials are in the drum. Ready-mixed concrete must be mixed and delivered as specified in Section 6-02.3(4)A and 6-02.3(4)B and other requirements of Section 6-02.3(4) not addressed in Section 5-05.3(5).

When mixed in a batching plant, the mixing time must not be less than 50 seconds nor more than 90 seconds.

Operate the mixer at a drum speed as shown on the manufacturer's nameplate on the mixer. Any concrete mixed less than the specified time must be discarded and disposed of by the Contractor at no expense to the Owner. The volume of concrete mixed per batch must not exceed the mixer's rated capacity, as shown on the manufacturer's standard rating plate on the mixer.

Each concrete mixing machine must be equipped with a device for counting automatically the number of batches mixed during the day's operation.

Retempering concrete by adding water or by other means is not permitted.

5-05.3(5)A LIMITATIONS OF MIXING

Do not mix, place, or finish concrete when the natural light is inadequate, as determined by the Engineer, unless an adequate and approved artificial lighting system is operated.

Discontinue mixing and placing concrete when a descending air temperature in the shade away from artificial heat reaches 40 ºF and do not resume until an ascending air temperature in the shade and away from artificial heat reaches 35 ºF, unless authorized in writing by the Engineer.

When mixing and placing is authorized during cold weather, the aggregates may be heated by either steam or dry heat before being placed in the mixer. The apparatus used must heat the mass uniformly and must be arranged to preclude the possible occurrence of overheated areas which might injure the materials. Unless otherwise authorized, the temperature of the mixed concrete must not be less than 50 ºF or more than 90 ºF during discharge into or from the hauling conveyance. Do not mix concrete with aggregates less than 32 ºF.

5-05.3(6) SUBGRADE

The subgrade must be constructed as specified in Section 2-09.

Do not place concrete on a frozen subgrade nor during heavy rainfall.

The subgrade must be moist before the concrete is placed.

When the subgrade is an asphalt treated base, the surface must be clean and free of any deleterious materials. When placing concrete on a treated base, the surface temperature must not exceed 90 °F. If water is used for cooling, remove any excess water standing in pools or flowing on the surface before placing concrete.

When applicable, the subgrade must be prepared and compacted to a minimum of 3 feet beyond each edge of the area receiving concrete pavement, to accommodate the slip form equipment.

Where thickened edges for pavements are required, excavate the subgrade and shape to provide for the section shown.

5-05.3(7) PLACING, SPREADING, AND COMPACTING CONCRETE

All the requirements apply regardless of the methods used to place concrete pavement.

The Specifications relating to the frequency and amplitude of internal vibration are considered the minimum requirements and are intended to ensure adequate density in the hardened concrete.

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5-05.3(7)A SLIP FORM CONSTRUCTION FOR CONTINUOUS PAVING

When and where specified in the Contract, or as desired by the Contractor and approved by the Engineer, the method of constructing concrete pavement may use slip form paving equipment.

Distribute the concrete uniformly into final position by a self-propelled slip form paver without delay. The alignment and elevation of the paver must be regulated from outside reference lines established for this purpose. The paver must vibrate the concrete for the full width and depth of the strip of pavement being placed with vibration adequate to provide a consistency of concrete that will stand normal to the surface with sharp well-defined edges. The sliding forms must be rigidly held together laterally to prevent spreading of the forms.

The plastic concrete must be effectively consolidated by internal vibration with transverse vibrating units for the full width of pavement and/or a series of equally spaced longitudinal vibrating units. The space from the outer edge of the pavement to the outer longitudinal unit must not exceed 9 inches. The spacing of internal units must be uniform and not exceed 18 inches.

The term internal vibration refers to vibrating units located within the specified thickness of pavement section.

The rate of vibration of each vibrating unit must not be less than 7,500 cycles per minute, with an amplitude of vibration sufficient to be perceptible on the surface of the concrete along the entire length of the vibrating unit and for a distance of at least 1 foot. The frequency of vibration or amplitude must be varied proportionately with the rate of travel to result in a uniform density and air content. The paving machine must be equipped with a tachometer or other suitable device for measuring and indicating the actual frequency of vibrations.

The concrete must be held at a uniform consistency. Operate the slip form paver with as nearly a continuous forward movement as possible. Coordinate all operations of mixing, delivering, and spreading concrete to provide uniform progress with stopping and starting of the paver held to a minimum. If, for any reason, it is necessary to stop the forward movement of the paver, the vibratory and tamping elements must also be stopped immediately. Do not apply tractive force to the machine in addition to that which is controlled from the machine.

When concrete is being placed adjacent to an existing pavement, that part of the equipment which is supported on the existing pavement must be equipped with protective pads on crawler tracks or rubber-tired wheels on which the bearing surface is offset to run a sufficient distance from the edge of the pavement to avoid breaking the pavement edge.

5-05.3(7)B STATIONARY SIDE FORM CONSTRUCTION

Side form sections must be straight, free from warps, bends, indentations, or other defects. Remove defective forms from the Work. Use metal side forms unless other forms are approved by the Engineer.

Side forms may be built up by rigidly attaching a section to either top or bottom of forms. If such buildup is attached to the top of metal forms, the buildup must be of metal.

Side forms must be sufficiently rigid, both in the form and in the interlocking connection with adjoining forms, such that springing will not occur under the weight of grading and paving equipment or from the pressure of concrete. Provide sufficient forms so that there will be no delay in placing the concrete due to lack of forms.

Before placing side forms, the underlying material must be at the proper grade. Place side forms to the required grade and alignment of the edge of the finished pavement. Wood wedges may be used to adjust the form elevation provided they do not extend into the concrete. The forms must be firmly supported during the entire operation of placing, compacting, and finishing the pavement.

Drill forms in advance of being placed to line and grade to accommodate tie bars where specified.

Immediately in advance of placing concrete and after all subgrade operations are completed, side forms must be trued and maintained to the required line and grade for a distance sufficient to prevent delay in placing concrete. Do not place concrete until the forms are approved by the Engineer.

Side forms must remain in place at least 12 hours after the concrete has been placed, and in all cases until the edge of the pavement no longer requires the protection of the forms. Apply curing compound to the concrete immediately after the forms are removed.

Side forms must be thoroughly cleaned and oiled each time they are used and before concrete is placed against them.

Unless otherwise approved by the Engineer, concrete must be spread, screeded, shaped, and consolidated by 1 or more self-propelled machines. These machines must uniformly distribute and consolidate concrete without segregation so that completed pavement will conform to required cross-section with a minimum of handwork.

The number and capacity of machines furnished must be adequate to perform the Work required at a rate equal to that of concrete delivery.

Concrete for the full paving width must be effectively consolidated using surface vibrators, in combination with internal vibrators, or by some other method of consolidation that produces equivalent results without segregation.

When vibrators are used to consolidate concrete, the rate of vibration must not be less than 3,500 cycles per minute for surface vibrators or less than 7,000 cycles per minute for internal vibrators. Amplitude of vibration must be sufficient to be perceptible on the surface of the concrete more than 1 foot from the vibrating element. Furnish a tachometer or other suitable device for measuring and indicating frequency of vibration.

Connect power to vibrators so that vibration stops when forward or backward motion of the machine is stopped.

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5-05.3(8) JOINTS - ROADWAY

Joints in cement concrete pavement will be designated as longitudinal and transverse contraction joints, longitudinal and transverse construction joints, through joints, or isolation joints, and must be constructed as shown on the Drawings or Standard Plans per the following Specifications:

Construct the faces of all joints perpendicular to the surface of the cement concrete pavement.

All joints in intersections where traffic lanes cross are considered transverse joints; use dowel bars on all joints per the following or as shown on the Drawings.

If bar details are not shown on joint details on Drawings, then Standard Plans reinforcement steel details must apply for steel placement.

Where called for on the Drawings or directed by the Engineer, the vertical face of the joint between new cement concrete base pavement and existing cement concrete pavement must be covered with a bond breaking Material such as polyethylene film, roofing paper, or other Materials approved by the Engineer.

5-05.3(8)A CONTRACTION JOINTS

All contraction joints must be constructed at the locations, intervals, and depths specified in the Contract. Sawed joints are typically used with continuous or full reconstruction paving. Unless otherwise specified, the use of sawed or formed contraction joints is at the option of the Contractor, however, sawing into adjacent cement concrete paving or curbs is not allowed.

5-05.3(8)A1 SAWED CONTRACTION JOINTS

The depth of sawcuts must be as shown on the Drawings or Standard Plans and must not cut underlying pavement tie bars or dowels.

Transverse and longitudinal contraction joints must be sawed with suitable power-driven concrete saws. Provide sufficient sawing equipment capable of completing the sawing to the required dimensions and at the required rate to control cracking. To ensure continuity of sawing, standby equipment must be on the Job Site and all sawing equipment must be available immediately and continuously on a 24 hour basis.

Provide adequate artificial lighting facilities for night sawing. Joints must not vary from the specified or indicated line by more than 3/4 inch.

Sawing transverse contraction joints depends on the setting time of the concrete, and must be done at the earliest possible time following placement of the concrete without tearing or raveling the adjacent concrete excessively.

Longitudinal contraction joints must be sawed as required to control cracking and as soon as practical after the initial control transverse contraction joints are completed. For HES concrete this should be within 6 hours of placement. Any sawing of joints that result in premature or uncontrolled cracking must be changed immediately by adjusting the time interval between placing of concrete and the sawing of joints.

Any damage to the curing Material during the sawing operations must be repaired immediately after the sawing is completed. If curing compound is used, the area disturbed by sawing of joints must be reapplied immediately upon completion of the sawing operation and care taken to prevent the curing compound from getting into the groove.

Install formed transverse contraction joints where designated by the Engineer, if necessary to prevent uncontrolled transverse cracks from occurring before the pavement can be sawed.

5-05.3(8)A2 SEALING SAWED CONTRACTION JOINTS (NON-BASE ONLY)

Sawed contraction joints must be filled with joint sealant filler conforming to the requirements of Section 9-04.2. Joints must be thoroughly clean when sealing and dry if the hot-poured type is used. Take care to avoid air pockets. The hot-poured compound may be applied in 2 or more layers, if necessary. The hot-poured compound and the cold-poured compound must be applied under sufficient pressure to fill the groove from bottom to top, with the cured joint sealant between 1/4 inch and 5/8 inch below the top surface of the concrete.

5-05.3(8)A3 FORMED CONTRACTION JOINTS (NON-BASE ONLY)

Construct formed contraction joints by embedding a 3/8 inch thick premolded joint filler as specified in Section 9-04.1 and as shown on the Drawings or Standard Plans. The depth of the formed joints must be as shown on the Drawings or Standard Plans. Cut the premolded joint filler to the exact section of the joint. The length of the premolded joint filler must extend to within 1/4 inch of any panel edge.

Place formed contraction joints after compaction and finishing of concrete are completed and before initial set. Cut a vertical groove into the surface at the location of the joint, using a tool provided with stops (tee iron) to prevent cutting the groove deeper than the planned depth. Then embed the preformed joint filler into the groove until the top is flush with the pavement surface, with a deviation of not more than 1/8 inch below the surface. The premolded joint filler must be perpendicular to the surface and always in a straight line.

The surface of the pavement must be finished against the filler strip with hand floats to restore the surface finish. Maintain the premolded joint filler in a perpendicular position, true to alignment without irregularities.

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5-05.3(8)A4 WEAKENED PLANE CONTRACTION JOINTS (BASE ONLY)

A weakened plane must be made in the plastic concrete to match existing joints or cracks as designated by the Engineer or as shown on the Drawings and Standard Plans. Typically, maximum joints spacing must not exceed 15 feet for a base slab thickness greater than 7 inches; and must not exceed 12-1/2 feet for a base slab thickness less than 7 inches.

The plane must be weakened with a joint cutter to a minimum depth of 1/3 to ½ depth of the base pavement. Bulging caused by the joint cutter must be corrected by floating lightly.

Unless otherwise specified, if new curb is also being placed, place preformed joint filler completely through the curb at the point where the weakened plane intersects the curb.

5-05.3(8)B CONSTRUCTION JOINTS

When placing of standard or slow curing (non-high-early-strength) concrete is discontinued for more than 45 minutes, a transverse construction joint must be installed. Construction joints must be as shown on the Standard Plans. Place traffic cement concrete construction joints at the direction of the Engineer.

Construct transverse construction joints between cement concrete pavement and reinforced concrete bridge approach slabs.

Except for base paving, all transverse and longitudinal construction joints, including the joint between new and existing pavement when widened must be formed and sealed with a 3/8-inch thick premolded joint filler as specified in Section 9-04.1(1) or as shown on the Drawings or Standard Plans.

Unless otherwise specified, construct all longitudinal construction joints with tie bars and all transverse construction joints with dowel bars as shown on the Drawings or Standard Plans. See Section 5-05.3(10)A for exceptions to tie-bars and dowels placement requirements for new to existing joints.

Unless otherwise specified, optional keyways are allowed only as detailed in the Standard Plans.

5-05.3(8)C THROUGH JOINTS

Place through joints only where shown on the Drawings. Unless otherwise shown, joint alignment must be at right angles to the pavement Structure centerline.

Construct through joints with 3/4 inch premolded joint filler as specified in Section 9-04.1(2). The premolded joint filler must extend from 1 inch below the subgrade to 1 inch below the top of the pavement. Through joints must extend the full width of the pavement Structure. Use dowels unless otherwise directed or otherwise shown on the Drawing.

The premolded joint filler must be held accurately in place during the placing and finishing of the concrete by a bulkhead, a holder, a metal cap, or any other approved method. The joint must be perpendicular to the paved surface and the holder must be in place long enough to prevent sagging of the Material, especially on streets having steep grades.

Place a wood filler strip or metal cap on the top of the premolded joint filler to form the groove 1 inch deep.

After concrete is significantly set and before opening to traffic, remove the wood filler strip or the metal cap above the top of the premolded joint filler and thoroughly cleaned of all loose material. It must then be filled level with the pavement surface with joint sealant meeting the requirements of Sections 9-04.2(2).

Heat and place the joint sealant Material per the manufacturer's instructions. Burned Material will be rejected. The through joint groove must be dry when pouring the sealing compound.

5-05.3(8)D ISOLATION JOINTS

When drainage features are placed within the concrete pavement, place premolded joint filler (as specified in Section 9-04.1(2)) as detailed in the Drawings through the full depth of concrete pavement.

5-05.3(8)E JOINT LOCATION

Unless otherwise shown on the Drawings or directed by the Engineer, the following applies:

5-05.3(8)E1 TRANSVERSE JOINTS

Standard spacing of transverse contraction joints along straight sections of pavement Structures, between through joints or between intersections or other irregular areas, must be at intervals as shown on the Standard Plans. Where the spacing between intersections, transverse through joints, or other irregular areas are not in even multiples, the last several spaces approaching the through joint or header must be varied by shortening the spaces. The Contractor must provide advance notice to the Engineer and coordinate the spacing. On horizontal curves, the joint spacing must be measured along the outer edge of the outside lane and at right angles to the center line.

When paving adjacent to existing pavement or a previously paved lane, the new transverse joints must be placed to match joint locations in the adjacent pavement. Where the existing joint spacing is greater than intervals as shown on the Standard Plans, intermediate transverse joints must be constructed. The Contractor must provide advance notice to the Engineer and coordinate the spacing.

For intersections and other irregular areas, the arrangement of contraction joints must be per standard intersection patterns as shown on the Drawings and Standard Plans. The area of any one irregular panel formed by doweled contraction joints in intersections must not exceed:

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1. 225 square feet, or dimensions of 15 feet, for a slab thickness greater than 7 inches; or
2. 156 1/4 square feet, or dimensions of 12-1/2 feet for a slab thickness less than 7 inches.

The Contractor must provide advance notice to the Engineer and coordinate the spacing.

Unless otherwise directed by the Engineer, where uncontrolled cracks have appeared or exist in the adjacent lane not to be replaced, they must be matched as nearly as possible by uniform transverse joints in the second lane. In the event uncontrolled cracks in the existing lane are too frequent or in random locations and impossible to match with a uniform spacing, the 2 lanes must be completely separated by a longitudinal through joint (for non-base paving) or a bond breaking material (for base paving) when directed by the Engineer.

Where integral curb or doweled curb is placed along the concrete pavement, place premolded joint filler transversely across the full section of the curb in true alignment with the pavement joint, perpendicular to the pavement grade.

All joints in an intersection are considered transverse joints except those joints that end normal to the curb radius.

5-05.3(8)E2 LONGITUDINAL JOINTS

Standard locations for longitudinal joints for the following pavement widths, whether contraction or construction, must be as shown on the Standard Plans unless otherwise shown on the Drawings. Typically, longitudinal joints are placed at lane lines; bike lane must be combined with parking and treated as a single lane. Longitudinal or skewed joints must not be placed within bike lanes.

Typically, maximum longitudinal joints spacing should not exceed:

1. 15 feet for a slab thickness greater than 7 inches; and,
2. 12 1/2 feet for a slab thickness less than 7 inches.

A 3/8” x 2” minimum preformed joint filler must be placed between the 2 lanes when the second lane is constructed. See Standard Plans.

5-05.3(9) CASTINGS AND STEEL REINFORCING IN CONCRETE PAVEMENT

Unless otherwise specified in the Drawings or directed by the Engineer, use reinforcing steel to reinforce cement concrete in rigid pavement around all maintenance hole castings, drainage structures, vaults and monument casings in the roadway. Reinforcing steel not required when the casting crosses or is less than 18 inches from any pavement joint unless otherwise specified in the Drawings or directed by the Engineer.

Use one of the following methods of reinforcement:

1. Steel Reinforcement (Wire Mesh): Install square or rectangle steel reinforcement around the casting at mid depth of the concrete pavement slab as shown on Standard Plan 406. The centered hole cut for the casting must be cut a minimum of 3 inches to a maximum of 4 inches from the casting at mid depth of the concrete pavement. Wire mesh must be W4.0 with spacing of 4 inches on-center in both the lateral and transverse directions. Wire mesh for concrete reinforcement must conform to the requirements of Section 9-07.7.
2. Steel Reinforcement (Rebar): Install #5 rebar at 12 inches on center each way, around the casting at mid depth of the concrete pavement slab as shown on Standard Plan 406. Rebar must be tied at rebar intersection points as shown. Reinforcing steel must not be within 2-1/2 inches of any cement concrete pavement surfaces or the flange of a casting. Rebar must be as specified in Section 9-07.2.

See Section 7-20.3(1)C for temporary transition tapers around exposed castings.

If reinforcement details are shown on the Drawings, those details must be followed as described. Unless otherwise indicated, any wire mesh and rebar shown on these details must comply with the applicable requirements in methods 1 and 2, respectively.

5-05.3(10) TIE BARS AND DOWEL BARS

Unless otherwise indicated or directed by the Engineer, tie bars must be placed at all longitudinal contraction and construction joints, per the requirements shown on the Standard Plan. In addition, tie bars must be installed when concrete shoulders are placed as a separate operation or when widening existing pavement. See 5-05.3(10)A for new to existing joints tie bars and dowel use requirements.

Tie bars must be placed at longitudinal construction joints between lanes so that the individual bars are at the required elevation and spaced as shown on the Standard Plan. Place so that the vertical edge of the concrete is not deformed or otherwise damaged during placement of the bars.

Placement tolerances for tie bars must be within 1 inch of the middle of the concrete slab, within 1 inch of being centered over the joint and placed parallel or perpendicular to centerline within 1 inch of the vertical and horizontal plane.

Unless otherwise indicated or directed by the Engineer, dowel bars are required for the construction joint at the end of paving operations each day and must be placed per the Standard Plan. Unless otherwise indicated or directed by the Engineer, dowel bars must be placed at all transverse contraction joints as specified in the Contract or per the Standard Plans. See 5-05.3(10)A for New to Existing joints tie bars and dowel use requirements. All dowel bars must have a parting compound, such as curing compound, grease or other Engineer approved equal applied to them before placement. Wire baskets that remain in the pavement to hold the dowels must be approved by the Engineer. Any dowel bar delivered to the project that displays rust/oxidation, pinholes, questionable blemishes, or deviates from the round will be rejected.

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The Contractor must furnish a manufacturer's certificate of compliance as specified in Section 1-06.3, including mill test report verifying conformance to the requirements of Section 9-07.5 as well as written certification identifying the patching material, when applicable, used at cut dowel bar ends.

Only 1 type of dowel bars is allowed per contract; intermixing of different dowel bar types is not allowed.

Placement tolerances for dowel bars must be within 1 inch of the middle of the concrete slab, within 1 inch of being centered over the transverse joint and parallel to centerline within 1/2 inch of the vertical and the horizontal plane.

Cutting of stiffeners within the dowel bar cage is not allowed.

5-05.3(10)A "NEW TO EXISTING" JOINTS – TIE-BARS AND DOWELS

Unless otherwise directed by the Engineer, when new concrete pavement is to be placed against existing cement concrete pavement, tie bars, and dowel bars must be drilled and grouted into the existing pavement with either Type I or IV epoxy resin as specified in Section 9-26.

Tie bars are not required when the existing pavement is less than 8 inches thick.

Dowel bars are not required when the existing pavement is 8 inches or less in thickness.

Tie bars or dowels are not required when indicated on the Drawings or when the Engineer determines the existing concrete to be incompetent.

The epoxy-bonding agent must be either Type I or IV epoxy resin as specified in Section 9-26. The Contractor may use any method for drilling the holes, provided the method selected does not damage the existing concrete. Any damage caused by the Contractor's operations must be repaired by the Contractor at no cost to the Owner as specified in Section 1-07.13.

The tie bar holes must be blown clean with compressed air before grouting. The bar must be centered in the hole for the full length of embedment before grouting. The grout must then be pumped into the hole around the bar in a manner that the back of the hole will be filled first. Blocking or shimming must not impede the flow of the grout into the hole. Dams, if needed, must be placed at the front of the holes to confine the grout. The dams must allow the escape of air without leaking grout and must not be removed until grout has cured in the hole.

5-05.3(11) ROADWAY FINISHING

After the concrete has been given a preliminary finish using finishing devices, the surface of the fresh concrete must be checked by the Contractor with a straight edge device not less than 10 feet in length. High areas indicated by the straight edge device must be removed by the hand-float method. Each successive check with the straight edge device must lap the previous check path by at least of the length of the straight edge.

Any edge slump of the pavement, exclusive of specified edging, in excess of 1/4 inch must be corrected before the concrete has hardened. If edge slump on any 1 foot or greater length of hardened concrete exceeds 1 inch, the concrete must be repaired as specified in Section 5-05.3(19).

5-05.3(11)A EDGING (NON-BASE ONLY)

Before the final finishing is completed and before the concrete has taken the final set, the pavement must be edged as described in the following table:

Location	Radius
Edge of Pavement	1/2 inch
Contraction Joints (non-sawed)	1/4 inch
Through or Construction Joints	1/2 inch

Particular attention must be given to edge at the appropriate time. The concrete must attain a partial set and all free water must have disappeared so that the edged joints are clearly defined with no tearing or slump of the edges.

5-05.3(11)B ROADWAY SURFACE FINISHING (NON-BASE ONLY)

Rough Finish: The pavement must be given a final finish surface by texturing with a comb perpendicular to the centerline of the pavement. The comb must produce striations approximately 1/8 inch to 3/16 inch in depth. Randomly space the striations from 1/2 inch to 1-1/4 inch. The comb must be operated mechanically either singly or in gangs with several placed end to end. Finishing must take place with the elements of the comb as nearly perpendicular to the concrete surface as possible, to eliminate dragging the mortar. If the striation equipment has not been previously approved, a test section must be constructed before approval of the equipment. If the pavement has a raised curb without a formed concrete gutter, the texturing must end 2 feet from the curb line. This 2-foot un-textured strip must be hand finished.

5-05.3(11)C ROADWAY BASE FINISHING (BASE ONLY)

Roadway cement concrete base is pavement that is intended as a base for an asphalt wearing course, the concrete must be placed and screed to the finished grade and floated to a uniform surface. It must be brushed transversely with a fiber or

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wire brush of a type approved by the Engineer. The brush finish should provide a texture finish throughout the pavement base surface. The surface tolerance is 3/8 inch in 10 feet.

5-05.3(11)D UTILITY ADJUSTMENTS

Utility castings must be adjusted to roadway finished grade before the construction of the final wearing course. See Section 7-20.3(1) for adjustment tolerances of maintenance holes, catch basins, and similar Structures; and corrective action for non-compliance.

5-05.3(12) ROADWAY SURFACE SMOOTHNESS

Surface smoothness will be measured with a 10-foot straight edge before 5:00 p.m. of the Day following the placing of the concrete. A 10-foot straight edge will be placed to bridge any depressions and touch all high spots. Surface variances (SV) are as follows:

Location	SV
Roadway	1/4 inch
Alleys	3/8 inch
Cement Concrete Base	3/8 inch

Should the surface vary more than the specified surface variance (SV) from the lower edge of the straight edge, the high portion must be reduced by the Contractor to the specified SV tolerance by abrasive means at no expense to the Owner. If reduction of high portions of the surface involves breaking, dislodging, or other disturbance of the aggregates, such cutting is not permitted until the pavement has achieved its design strength. If in the opinion of the Engineer irregularities cannot be satisfactorily removed by such methods, the Contractor must remove and replace the pavement at no expense to the Owner.

Smoothness perpendicular to the centerline will be measured with a 10-foot straight edge across all lanes with the same cross slope, including shoulders when composed of cement concrete pavement. The overlapping 10-foot straight edge measurement must be discontinued at the point 6 inches from the most extreme outside edge of the finished cement concrete pavement. The transverse slope of the finished pavement must be uniform so that no variations greater than specified SV are present when tested with a 10-foot long straight edge laid in a direction perpendicular to the centerline. Any areas that are in excess of this specified tolerance must be corrected by abrasive means.

Smoothness parallel to the centerline will be measured with a 10-foot straight edge across all lanes, including shoulders when composed of cement concrete pavement. The overlapping 10-foot straight edge measurement must be discontinued at the point 6 inches from the starting or ending of the finished cement concrete pavement, or any point of vertical grade change, referred to as vertical point of intersection. The longitudinal slope of the finished pavement must be uniform so that no variations greater than specified SV are present when tested with a 10-foot long straight edge laid in a direction parallel to the centerline after adjusting for any horizontal curvature between vertical point of curvature and vertical point of tangent. Any areas that are in excess of this specified tolerance must be corrected by abrasive means.

5-05.3(13) CURING

Immediately after the finishing operations have been completed and as soon as marring of the concrete will not occur, the entire surface of the newly placed concrete must be cured using one of the following methods.

5-05.3(13)A CURING COMPOUND

Liquid membrane-forming concrete curing compound Type 2 meeting the requirements of Section 9-23.2 must be applied to the entire area of the exposed surface of the concrete with an approved mechanical spray machine. The spray fog must be protected from the wind with an adequate shield. Curing compound must be applied uniformly in two coats at the rate of 1 gallon to not more than 150 square feet for the combined total of both coats. Apply the second coat approximately at right angles to the direction of application of the first coat. Coat the surfaces in contact with forms immediately after the forms are removed. Reapply the curing compound after removing surface imperfections with a carborundum brick or cleaning the slurry from sawn decorative scoring.

The compound must be applied with equipment of the pressure tank or pump type equipped with a feed tank agitator which ensures continuous agitation of the compound during spraying operations. The nozzle must be of the 2-line type with sufficient air to properly atomize the compound.

Do not apply the curing compound during or immediately after rainfall. If it becomes necessary to leave the pavement uncoated overnight, it must be covered with polyethylene sheeting, which must remain in place until weather conditions are favorable for the application of the curing compound.

If rain falls on the newly coated pavement before the film has dried sufficiently to resist damage, or in the event of damage to the film from any cause, the Contractor must apply a new coat of curing compound in 1 or 2 applications to the affected area at the rate which, in the opinion of the Engineer, will result in a film of curing value equal to that specified in the original coat.

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Before placing the curing compound in the spray tank, it must be thoroughly agitated as recommended by the Manufacturer, and the curing compound must be properly mixed and ready for spraying. Do not dilute the compound by adding solvents, or alter it in any manner. If the compound has become chilled to the extent that it is too viscous for proper stirring or application, or if portions of the vehicle have been precipitated from solution, it must be heated to restore proper fluidity but not above 100 ºF or manufacture's recommendations. All curing compound must have been accepted in accordance to Section 1-05.3 before placing in the spray tanks.

The curing compound must be applied immediately after the concrete has been finished and after any bleed water that has collected on the surface has disappeared, or at a time designated by the Engineer. The compound must form a uniform, continuous, coherent film that will not check, crack, or peel and must be free from pinholes or other imperfections. If pinholes, abrasion, or other discontinuities exist, apply an additional coat to the affected areas within 30 minutes.

If hairline cracking develops in the pavement before finishing is completed, the Engineer may direct the application of the curing compound at an earlier stage, in which event any concrete cut from the surface in finishing operations must be removed entirely from the pavement. If additional mortar is then needed to fill torn areas, it must be obtained ahead of the spraying operations. All areas cut by finishing tools after the application of the curing compound must immediately be given new applications at the rate specified above.

The curing compound, after application, must be protected from injury until the pavement has reached a minimum compressive strength of 3000 psi. All traffic, either by foot or otherwise, is considered injurious to the film of the applied compound.

The Contractor must provide on the Job Site a sufficient quantity of white polyethylene sheeting to cover all pavement laid in 3 hours of maximum operation. This sheeting must be reserved exclusively for the protection of the pavement in case of rain or breakdown of the spray equipment used for applying the curing compound. The protective sheeting must be placed over the pavement when directed, and in the manner specified by the Engineer.

All liquid membrane-forming curing compounds must be removed from the Portland cement concrete pavement to which traffic delineators will be bonded. Curing compound removal must not start until roadway pavement and driveways have attained a minimum compressive strength for traffic to be allowed on it, or for 3 Days for non-roadway cement concrete except driveways. The Contractor must submit a proposed removal method to the Engineer and must not start the removal process until the Engineer has approved the removal method.

The Contractor must assume all liabilities for and must protect the Owner from any damages or claims arising from the use of materials or processes described here.

Alternate curing for cement concrete base:

On cement concrete base, emulsified asphalt CSS 1 or CRS 1 meeting the requirements of Section 9-02.1(6) may be applied at a rate between 0.15 gallon and 0.25 gallon per square yard of surface. Do not apply the emulsified asphalt during or immediately after rainfall. If it becomes necessary to leave the pavement uncoated overnight, it must be covered with polyethylene sheeting, which must remain in place until weather conditions are favorable for the application of the emulsified asphalt.

If rain falls on the newly coated pavement before the emulsified asphalt has dried sufficiently to resist damage, or in the event of damage to the emulsified asphalt from any cause, the Contractor must apply a new coat of emulsified asphalt to the affected area at the rate which, in the opinion of the Engineer, will result in a film of curing value equal to that specified in the original coat.

5-05.3(13)B WHITE POLYETHYLENE SHEETING

The sheeting must be placed over the pavement immediately after finishing operations are completed, or at a time designated by the Engineer.

The sheeting must be laid so that individual sheets overlap at least 2 feet, and the lapped areas held in close contact with the pavement by weighting with sand bags or boards to prevent movement by the wind. The sheeting must extend downward to cover the edges of the pavement and must be secured to the subgrade with sand bags or boards or a continuous bank of base material. Any holes occurring in the sheeting must be patched immediately to the satisfaction of the Engineer. The sheeting must be maintained against injury and remain in place until the roadway pavement and driveways have attained a minimum compressive strength for traffic to be allowed on it, or for 3 Days for non-roadway cement concrete except driveways.

5-05.3(13)C WET CURING

Wet curing must be accomplished by applying a continuous fog or mist spray to the entire pavement surface until the roadway pavement and driveways have attained minimum compressive strength, or for 3 Days for non-roadway cement concrete except driveways. If minimum compressive strength for traffic to be allowed is reached prior, a curing compound must be applied in accordance Section 5-05.3(13)A before opening to traffic.

If water runoff is not a concern, continuous sprinkling is acceptable. Do not start sprinkling until the concrete has achieved initial set as determined by AASHTO T 197 or other approved method.

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5-05.3(14) COLD WEATHER WORK

When concrete is being placed and the ambient air temperature is expected to drop below 35 °F (2 °C) during the day or night, the Contractor must protect the concrete from freezing. The Contractor must provide a Cold Weather Plan before placing concrete when ambient air temperature below 35 °F may occur or when requested by the Engineer.

Under the Cold Weather Plan, the Contractor must, at no expense to the Owner, provide a sufficient supply of straw, hay, blankets, or other suitable blanketing material and spread it over the pavement to a sufficient depth to prevent the concrete from freezing. Straw, hay, blankets, or other suitable blanketing material must be spread over the pavement to a sufficient depth to keep the concrete from freezing. The blanket material must be covered with a layer of burlap or plastic sheeting, weighted, or anchored to prevent the wind from displacing the insulation. The Engineer may require recording thermometers if daytime temperature is below 35 °F.

The protection must be maintained for 10 Days or until opening strength is obtained, whichever occurs first. The Contractor must replace any concrete damaged by freezing at no additional cost to the Owner.

The Contractor is responsible for the quality and strength of the concrete thus cured. Any concrete injured by frost action or freezing must be removed and replaced at the Contractor's expense as specified in this Section.

5-05.3(15) CONCRETE PAVEMENT CONSTRUCTION IN ADJACENT ROADWAY LANES

Unless otherwise shown on the Drawings or in the Contract, the pavement may be constructed in multiple lanes (2 or more adjacent lanes paved in a single operation). Use longitudinal contraction joints between adjacent lanes that are paved concurrently and construction joints when lanes are paved separately. Tie bars must be installed during initial lane construction.

The Contractor must replace, at no expense to the Owner, any panels on the new pavement that are cracked or broken as a result of the Contractor's operations.

5-05.3(16) PROTECTION OF ROADWAY CEMENT CONCRETE.

The Contractor must protect the pavement and its appurtenances from any damage. Protection includes personnel to direct traffic and the erection and maintenance of warning signs, lights, barricades, temporary take-down bridges across the pavement with adequate approaches, and any other means necessary to accommodate local traffic and to protect the pavement during the curing period or until opened to traffic as determined by the Engineer.

The operation of construction equipment on the new roadway pavement is not allowed until the pavement has developed a compressive strength of 3000 psi as determined from cylinders, made during placement, cured under comparable conditions, and tested per AASHTO T 22, or by maturity meter for HES cement concrete. An exception is 1 track from a slip form-paving machine when paving adjacent lanes or light vehicles required for sawing operations or taking cores.

Placement of shoulder material may start when the pavement has developed a compressive strength of 1800 psi as determined from cylinders made at the time of placement, cured under comparable conditions, and tested per AASHTO T 22 as long as construction equipment is not operated on the new pavement.

If shown on the Drawings, a continuous barrier must be constructed and maintained along the edge of the pavement being constructed and adjacent to the portion of the roadway used for traffic. The barriers must be left in place until the new pavement is ready to be opened to traffic and must then be removed by the Contractor. If not shown on the Drawings, use requirements of Section 1-10 for traffic control.

Any damage to the pavement occurring before final acceptance must be replaced or repaired as specified in Section 5-05.3(19).

5-05.3(17) OPENING TO VEHICLE TRAFFIC

The pavement may be opened to traffic when the concrete has developed a compressive strength of 3000 psi (2500 psi for residential driveways) as determined from cylinders, made at the time of placement, cured under comparable conditions, and tested per AASHTO T 22, or by maturity meter. Maturity meters testing is at the option of the Engineer and requires the Contractor to develop the maturity-strength relationship and provide maturity curves along with supporting data for approval by the Engineer. The submittal of maturity curves is required for all HES cement concrete and at the option of the Contractor for other mixes. The Contractor must provide and maintain approved maturity meter sensors.

The Contractor is responsible for Fabrication, curing, and testing of cylinders to measure early strength. Obtain the services of an approved independent Laboratory to perform these activities. However, at the Engineer's option, fabrication, curing, and testing of cylinders may be performed by the Engineer. If the Engineer agrees to perform testing, the requirements for the Contractor to do so are waived.

At the Contractor's request, or when desired by the Engineer, time for opening pavement may be determined by the Engineer through the use of the maturity test per ASTM C 1074. The pavement must not be opened to traffic until the maturity-strength relationship shows the roadway pavement has a compressive strength of 3000 psi (2500 psi for residential driveways) as determined by the Engineer.

If the Contractor's test results conflict with the Owner's, use the Owner's testing results.

Clean the pavement before opening to traffic.

All costs associated with Work specified above are borne by the Contractor.

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5-05.3(18) PRE-PAVING MEETING

The Contractor must coordinate with the Engineer to have a pre-paving meeting at least 5 Working Days before the first paving operation. Be prepared to discuss operations as they relate to other entities and the public's safety and convenience, including: driveway and business access; garbage truck operations; KCM transit operations and working around energized overhead wires; school, nursing home, hospital, and other access; other contractors who may be operating in the area; pedestrian and bicycle traffic; emergency services; and other applicable public interests. Be prepared to discuss the placement and finishing methods, reinforcement placement, joint placement, and the curing methods for all classes and subclasses (variable mixes) of cement concrete to be used.

5-05.3(19) REPAIR OF DEFECTIVE ROADWAY PAVEMENT SLABS

Broken slabs, slabs with random cracks, nonworking contraction joints near cracks, edge slumping and spalls along joints and cracks must be replaced or repaired as specified at no expense to the Owner; this must be accomplished before completion of joint sealing.

New pavement slabs containing 1 or more cracks must be entirely removed and replaced. When new pavement slab is to be removed and replaced, saw cut the full pavement depth along all longitudinal joints and at transverse locations to sever tie-bars and dowel bars to preserve the adjacent pavement. Install new tie bars and dowel bars as specified in Section 5-05.3(10).

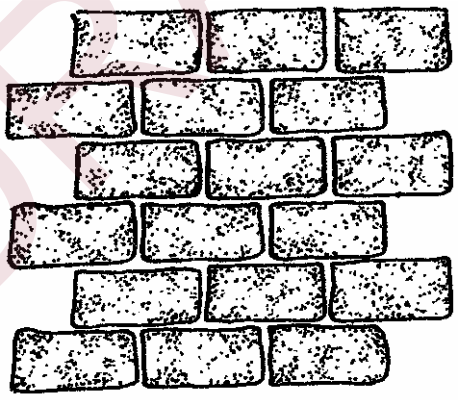
Repair of spalls and edge slumps in new pavement is allowed. Patching material must be submitted and approved by the Engineer prior to repairing of spalls or edge slumps. The approved patching material must be mixed, placed, consolidated, finished, and cured according to the manufacturer's recommendations. Slab/patch interfaces that will not receive pavement grinding must be sealed with 1:1 cement water grout along the patch perimeter.

5-05.3(20) PATTERNED AND COLORED CEMENT CONCRETE TREATMENT

Use colored and/or imprinted concrete, including color matching joint material, when specified.

Patterned Cement Concrete Treatment: Patterned cement concrete is defined as additional work necessary to imprint cement concrete with a pattern, and is referenced by "Patterned" and "Running Bond Used Brick" or other pattern in the Bid Item description and call-outs for locations on the Drawings. Other patterns may be shown on the Drawings or on Drawing Details in the Appendix of the Contract. Refer to the sketch below for Running Bond Used Brick pattern details. Nominal size for a typical brick is 8" long x 4" wide. The long edge of each brick must be laid perpendicular to the crosswalk.

Running Bond Used Brick pattern



The Contractor must use the Running Bond Used Brick pattern for crosswalks or at other locations when shown on the Drawings.

Other cement concrete surface treatment patterns must be applied at locations and alignments, and as shown in the Drawings or Drawing Details.

The Contractor must submit technical data and manufacturer's specifications for patterned concrete components and a proposed plan for mixing, delivery, placement, finishing, and curing of the patterned concrete. This plan must be submitted to the Engineer for approval at least 10 Working Days before constructing the test panel.

Monitor the water content, weight of cementitious materials, and size, weight, and color of aggregate to maintain consistency and accuracy of the mixed concrete. Schedule delivery of concrete to provide consistent mix times from batching until discharge. Do not add water after a portion of the batch has been discharged.

Use imprinting tools capable of imprinting the surface of the concrete with a uniform and aligned pattern and/or texture. Use a clear release agent as specified by the imprinting tool manufacturer. These materials must be approved before use.

Unless approved manufacturer's recommendations differ:

1. Screed concrete to the finished grade and apply release agent. Using methods as recommended by the manufacturer, apply pre-approved imprinting tools to the surface while the concrete is still plastic. Do not lightly broom surface.
2. For sidewalks, unless otherwise specified, score or saw cut the surface to a minimum depth of 1/4 the thickness of the slab at intervals of 5 feet. Tool the edges, joints and scored areas as consistent with the imprinting pattern. If the saw cut option is used, the Contractor is responsible for performing the saw cut operation at such time as to minimize the possibility of spalling and/or cracking.
3. Within 24 hours, remove release agent with pressure wash and apply a pre-approved sealer, recommended by the coloring manufacturer, at a rate consistent with manufacturer's recommendations.

Colored Cement Concrete Treatment:

Colored cement concrete is defined as additional work necessary to color cement concrete with a color, and is referenced by "Colored" and a Federal Standard 595B "F (color code)" in the Bid Item description and call-outs for locations on the Drawings.

All coloring agents must produce a color conforming to the Federal Standard 595B. The color must be as specified in the Contract. Color pigments must be high quality iron oxides conforming to ASTM C 979. The dosage must not exceed 10 percent by weight of cementitious material in the concrete mix design. Color admixtures for integrally colored concrete must be certified by the manufacturer as meeting the requirements of ASTM C 979 - Pigments for Integrally Colored Concrete must be packaged such that 1 dose is the proper dosage for 1 cubic yard of concrete.

Submit technical data and manufacturer's Specifications for colored concrete components and a proposed plan for mixing, delivery, placement, finishing, and curing of the colored concrete. This plan must be submitted to the Engineer for approval at least 10 Working Days before constructing the test panel.

Monitor the water content, weight of cementitious materials, and size, weight, and color of aggregate to maintain consistency and accuracy of the mixed colored concrete. Schedule delivery of concrete to provide consistent mix times from batching until discharge. Do not add water after a portion of the batch has been discharged.

When more than 1 concrete pump is used to place concrete, the Contractor must assign the pumps to receive colored concrete. The assigned pumps must receive only colored concrete throughout the concrete placement operation.

Use consistent finishing practices to ensure uniformity of texture and color.

The curing compound used for curing colored concrete surfaces must be clear or match the color of the colored concrete must be manufactured specifically for colored concrete. Do not use curing compounds containing calcium chloride. The time between completing surface finishing and applying curing compound must be the same for each colored concrete component.

Unless approved manufacturer's recommendations differ:

a. Apply color admixtures and dry shake additives at the manufacturers recommended dosage rate. This rate is to remain constant for all batches of concrete produced. Before placing concrete, protect adjacent surfaces and Structures from spatters. Once a portion of the batch has been placed, no additional water must be added to the remaining batch.
b. To integrally color the concrete, introduce the color additive into the mixer drum as recommended by the manufacturer. The quantity of concrete being delivered must be less than 1/3 the capacity of the mixer drum. Batch the concrete in full cubic yard increments.
c. After the concrete is placed, apply a color matching hardener evenly to the plastic surface by the dry shake method as recommended by the manufacturer.

Color Matching Joint Material:

When specified for any location, use a color matched caulking compound designed for joint sealing.

Install premolded resilient joint filler where the sidewalk line intersects a building, walk, permanent Structure or other location designated by the Engineer, to within 1 inch of the top of the slab. Caulk the top 1 inch of the joint with color matching caulking compound.

Test Panels:

Before the start of work, must show evidence of successful completion of similar installations. Construct a Job Site test panel for each individual color and pattern or combination of color and pattern specified in the Contract at least 10 Working Days before placing patterned and/or colored concrete. The test panels must be 5' x 5' minimum, and constructed at a location selected by the Engineer.

Construct as many test panels as necessary to produce sample panels that meet the approval of the Engineer. The permanent work must be consistent with the appearance of the approved test panels. The test panels must not be incorporated into the Work and must be disposed of under the Contract.

The approved test panel must be used as the standard of comparison in determining acceptability of concrete surfaces.

5-05.3(21) EXPOSED AGGREGATE CEMENT CONCRETE TREATMENT

Use exposed aggregate concrete when specified. Exposed aggregate finish on concrete surfaces must be as shown on the Drawings, the cement concrete Specifications of the Contract, and either Section 5-05 for flat work or Section 6-02 for Structures.

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Exposed aggregate cement concrete is defined as additional work necessary to expose aggregate on the surface of cement concrete.

Exposed aggregate is an architectural finish on concrete surfaces, it must not be used on new sidewalks, walkways, or any pedestrian access unless otherwise approved by SDOT. It may be used to repair existing exposed aggregate concrete sidewalks only. It may be used for vertical or sloped features and within architectural landscaping such as within traffic inlands.

Exposed Aggregate Finish:

Exposed aggregate architectural finish on concrete surfaces must conform to the details shown on the Drawings and these provisions:

1. If provided, the exposed aggregate finish must match the texture, color, and pattern of the referee panel or existing exposed aggregate surface. If provided, location of referee panel will be provided in the Contract documents.
2. The facing aggregate must match the variegated colors and color distribution found in the natural aggregates at the location provided in the Contract documents.
3. If cement concrete for exposed aggregate is to be colored, see Section 5-05.3(20).

Cast-in-place Concrete Surfaces; unless otherwise specified in the Contract:

Coarse aggregate for exposed aggregate finish for cast-in-place concrete surfaces must be river gravel, exclusive of crushed gravel and rock, conforming to the applicable course aggregate requirements of the cement concrete specified. The matrix of cement and fine aggregate must be removed from the surface of the concrete by water jetting, coarse brooming, abrasive blasting, or a combination of these procedures to expose coarse aggregates to a depth of approximately 1/4 inch to 1/2 inch from the formed or floated surface. Removal methods must not dislodge or loosen the coarse aggregate from embedment in the concrete matrix. At the option of the Contractor, a commercial quality, water-resistant set retarder manufactured for the intended use may be used. Exposed aggregate finish must have cement film, discoloring agents, dirt, dust, grease, loose concrete, and other foreign material removed and must be uniform in appearance.

Precast Concrete Surfaces; unless otherwise specified in the Contract:

Facing aggregate for exposed aggregate finish for precast concrete surfaces must be river gravel, exclusive of crushed gravel and rock, with maximum dimension of each rock between 2.5 inches and 5 inches. Precast panels may be cast with facing aggregate up or down on the casting bed, at the option of the Contractor. The aggregate facing mix must be separately prepared, applied to the form or fresh concrete, and its integrity maintained during the casting process, so that the facing is cast integrally with the concrete wall panel, and the entire panel is homogeneous and structurally monolithic. The facing rock must be placed finger width apart in a pattern of randomly distributed colors and sizes. Matrix must be removed from the front face of the panel to expose the facing aggregate to a depth of 1 inch to 1-1/2 inches. Exposed aggregate finish must have cement film, discoloring agents, dirt, dust, grease, loose concrete, and other foreign material removed and must be uniform in appearance.

Cast-in-place concrete surfaces with finish must be cured by the water method. Do not use seals and curing compounds.

Test Panels:

Before the start of work, the Contractor must show evidence of successful completion of similar installations. Construct a Job Site test panel for each individual exposed aggregate surface specified in the Contract at least 10 Working Days before placing exposed aggregate, and colored if applicable, concrete. The test panels must be 5 feet x 5 feet, minimum, and constructed at a location selected by the Engineer.

Construct as many test panels as necessary to produce sample panels that meet the approval of the Engineer. The permanent work must be consistent with the appearance of the approved test panels. The test panels must not be incorporated into the Work and must be disposed of under the Contract.

The approved test panel must be used as the standard of comparison in determining acceptability of concrete surfaces.

5-05.4 MEASUREMENT

Surfaces and base roadway cement concrete will be measured by the square yard for the completed pavement. The area is determined from measurements taken as listed below.

1. The width measurement is the width of the pavement shown on the typical cross-section in the Standard Plans or Drawings, additional widening where called for, or as otherwise specified in writing by the Engineer.
2. The length is measured along the center of each roadway or ramp.

If Bid Item is included in the Bid Form, dowel bar will be measured per each for the actual number of bars used in the completed Work, otherwise no measurement will be made.

If Bid Item is included in the Bid Form, Tie bar with drill hole will be measured per each for the actual number of bars used in the completed Work, otherwise no measurement will be made.

The calculation for Portland or hydraulic cement concrete compliance adjustment is the area of concrete represented by the composite pay factor for compressive strength and air content. A Deficiency Adjustment is applied independently for thickness deficiency adjustment.

Measurement for “Portland Cement Reduction Incentive/Disincentive Adjustment - Roadway” will be calculated based on the in-place quantity of all sidewalk, curb, driveway, alley, and roadway concrete. Depth is determined by the specified thickness, excluding thickened edges. Measurements will only be made when this Bid Item is included in the Bid Form.

Measurement for "Patterned Cement Concrete, (pattern)" will be by the square yard of area where imprinting tools are applied.

5-05.5 PAYMENT

1. **"Roadway Cement Concrete**, **Variable Mixes, (thickness)"**, per square yard
2. **"Roadway Cement Concrete, HES (time), (thickness)"**, per square yard
3. **"Roadway Cement Concrete**, **(thickness)"**, per square yard
4. **"Roadway Cement Concrete**, **W/25% pozzolans, (thickness)"**, per square yard
5. **"Roadway Cement Concrete Base**, **Variable Mixes, (thickness)"**, per square yard
6. **"Roadway Cement Concrete Base**, **HES (time), (thickness)"**, per square yard
7. **"Roadway Cement Concrete Base, (thickness)"**, per square yard
8. **"Roadway Cement Concrete Base**, **W/25% pozzolans, (thickness)"**, per square yard

The unit Contract price per square yard for "Roadway Cement Concrete" is full payment for all costs incurred to carry out the requirements of Section 5-05, except for those costs included in other items, which are included in this Section and are included in the Proposal. If no Bid Items for "Dowel Bar" and "Tie Bar with Drill Hole" are included in the Bid Form this work is included in the unit Contract price per square yard for "Roadway Cement Concrete"

9. **"Dowel Bar"**, per each,

The unit Contract price per each for "Dowel Bar" is full payment for furnishing, and installing dowel bars and any costs for drilling holes, placing dowel bars with baskets, furnishing and installing parting compound and all other costs associated with completing the installation of dowel bars.

10. **"Tie Bar with Drill Hole"**, per each.

The unit Contract price per each, "Tie Bar with Drill Hole" is full payment for furnishing, and installing tie bars and any costs for drilling holes, and all other costs associated with installation of tie bars.

11. **"Cement Concrete Compliance Adjustment"**, by calculation.

Payment for "Cement Concrete Compliance Adjustment" will be calculated by multiplying the unit Contract unit cost for the cement concrete Bid Items, times the areas for adjustment, times 100 percent less the percent of the composite pay factor (CPF), and subtract the Contract unit cost for the cement concrete, times the areas for adjustment, times the deficiency adjustment factor (DAF) listed in Section 5-05.5(2)A. Both of these adjustments will be negative amounts; thus deductions.

Adjustment =

Unit Price x quantity area[1] x (CPF-1)

+ Unit Price x quantity area[2] x DAF

Calculate for each area[1], (lot, sublot not included in a lot, and/or other areas as determined by the Engineer), and for each area[2] (primary units or secondary units as determined by the Engineer) where a thickness deficiency exists.

12. **"Patterned Cement Concrete Treatment**, **Roadway, (pattern)"**, per square yard.

The Bid Item price for "Patterned Cement Concrete" includes all costs for additional work as specified in Section 5-05.3(20) and necessary to imprint cement concrete with a pattern referenced in the Bid Item description.

5-05.5(1) MISCELLANEOUS ITEMS

All mix designs, submittals, plans, joints filling and saw cutting, cure boxes, curing, protection, and associated labor, materials, and equipment are included in associated Bid Items of work.

The cost of construction and removal of the test panels must be included in the Bid Item price for the specified exposed aggregate, colored, and/or imprinted cement concrete.

5-05.5(2) PAVEMENT THICKNESS

Cement concrete pavement must be constructed per the thickness requirements in the Drawings and Specifications. Tolerances allowed for subgrade construction and other Specifications, which may affect thickness, must not be construed to change such thickness requirements.

A primary unit of pavement is defined as the area of pavement placed in each Day's paving operations or a complete intersection. Within such primary unit of pavement there may be an area or areas that are deficient in thickness by more than 0.60 inch. The deficient area or areas will be defined as a secondary unit or units. If secondary units are found to exist, the primary unit area will be reduced by the secondary unit area included therein. At a time determined by the Engineer, thickness measurements will be made in each primary unit of pavement. Impact-echo tests or cores will be taken at the discretion of the Engineer. If taken, the exact location and number of thickness measurements within each primary unit, both longitudinally and transversely, will be determined by the Engineer. Tests will not be taken within 18 inches of joints

If thickness deficiencies greater than 0.60 inches are found to exist, supplemental thickness measurements will be made as specified in Section 5-05.5(2)B. Pavement thickness variations, if any, from the thickness requirements in the Drawings and Specifications will be determined by comparing the actual thickness measurement with the thickness specified at the measurement location. Such variation will be determined to the nearest 0.02 inches as either excess or deficient thickness.

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Additional impact-echo tests or cores may be requested by the Contractor to isolate the area of thickness deficiency. These impact-echo tests or cores will be used to create a secondary unit. All costs for the additional impact-echo tests or cores including grouting the core holes are borne by the Contractor.

If no impact-echo tests or core at taken by the Engineer for a primary unit, no "Deficiency Adjustment" will be made for that primary unit.

5-05.5(2)A THICKNESS DEFICIENCY ADJUSTMENT

If no thickness measurements in a primary unit are deficient by more than 0.60 inches plus 3 percent of the specified thickness when measured using the Impact-Echo Method per ASTM C-1383, or 0.60 inches when measured using the cores per AASHTO T 24 and AASHTO T 22, all thickness measurements in the primary unit will be averaged to the nearest 0.02 inches to determine the average thickness deficiency, if any. For the purpose of determining the average thickness deficiency, an excess thickness variation of more than 0.50 inches will be considered to be 0.50 inches greater than the specified thickness.

For each primary unit of pavement which is deficient in average thickness by not more than 0.60 inches plus 3 percent of the specified thickness when measured using the Impact-Echo Method, or 0.60 inches when measured using the cores, the Contractor must pay to the Owner, or the Owner may deduct from any moneys due or that may become due the Contractor under the Contract, a sum computed by multiplying the deficiency adjustment from the following table by the unit Contract price by the area of the primary unit.

Primary units for thickness measurements are independent of lot, sublots, or representative areas for compressive strength and air measurement. Determination of primary units, and secondary units, are determined by the Engineer.

Average Thickness Deficiency (inches) by Echo	Average Thickness Deficiency (inches) by Core	Deficiency Adjustment (per square yard)
<=0.10+(.03xD)	<=0.10	-0.02
>0.10+(.03xD) & <=0.20+(.03xD)	>0.10 & <=0.20	-0.04
>0.20+(.03xD) & <=0.30+(.03xD)	>0.20 & <=0.30	-0.09
>0.30+(.03xD) & <=0.40+(.03xD)	>0.30 & <=0.40	-0.16
>0.40+(.03xD) & <=0.50+(.03xD)	>0.40 & <=0.50	-0.25
>0.50+(.03xD) & <=0.60+(.03xD)	>0.50 & <=0.60	-0.36

NOTE: D = specified thickness (in)

5-05.5(2)B THICKNESS DEFICIENCY REJECTION

When a thickness deficiency greater than 0.60 inches is encountered, the Engineer will determine from supplemental thickness measurements the limits of the secondary unit area. Thickness measurements will be made in each panel of pavement adjacent transversely and longitudinally to the panel of the original measurement. This procedure will continue, regardless of unit boundaries, until such secondary unit area is bounded by panels with a thickness deficiency of 0.60 inches or less. Cores taken to isolate the secondary unit are not used to compute average thickness of the primary unit.

Panels are the areas bounded by longitudinal and transverse joints and pavement edges. If longitudinal or transverse joints are eliminated by the Contract, or for any other reasons, the limits of panels will be determined by the Engineer as if such joints had been constructed.

The secondary unit area will be made up of entire panels only. The entire panel will be considered to be of the thickness shown by measurement.

After the Engineer has determined the limits of the secondary unit area, a further determination will be made whether any panels within this area are usable and may be left in place. Following this determination, the Contractor must remove and replace all designated panels at no expense to the Owner, per the following:

1. If the area to be removed is not bounded by longitudinal or transverse joints, the Contractor must saw, at no expense to the Owner, weakened plane joints at the locations designated by the Engineer. The subgrade must be lowered to comply with the full thickness requirements. The replaced pavement will be tested for thickness with additional measurements and will be subject to all requirements of this Section.
2. Usable panels may be removed and replaced as outlined above at the option of the Contractor, or these panels will be permitted to remain in place, provided that no payment will be made for any panels left in place, and that a further penalty will be assessed in the amount of 25 percent of the Contractor’s unit Bid price for all such panels. The Owner may deduct such amount from any moneys due or that may become due the Contractor under the Contract.
3. The cost of all thickness measurements made to determine the secondary unit areas, including filling the core holes with concrete, will be deducted at the rate of $200.00 per core from any moneys due or that may become due the Contractor under the Contract.

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4. All additional Work required and any delay to the Contractor's operations as a result of this Specification are not cause for additional pay or extension of time.

SECTION 5-06 PERVIOUS CEMENT CONCRETE PAVEMENT

5-06.1 DESCRIPTION

Section 5-06 describes constructing pervious cementitious sidewalk, walkway, and alley pavement including excavation, subgrade preparation, separation geotextile, and aggregate discharge subbase or permeable ballast. The pavement section including subbase materials must allow surface water to permeate through the pervious surface into the supporting materials to allow infiltration or detention of surface waters.

5-06.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Material	Section
Portland Cement and Blended Hydraulic Cement	Section 9-01
Aggregate for Portland Cement Concrete	Section 9-03.1
Permeable Ballast, Mineral Aggregate Type 13	Section 9-03
Aggregate Discharge Subbase, Mineral Aggregate Type 24	Section 9-03
Premolded Joint Filler for Isolation Joints	Section 9-04.1(2)
Concrete Curing Materials, Pozzolans, and Admixtures	Section 9-23
Water	Section 9-25
Separation Geotextiles	Section 9-37

Synthetic fibers, if used, must conform to the requirements of Section 9-23.11. Dosage must be per fiber manufacturer's recommendations.

Cementitious materials are the following: Portland cement, blended hydraulic cement, fly ash, ground granulated blast furnace slag, microsilica, silica fume, and metakaolin.

Unless otherwise specified or shown on the Drawings, separation geotextile must be nonwoven and comply with the requirements of Tables 1 and 2 of Section 9-37.2 for "moderate survivability" and Class C.

5-06.3 CONSTRUCTION REQUIREMENTS

5-06.3(1) PERVIOUS CONCRETE PRECONSTRUCTION MEETING

Prior to the start of construction of the pervious concrete pavement section, including excavation of the pavement section, the Contractor must coordinate, schedule and attend a preconstruction meeting for the pervious concrete pavement. The following are required to attend the meeting:

1. Owner's representative
2. Contractor's representatives
3. Engineer of Record for the pervious concrete pavement
4. Concrete placement lead persons
5. Associated Subcontractor's representative
6. Pervious concrete Supplier's representative
7. Material testing Laboratory's representative

The meeting must cover all aspects of the work including, but not limited to:

a. Submittals;
b. Short and long term schedule;
c. Inspection of the Work;
d. Protection of the Work;
e. Subgrade Preparation Plan, see Section 2-09.3(6)A;
f. Pervious concrete placement;
g. Curing;
h. Materials;
i. Specifications;
j. Testing;

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k. Test panel and job mix formula; and
l. Acceptance criteria.

5-06.3(2) PERVIOUS CONCRETE MIX DESIGN

The Contractor must propose a mix design for pervious concrete and must submit the mix design to the Engineer for acceptance before constructing the test panels. Do not place pervious concrete in the test panels prior to the Engineer's approval of the mix design.

5-06.3(2)A MIX DESIGN CRITERIA

The Contractor must include the following elements and results of the described procedures in the proposed mix design:

1. A unique identification number for the mix design that is approved for the job mix formula.
2. Portland cement type. Must be Type I, Type II, Type I-II Type IP, or Type IS.
3. The cementitious content, including pozzolans if used, must be a minimum of 480 pounds per cubic yard.
4. The hydration stabilizing admixture used.
5. Synthetic microfibers, if used. Synthetic microfibers may be utilized at the manufacturer's recommended dosage rate.
6. The water/cement ratio. Must not exceed 0.35.
7. Percent of Portland cement replaced by fly ash, ground granulated blast furnace slag, or a combination of both. No more than 25 percent of Portland cement in the mix, by weight, may be replaced by fly ash, ground granulated blast furnace slag, or a combination of both.
8. Coarse Aggregate used. Coarse Aggregate must conform to Section 9-03.1(3), AASHTO Grading No.8.

5-06.3(2)B JOB MIX FORMULA (JMF)

The approved mix design established through the approved test panel becomes the job mix formula.

5-06.3(3) SUBMITTALS

As specified in Section 1-05.3, the Contractor must submit the following items to the Engineer for review and approval prior to placing any pervious concrete pavement or test panels:

1. The source of all materials proposed for use in constructing pervious concrete pavement.
2. Batch weights for all constituents of 1 cubic yard of the proposed pervious concrete mix.
3. The specific gravity (SSD) of all aggregates to be used in the proposed pervious concrete mix.
4. The proposed gradation of coarse aggregates used in pervious concrete.
5. The designed volume in cubic feet of all proposed components for 1 cubic yard of the proposed pervious concrete mix.
6. The design water/cement ratio of the proposed mix design.
7. The fresh density of the proposed pervious concrete mixture as determined by ASTM C1688.
8. The proposed gradation of aggregates to be used in the discharge subbase gravel.
9. Catalogue cuts and certificates of compliance for all proposed admixtures and synthetic fibers (if used).
10. Catalogue cuts and certificates of compliance for separation geotextiles.
11. Mill certification of the Portland cement and pozzolans, if used, for the current lot to be used in the production of the proposed pervious concrete mix. The Contractor must maintain this submittal throughout the duration of the project as lots change.
12. Current certifications by the National Ready Mix Concrete Association (NRMCA) for the batch plants to be used in the production of pervious concrete.
13. Current certifications by the NRMCA for the trucks to be used in transporting pervious concrete from the batch plant to the point of placement.
14. Qualification documentation for current certifications by the NRMCA for the Contractor's personnel who will be installing pervious concrete. See Section 5-06.3(10)A. Valid acceptable documentation is the NRMCA issued wallet card or certification certificate.
15. At the time of delivery of the material to the Project Site, the Contractor must provide an original certificate of compliance for each truckload of pervious concrete. The certificate of compliance must include information noted in Section 6-02.3(5)B. If the certificate of compliance from the concrete producer is not provided to the Engineer upon delivery, the truckload must not be placed.

5-06.3(4) EQUIPMENT

Equipment necessary for handling materials, mixing, delivering, and performing all parts of the Work, must be in good repair, designed for the task, and operated by trained and qualified personnel.

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5-06.3(4)A BATCHING PLANT

Pervious concrete must be mixed in a batch plant as specified in Section 6-02.3(4)A and 5-05.3(3)A.

5-06.3(4)B MIXER TRUCKS

Pervious concrete must be transported to the location by truck mixers, non-agitating trucks must not be used for the transport of pervious concrete. The drums on mixer trucks used to transport pervious concrete must have fins that are not excessively worn, damaged or have excessive concrete buildup. Mixer trucks must have a current NRMCA certification.

5-06.3(4)C SIDE FORMS

Pervious concrete must be constructed using stationary forms. If pervious concrete is to be placed against a curb, previously placed concrete, or other existing structure, they may be used as a side form for the pervious concrete paving. Forms for pervious concrete must be made of steel or wood and must be capable of being anchored in place so that they will be true to grade, line, and slope. Forms must be sufficiently rigid to maintain specified tolerances and capable of supporting concrete and mechanical concrete placing equipment. Forms must be in good condition, straight, clean, free of debris, non-adherent rust and hardened concrete.

Set, align, and brace forms so the hardened pavement meets the lines, grades and slopes as shown on the Drawings. Apply form-release agent to the form face, which will be in contact with concrete, immediately before placing concrete. Form release agent must not be applied to previously placed concrete. Previously placed pavement must be protected from damage.

The Contractor must inspect all forms for line, grade, and slope. Do not place pervious concrete until the forms are accepted by the Engineer.

5-06.3(4)D FINISHING EQUIPMENT

Finishing equipment for pervious concrete sidewalk paving must be designed for the intended work, clean, and in good operating condition.

Equipment used for striking off the pervious concrete must leave a smooth surface at the planned grades and must not cause excess paste to be left on, or drawn to, the surface. If rollers or spinning screeds are used to compact, they must be of sufficient weight and width to compact the pervious concrete uniformly through its depth and to grade without marring the surface. Equipment used for compacting pervious concrete must not cause the surface to close or otherwise clog and must produce a surface that is free of ridges or other imperfections. Tools used for producing joints must be designed and manufactured for the purpose and must not otherwise damage or mar the surface.

Vibrating equipment must not be used for placement or compaction of pervious concrete.

Tamps, hand finishing equipment, and tools for joints must be in good repair and adequate for the intended use.

5-06.3(5) MEASURING AND BATCHING MATERIALS

Measuring and batching Materials for pervious concrete pavement must conform to the requirements of Section 5-05.3(4)A.

5-06.3(6) ACCEPTANCE

For acceptance, pervious concrete pavement will be divided into lots as follows: A single lot is represented by the lesser of 1 Day's production or 360 square yards of pervious concrete in place. Each pervious concrete pavement with a unique design thickness must have its own lot. Where the Contractor has more than one crew placing pervious concrete, lots will be associated with each crew. Representative lot size will be determined to the nearest square yard. If no sample is taken on a Day, that Day's quantities may be included in the next or previous Day's lots. The Engineer may isolate an area of pervious concrete within a lot that is deemed to be defective in any way and such an area will be considered to be a new lot for purposes of acceptance. New lots determined in this manner must be extended as necessary such that they are bounded by planned joints. Acceptance of a lot of pervious concrete pavement will be based on the following criteria:

1. Grade: Conform to the dimensions, lines, slopes and grades specified on the plans. Pervious concrete pavement must be true to planned grades and must not deviate from grade more than 1/4 inch in 10 feet. Where abutting existing facilities such as sidewalks, walkway, curbs, driveways, or other pavements, the pervious concrete pavement must be flush.
2. Conformance to job mix formula: The pervious concrete used must conform to the mix design for the job mix formula within the limits as set forth in Section 6-02.3(5)C and as determined from the accepted test panel.
3. Compacted Thickness and Average Hardened Density: After a minimum of 7 Calendar Days of curing, remove and measure 3 cores from each lot. Remove cores in accordance with ASTM C42/C42M. Measure the length of each core in accordance with ASTM C1542/1542M. No single core may be less than 3/4 inch of the design depth on the Drawings. The average of all cores from a lot must be within minus 3/8 inch of the design depth on the plans.

   After length is measured, measure hardened density of each core in the lot in accordance with ASTM C1754/C1754M. The hardened density from a lot must be within +/- 5 percent of the average hardened density of the job mix formula (approved test panel).

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4. Infiltration Rate: The infiltration rate at any single test point must not be less than 100 inches per hour and tested per Section 5-06.3(6)A.
5. Fresh Density: The fresh density of each lot will be measured per ASTM C1688 at the point of placement, and must be within +/-5 pounds per cubic foot of the fresh density determined from the job mix formula (approved test panel).
6. Appearance: The appearance of each lot must be consistent with the job mix formula (approved test panel). The pervious concrete pavement must have a consistent surface texture, must not be raveled, must be free of ridges or other surface imperfections, must have joints that are in the specified location and are constructed per specification, and must be free of cracks.

Testing for acceptance will be performed by the Engineer.

5-06.3(6)A INFILTRATION RATE OF THE PLACED PAVEMENT

The infiltration rate of the pervious concrete will be tested at 4 random locations within each lot. The locations for conducting infiltration tests will be determined by the Engineer. The Contractor must coordinate and schedule testing with the Engineer a minimum of 5 Working Days in advance. The infiltration rate on the finished surface will be determined in accordance with ASTM C1701, except the infiltration ring diameter may be 12-inches to 24-inches in diameter. The infiltration test will be conducted after a minimum of 7 Calendar Days of curing has occurred.

If the measured infiltration rate is less than 100 inches/hour at any test location, the Contractor may request in writing that the Engineer perform additional infiltration tests for the purpose of assessing overall infiltration performance and/or determining a defective lot in accordance with Section 5-06.3(6). The determination of a defective lot, or lots, and the extents, will be by the Engineer. The cost of additional testing must be borne by the Contractor.

5-06.3(7) REJECTION

Pervious concrete may be rejected by the Contractor for any reason.

A truckload of pervious concrete will be rejected if the certificate of compliance is not provided at the time of delivery of the material to the site. See Section 5-06.3(3).

Pervious concrete that is improperly cured or is allowed to freeze during the initial 7 Day curing period will be rejected.

Pervious concrete pavement that does not meet the acceptance criteria put forth in Section 5-06.3(3) will be rejected by the Engineer on a lot by lot basis. At the discretion of the Engineer, a localized area of pervious concrete pavement not meeting the requirements of Section 5-06.3(6) may be broken into a sublot bounded by planned joints.

During the removal process of the rejected pavement, the Contractor must implement measures to protect the adjacent pervious concrete pavement to remain. If pervious concrete pavement becomes damaged by the Contractor during removal of the rejected pavement then additional pavement areas may be rejected by the Engineer to the next planned joint.

Fresh pervious concrete that has been rejected by the Engineer, or the Contractor, must not be placed, or must be removed and replaced, at no additional cost to the Owner.

5-06.3(8) MIXING PERVIOUS CONCRETE

Batch, mix, and deliver pervious concrete in compliance with ASTM C94/C94M except that pervious concrete must not be transit mixed or shrink mixed. If water is added to the mix after it is delivered on site, the fresh density for the pervious concrete must meet the requirements of the approved job mix formula referenced in this Section.

5-06.3(8)A LIMITATIONS OF MIXING PERVIOUS CONCRETE

Mixing and placing concrete must be discontinued when a descending air temperature in the shade away from artificial heat reaches 40° F and must not resume until an ascending air temperature in the shade and away from artificial heat reaches 40° F.

Mixing and placing pervious concrete must only occur when the ambient air temperature, as measured at the placement location away from the shade and away from artificial cooling sources, is less than 80° F.

The temperature of fresh pervious concrete must not be less than 55° F, nor more than 90° F when placed.

Aggregates for pervious concrete must not be less than 32° F prior to mixing. Do not use frozen aggregates.

5-06.3(9) SUBGRADE PREPARATION AND SUBBASE

Prepare and protect subgrade in accordance with Section 2-09.

Prepare and protect subbase Materials used in the pervious concrete pavement section in accordance with Section 4-04.

5-06.3(10) PLACING, SPREADING, FINISHING, EDGING, TOLERANCES, AND CURING

Pervious concrete must not be placed, compacted, or finished when the natural light is inadequate, unless an adequate lighting system is in operation. The adequacy of light will be determined by the Engineer.

Wet the surface of the subbase with water immediately before placing pervious concrete. Deposit concrete either directly from the transporting equipment or by conveyor on the subbase, unless otherwise specified. Pervious concrete must not be placed on frozen subbase. Deposit concrete between the forms to an approximately uniform height. Spread the concrete using mechanized equipment or hand tools. Vibrating equipment must not be used for spreading pervious concrete.

Strike off concrete between forms using a form-riding paving machine, roller screed, or spinning screed.

Compact concrete to a uniformly dense structure without clogging the surface with paste.

Finish the pervious concrete to a uniform, open-textured surface to match the appearance of the approved job mix formula test panel.

Edges must be hand tooled to a radius of 1/4 inch.

Curing materials for pervious concrete must be in place no more than 20 minutes after the discharge of the pervious concrete onto the subbase. The pavement surface and all exposed edges must be completely covered with sheet curing materials conforming to Section 9-23.1. The curing material must be secured at all exterior edges and interior laps without damaging the pervious concrete. The method of securing the curing material must prevent wind from removing the sheet and from blowing under the sheet across the surface of the concrete. Cure the pavement for a minimum of 7 consecutive Calendar Days.

All foot and vehicular traffic, staging, stockpiling, or other work must be kept off of the pervious concrete pavement during the curing period. Any testing for acceptance must not occur until the end of the curing period.

Protect concrete from freezing and cold weather in accordance with 5-06.3(12).

5-06.3(10)A CONTRACTOR'S QUALIFICATIONS

Unless otherwise specified, the Contractor must employ no less than 1 NRMCA certified Pervious Concrete Craftsman, who must be on-site overseeing each placement crew during all pervious concrete placement, or no less than 3 NRMCA certified Pervious Concrete Installers, who must be on the Job Site working as members of each placement crew during all pervious concrete placement, or no less than 3 NRMCA certified Pervious Concrete Technicians and 1 Pervious Concrete Installer, who must be on the Job Site working as members of each placement crew during all concrete placement. For those crews with NRMCA certified Pervious Concrete Technician personnel, the placement crew must also successfully pass a Performance Evaluation required under NRMCA Pervious Concrete Installer certification.

The pervious cement concrete sidewalk test panels installed at the Project Site may be used as the mock-up placement required for the NRMCA mock-up Performance Evaluation exam for Pervious Concrete Installer certification. If the mock up placement installed for NRMCA certification does not comply with the project Specifications, the mock up placement must be removed at the Contractor's expense and a new pervious concrete sidewalk test panels must be installed, tested, and submitted for acceptance.

Documentation of NRMCA certifications for the Contractor's personnel must be submitted as specified in Section 5-06.3(3) before proceeding with production placement of the pervious concrete sidewalks.

If, in the opinion of the Engineer, personnel used for installing pervious concrete sidewalk are unqualified, inattentive to quality, or unsafe, they must be removed or reassigned from installation of pervious concrete sidewalk.

5-06.3(10)B TEST PANELS

Production placement of pervious concrete must not start until the Contractor has completed a test panel of pervious concrete pavement that meets all acceptance criteria Specified in this Section and is accepted by the Engineer. The Contractor should allow time in their schedule for the construction and acceptance of the test panels.

The Contractor must construct a test panel of pervious concrete pavement utilizing 7 cubic yards of pervious concrete. If multiple pavement section depths are shown on the Drawings, a test panel must be constructed for each pavement section depth or thickness. The width of the test panel must have a width no smaller than the greatest width to be used during the construction and installation of the pervious concrete pavement. For sidewalks, the width of the test panel must be equal to the nominal width of the sidewalk to be placed. The test panel must include at least one joint and at the spacing specified on the drawings and specifications. Test panels may be placed non-contiguously. The test panels must be equivalent and representative of the production pervious concrete pavement in all aspects including subbase, depth, joints, method of placement, curing, and preparation. Construction and evaluation of the test panels must occur as follows:

1. Notify the Engineer at least 10 Working Days before installing pervious concrete test panels.
2. Coordinate the location of the test panels with the Engineer.
3. Install the test panels in accordance with the Specifications and Drawings.
4. Notify the Engineer when the test panel is ready for inspection and acceptance testing.
5. Acceptance testing will be conducted in accordance with Section 5-06.3(6).
6. Remove, replace, and dispose of any unsatisfactory portions of test panels as determined by the Engineer and at no additional cost.

Failure to install acceptable test panels of pervious concrete will indicate unapproved test panels and require new test panels for review.

The completed and approved test panels will establish the job mix formula.

The approved test panel must meet the requirements of Section 5-06.3(6).

Upon successful completion of the infiltration test, unless otherwise determined by the Engineer, 3 cores will be cut in accordance with ASTM C42 and will be used to validate the mix design under the acceptance criteria of Section 5-06.3(6), except that a minimum of 3 infiltration tests must be conducted for the test panel. Cores must be taken at the same location

where the infiltration test was conducted. The average hardened density of the cores must be the hardened density used for the job mix formula. The hardened density of each core used for determining the job mix formula must be within 5 percent of the mean value of the three cores. Core holes must be filled by the Contractor with pervious concrete meeting the proposed job mix formula and must match adjacent pavement color, texture and grade.

The completed and accepted test panels must be maintained and protected throughout the duration of the Work and may not be demolished and disposed of without written permission from the Engineer. If the test panels are incorporated into the Work, they must remain in place accepted as a single lot.

5-06.3(11) JOINTS

Construct joints at the locations, depths, and with horizontal dimensions shown on the Drawings unless noted otherwise in this Section. Joints may be of 3 types: construction, contraction, or isolation. Construction joints must be formed at the end of a Day's work or when necessary to stop production for any reason. Use contraction joints to control random cracking. Use isolation joints where the pervious concrete abuts existing facilities or where shown on the Drawings.

5-06.3(11)A CONSTRUCTION JOINTS

Construction joints must be located as near as possible to the location of a planned contraction or isolation joint. Construction joints are formed by placing a header between the forms, at right angles, to the full depth of the finished pervious concrete, and set to the height of the forms. Pervious concrete must be placed against the header and compacted and finished as normal, including edging. The header must remain in place until paving resumes

5-06.3(11)B CONTRACTION JOINTS

Contraction joints, both transverse and longitudinal, must be constructed at the locations and intervals specified in the Contract. Contraction joints must be a depth of 1/3 the thickness of the pervious concrete pavement section and have a width of no more than 1/4 inch. Plastic formed contraction joints must be tooled on both sides of the joint with a radius of 1/2 inch. Tool joint to the depth and width in fresh concrete immediately after the concrete is compacted. Contraction joints must not be sawcut unless specifically noted on the Drawings. Sawcut joints must have a minimum width of 1/8 inch. Contractor must implement measures to protect the pervious concrete pavement from clogging from the sawcutting slurry that is generated.

5-06.3(11)C ISOLATION JOINTS

Isolation joints must be placed where the pervious concrete abuts existing Structures or where shown on the Drawings, except where pervious concrete sidewalk abuts back of curb. Isolation joints must continue through the depth of the pervious concrete using a 3/8-inch premolded joint filler. Isolation joints may be formed by inserting the premolded joint filler into the plastic concrete or by forming a construction joint, affixing the premolded joint filler against one side of the joint, and placing fresh pervious concrete against it. Isolation joints and filler must be flush with the surrounding pervious concrete and must not deviate from the acceptance criteria for smoothness as specified in Section 5-06.3(6). The edges of the pervious concrete on either side of the premolded joint filler must be hand tooled with a 1/2-inch radius.

5-06.3(12) COLD WEATHER WORK

When concrete is being placed and the ambient air temperature is expected to drop below 40° F during the day or night, the Contractor must, at no expense to the Owner, protect the concrete from freezing. The Contractor must submit for approval a Cold Weather Plan before placing concrete when ambient air temperature below 40° F is anticipated or when requested by the Engineer. When a Cold Weather Plan is required, pervious concrete must not be placed without an approved Cold Weather Plan.

Under the Cold Weather Plan, the Contractor must, at no expense to the Owner, provide a sufficient supply of straw, hay, blankets, or other suitable blanketing material and spread it over the pavement to a sufficient depth to prevent freezing of the concrete. The blanket material must be placed on top of the sheet curing materials and covered with a layer of burlap or plastic sheeting, weighted or anchored to prevent the wind from displacing the insulation. The temperature of the pervious concrete must not be allowed to drop below 55° F during the cure period. The Engineer may require recording thermometers if daytime temperature is below 50° F. The curing period may be extended by the Engineer if the pervious concrete temperature has been allowed to drop below 55° F.

The cold weather protection must be maintained for 7 Days. Pervious concrete that has frozen during this period will be rejected.

The Contractor is responsible for the quality of the cured concrete. Any concrete injured by frost action or freezing must be removed and replaced at the Contractor's expense as specified in this Section.

5-06.3(13) PROTECTION OF PERVIOUS CONCRETE SIDEWALK

As part of the CSECP, rain runoff, surface water of any kind, and sediment must be prevented from entering the area of pervious pavement construction, including excavation, until the pervious concrete application has cured, testing is completed, the Engineer has determined that the pervious concrete meets specifications, the adjacent areas that sheet flow/drain onto the pervious pavement are permanently stabilized from erosion, and plantings are established.

Do not open alley pavement to foot or vehicular traffic until the concrete has cured for at least 7 uninterrupted Calendar Days, testing has been completed, and the pavement has been accepted by the Engineer.

Do not open sidewalk pavement to foot traffic until the concrete has cured for at least 7 uninterrupted Calendar Days, testing has been completed, and the pavement has been accepted by the Engineer.

The Contractor must protect the pervious concrete pavement from damage, including the introduction of foreign materials to the surface, throughout the course of the Work. Pervious concrete pavement that is damaged or has been adversely impacted by the introduction of foreign materials must be remediated to the satisfaction of the Engineer or rejected and must be replaced to the nearest joint.

5-06.4 MEASUREMENT

Measurement for "Pervious Concrete Sidewalk" will be by the square yard for the surface of pervious concrete walk placed. Deduction will be made for blocked out areas, castings, or other discontinuities in the sidewalk 9 square feet or larger.

Measurement for "Pervious Concrete Pavement" will be by the square yard for the surface of pervious concrete pavement. Deduction will be made for blocked out areas, castings, or other discontinuities in the pavement 9 square feet or larger.

5-06.5 PAYMENT

1. **"Pervious Concrete Sidewalk"**, per square yard.

The Bid Item price for "Pervious Concrete Sidewalk" includes all costs for the work required to construct the pervious concrete sidewalk as specified in this Section, including performing mix designs, testing, excavation, and subgrade preparation, and furnishing and installing pervious concrete.

Payment of the volume of earthwork involved in excavating Material above the top surface of the sidewalk will be made as specified in Section 2-04.5 for common excavation.

2. **"Pervious Concrete Pavement"**, per square yard.

The Bid Item price for "Pervious Concrete Pavement" includes all costs for the work required to construct the pervious concrete pavement as specified in this Section, including performing mix designs, testing, excavation, and subgrade preparation, and furnishing and installing pervious concrete.

Payment of the volume of earthwork involved in excavating Material above the top surface of the pavement will be made as specified in Section 2-04.5 for common excavation.

END OF DIVISION

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DIVISION 6 STRUCTURES

SECTION 6-01 GENERAL REQUIREMENTS - STRUCTURES

6-01.1 DESCRIPTION

Section 6-01 describes structural and incidental items used in any or all types of existing or proposed Structures. These provisions supplement the detailed Specifications supplied for any Structure. These provisions apply only when relevant and when they do not conflict with the Contract.

6-01.2 FOUNDATION DATA

If obtained, foundation data in the Contract (from test borings, test pits, or other sources) are only to guide the Owner in planning and designing the project. These data reasonably represent the information at the test sites when the investigations were made, see Section 1-02.4(2).

6-01.3 CLEARING THE SITE

The Contractor must clear the entire Job Site of the proposed Structure to the limits shown on the Drawings or determined by the Engineer.

6-01.4 APPEARANCE OF STRUCTURES

To achieve a more pleasing appearance, the Engineer may require the Contractor to adjust the height and alignment of bridge railings, traffic barrier, and structural curbs.

6-01.5 LOAD RESTRICTIONS ON BRIDGES UNDER CONSTRUCTION

Bridges under construction must remain closed to all traffic, including construction equipment, until the substructure and the superstructure, through the bridge deck, are complete for the entire Structure, except as provided here. Completion includes release of all falsework, removal of all forms, and attainment of the minimum design concrete strength and specified age of the concrete per these Specifications. Once the Structure is complete, Section 1-07.7 must governs all traffic loading, including construction traffic and equipment.

If necessary and safe to do so, and if the Contractor requests it in writing, the Engineer may approve traffic on a bridge before completion. The maximum distributed load at each construction equipment support must not exceed the design load by more than 33 percent. The written request must:

1. Describe the extent of the Structure completion at time of the proposed equipment loading.
2. Describe the loading magnitude, arrangement, movement, and position of traffic (equipment) on the bridge, including but not limited to:
    a. Location of construction equipment, including outriggers, spreader beams, and supports for each, relative to the bridge framing plan (bridge girder layout).
    b. Mechanism of all load transfer (load path) to the bridge.
3. Provide stress calculations per AASHTO LRFD Bridge Design Specifications, current edition design criteria, prepared by, or under the direction of, a professional engineer, licensed under Title 18 RCW State of Washington, and carrying the professional engineer's signature and seal, including but not limited to the following:
    a. Supporting calculations showing the flexural and shear stresses in the main load carrying members due to the construction load are within the allowable stresses.
    b. Supporting calculations showing the flexural and shear stresses in the bridge deck due to the construction load are within the allowable stresses.
4. Provide supporting material properties, catalogue cuts, and other information describing the construction equipment and all associated outriggers, spreader beams, and supports.
5. State that the Contractor assumes all risk for damage.

6-01.6 NAVIGABLE STREAMS

The Contractor must keep navigable streams clear so water traffic may pass safely, providing and maintaining all lights and signals required by the U.S. Coast Guard. The Contractor must also comply with all channel depth and clearance line requirements of the U.S. Corps of Engineers. This may require removing material deposited in the channel during construction.

6-01.7 APPROACHES TO MOVABLE SPANS

No bridge deck or sidewalk slab on the approach span at either end of a movable span may be placed until after the movable span has been completed, adjusted, and closed.

6-01.8 WORKING DRAWINGS

The Contractor must submit supplemental structural Shop Drawings as specified in Section 1-05.3(3) and Section 1-05.3(11).

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6-01.9 NAME PLATES

The Contractor must not install permanent plates or markers on a Structure unless the Drawings show it.

6-01.10 FINAL CLEANUP - STRUCTURE

When the Structure is completed, the Contractor must leave it and the entire Job Site in a clean and orderly condition. Structure decks must be swept and washed. Temporary buildings, falsework, piling, lumber, equipment, and debris must be removed. The Contractor must level and fine grade all excavated material not used for backfill, and must fine grade all slopes and around all piers, bents, and abutments. This clean-up work includes the Specifications of Section 1-04.10.

6-01.11 ARCHITECTURAL FEATURES

To ensure uniform texture and color, the Contractor must obtain all cement for the Structure from the same manufacturing plant unless the Engineer waives this requirement in writing.

6-01.12 PREMOLDED JOINT FILLER

When the Drawings call for premolded joint filler, the Contractor must fasten it with galvanized wire nails to one side of the joint. The nails must not be more than 6 inches apart and must be 1-1/2 inches from the edges over the entire joint area. The nails must be at least 1-1/2 inches longer than the thickness of the filler.

The Contractor may substitute for the nails any adhesive approved by the Engineer. This adhesive, however, must be compatible with the Material specified in Section 9-04.1(2) and capable of bonding the filler to Portland cement concrete.

6-01.13 NORMAL TEMPERATURE

Bridge Drawings state dimensions at a normal temperature of 64 ºF. Unless otherwise noted, these dimensions are horizontal or vertical.

6-01.14 MAINTENANCE OF BRIDGE DRAINS

Unless measures are necessary to prevent construction stormwater discharge, the Contractor must keep existing and new bridge drains open and functioning during construction. Before bridge drain work starts, the Contractor must verify existing drains are clear and free flowing, and if not, must immediately notify the Engineer. Maintenance includes keeping drains clean, free of debris, and free flowing. During the construction, drainage must be addressed per the applicable Construction Stormwater Pollution Prevention Plans (Section 8-01). Before acceptance of the bridge drains, the existing and new bridge drains must be tested for drainage, and clogged or non-flowing drains must be cleaned and cleared to a free flowing state acceptable to the Engineer.

SECTION 6-02 CEMENT CONCRETE STRUCTURES AND CEMENT CONCRETE FOR MISC WORK

6-02.1 DESCRIPTION

Section 6-02 describes the construction of all Structures and their parts made of cement concrete with or without reinforcement, including bridge approach slabs. Any part of a Structure to be made of other materials must be built as these Specifications require elsewhere. This Section also provides cement concrete requirements for miscellaneous Work by reference.

6-02.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Material	Section
Portland Cement and Blended Hydraulic Cement	Section 9-01
Aggregates for Portland Cement Concrete	Section 9-03.1
Pit Run Sand, Washed Sand, and Gravel Backfill	Section 9-03.10
Joint and Crack Sealing Materials	Section 9-04
Reinforcing Steel	Section 9-07
Epoxy-Coated Reinforcing Steel	Section 9-07
Pigmented Sealer Materials for Coating of Concrete Surface	Section 9-08.3
Prestressed Concrete Girders	Section 9-19
Grout	Section 9-20.3
Mortar	Section 9-20.4
Concrete Curing Materials, Pozzolans and Admixtures	Section 9-23
Fly Ash	Section 9-23.6
Ground Granulated Blast Furnace Slag (GGBFS)	Section 9-23.7

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Material	Section
Microsilica Fume	Section 9-23.8
Metakaolin	Section 9-23.9
Plastic Waterstop	Section 9-24
Water	Section 9-25
Elastomeric Bearing Pads	Section 9-35

6-02.3 CONSTRUCTION REQUIREMENTS

6-02.3(1) CLASSIFICATION OF STRUCTURAL CONCRETE

The class of concrete to be used must be as noted in the Drawings and these Specifications. The class includes the specified minimum compressive strength in psi at 28 days (numerical class) and may include a letter suffix to denote structural concrete for a specific use. Letter suffixes include A for bridge approach slabs, D for bridge decks, P for piling and shafts, and W for underwater. The numerical class without a letter suffix denotes structural concrete for general purposes.

Concrete of a numerical class greater than 4000 must conform to the requirements specified for either Class 4000 if general-purpose, or for the appropriate Class 4000 with a letter suffix, as follows:

1. Mix ingredients and proportioning specified in Sections 6-02.3(2) and 6-02.3(2)A.
2. Consistency requirements specified in Section 6-02.3(4)C.
3. Curing requirements specified in Section 6-02.3(11).

The Contractor may request, in writing, permission to use a different class of concrete with either the same or a higher compressive strength than specified. The substitute concrete must be evaluated for acceptance based on the specified class of concrete. The Engineer will respond in writing. The Contractor must bear any added costs that result from the change.

The phrase "w/ ___% minimum pozzolans" under the class of concrete and any designation identifies a minimum use of Pozzolans (fly ash and/or ground granulated blast furnace slag) not exceeding 40 percent is required. Ground granulated blast furnace slag and fly ash maximums must not be exceeded individually. See table Cementitious Requirement for Concrete in Section 6-02.3(2).

6-02.3(2) PROPORTIONING MATERIALS

The soluble chloride ion content is determined by the concrete Supplier and included with the mix design. The soluble chloride ion content is determined by (1) testing mixed concrete cured at least 28 Days or (2) totaled from tests of individual concrete ingredients (cement, aggregate, admixtures, water, fly ash, ground granulated blast furnace slag, and other supplementary cementing materials). Chloride ion limits for admixtures and water are in Section 9-23 and Section 9-25. Soluble chloride ion limits for mixed concrete must not exceed the following percent by mass of cement when tested per AASHTO T260:

Category	Acid-Soluble	Water-Soluble
Prestressed concrete	0.08	0.06
Reinforced concrete	0.10	0.08

Unless otherwise specified, the Contractor must use Type I or II Portland cement in all concrete as defined in Section 9-01.2(1).

The use of fly ash is required for Class 4000D and 4000P concrete. Ground granulated blast furnace slag may be substituted for fly ash at a 1:1 ratio. The use of fly ash and ground granulated blast furnace slag is optional for all other classes of concrete and may be substituted for Portland cement at a 1:1 ratio as noted in the table below.

Cementitious Requirement for Concrete

Class of Concrete	Minimum Pounds of Cementitious Material per Cubic Yard	Minimum Percent Replacement of Pozzolans for Portland Cement	Maximum Percent Replacement of Fly Ash for Portland Cement	Maximum Percent Replacement of Ground Granulated Blast Furnace Slag for Portland Cement
6000	658	0[1]	35	40
5000	611	0[1]	35	40
4000	564	0[1]	35	50
4000A	564	0[1]	20	30

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Class of Concrete	Minimum Pounds of Cementitious Material per Cubic Yard	Minimum Percent Replacement of Pozzolans for Portland Cement	Maximum Percent Replacement of Fly Ash for Portland Cement	Maximum Percent Replacement of Ground Granulated Blast Furnace Slag for Portland Cement
4000D	660	10[1]	20	30
4000P	600	15[1]	35	50
4000W	564	0[1]	35	50
3000	564	0[1]	35	50
Commercial Concrete	N/A	0	35	50
Lean Concrete	145[2]	0	35	50

NOTES:

1. Unless otherwise specified in Bid Item.
2. Maximum of 200 pounds.

When both ground granulated blast furnace slag and fly ash are included in the concrete mix, the total weight of both these materials is limited to 40 percent by weight of the total cementitious material.

The water-cement ratio must be calculated on the total weight of cementitious material. The following are considered cementitious materials: Portland cement, fly ash, ground granulated blast furnace slag, microsilica fume and metakaolin. With the Engineer's written approval, microsilica fume and metakaolin can be used in all classifications of Class 4000, Class 3000, and commercial concrete and is limited to a maximum of 10 percent of the cementitious material.

As an alternative to fly ash, ground granulated blast furnace slag and cement as separate components, a blended hydraulic cement that meets the requirements of Section 9-01.2(3) may be used.

6-02.3(2)A CONTRACTOR MIX DESIGN

The Contractor must provide a mix design in writing to the Engineer for all classes of concrete specified in the Drawings except for those accepted based on a certificate of compliance. Do not place concrete until the Engineer has reviewed the mix design. The required average 28 Day compressive strength must be selected per ACI 318, Chapter 5, Section 5.3.2. ACI 211.1 and ACI 318 must be used to determine proportions. All proposed concrete mix must comply with the cementitious material requirements listed in the table titled Cementitious Requirement for Concrete in Section 6-02.3(2).

The Contractor's submittal of a mix design must be per Section 1-05.3 and must provide a unique identification for each mix design. Each mix design must include the mix proportions per cubic yard, the proposed sources, the average 28 Day compressive strength, the fineness modulus, and the water-cement ratio. The Contractor is responsible for concrete placeability, workability, and strength. The Contractor must notify the Engineer in writing of any mix design modifications.

Fine aggregate must conform to Section 9-03.1(2) Class 1 or Class 2.

Coarse aggregate must conform to Section 9-03.1(3). An alternate combined aggregate gradation conforming to Section 9-03.1(4) may also be used. The nominal maximum size aggregate for Class 4000P must be 3/8 inch. The nominal maximum size aggregate for Class 4000D must be 1 inch. The nominal maximum size aggregate for Class 4000A must be 1 inch.

Nominal maximum size for concrete aggregate is defined as the smallest standard sieve opening through which the entire quantity of the aggregate is permitted to pass.

Class 4000D and 4000P concrete must include a water reducing admixture in the quantity recommended by the manufacturer. A retarding admixture is required in concrete Class 4000P. Water reducing and retarding admixtures are optional for all other concrete classes.

A high-range water reducer (superplasticizer) may be used in all mix designs. Microsilica fume may be used in all mix designs. The use of a high-range water reducer or microsilica fume must be submitted as a part of the Contractor's concrete mix design.

Air content must be a minimum of 4.5 percent and a maximum of 7.5 percent for all concrete placed above the finished groundline.

6-02.3(2)B COMMERCIAL CONCRETE

Commercial concrete must have a minimum compressive strength at 28 Days of 3000 psi per AASHTO T 22. Commercial concrete placed above the finished groundline must be air entrained and have an air content from 4.5 percent to 7.5 percent per AASHTO T 152. Commercial concrete does not require plant approval, mix design, or source approvals for cement, aggregate, and other admixtures.

Where concrete Class 3000 is specified for items such as culvert headwalls, plugging culverts, concrete pipe collars, pipe anchors, thrust blocks, monument cases, light standard foundations, pedestals, cabinet bases, guardrail anchors, signpost foundations, fence post footings, sidewalks, curbs, and gutters, the Contractor may use commercial concrete. If commercial concrete is used for sidewalks, curbs, and gutters, it must have a minimum cementitious material content of 564 pounds per

cubic yard of concrete, must be air-entrained, and the tolerances of Section 6-02.3(5)C must apply. Commercial concrete must not be used for items such as bridges, retaining walls, box Culverts, curb walls, stairs, or foundations for high mast luminaires, mast arm traffic signals, cantilever signs, and sign bridges. The Engineer may approve the use of commercial concrete for other applications not listed above.

6-02.3(2)C LEAN CONCRETE

Lean concrete must contain between 145 and 200 pounds of cement per cubic yard and have a maximum water-cement ratio of 2:1.

6-02.3(3) ADMIXTURES

Concrete admixtures must be added to the concrete mix when batching the concrete or per the manufacturer's written procedure and as approved by the Engineer. A copy of the manufacturer's written procedure must be furnished to the Engineer before use of any admixture. Any deviations from the manufacturer's written procedures must be submitted to the Engineer for acceptance as specified in Section 1-05.3. Admixtures must not be added to the concrete with the modified procedures until the Engineer has accepted them in writing.

When the Contractor is proposing to use admixtures from different admixture manufacturers, they must provide evidence to the Engineer that the admixture will be compatible and not adversely affect the air void system of the hardened concrete. Test results complying with ASTM C 457 must be provided as the evidence to satisfy this requirement. Proposed combinations must comply with this requirement.

Do not use accelerators.

Do not use air entrained cement to air entrain concrete.

6-02.3(4) READY-MIX CONCRETE

All concrete, except commercial concrete and lean concrete must be batched in a prequalified manual, semi-automatic, or automatic plant as specified in Section 6-02.3(4)A. The Engineer is not responsible for any delays to the Contractor due to problems in getting the plant certified.

6-02.3(4)A QUALIFICATION OF CONCRETE SUPPLIERS

Batch Plant Prequalification may be obtained through one of the following methods:

1. Certification by the National Ready Mix Concrete Association (NRMCA): Information concerning NRMCA certification may be obtained from the NRMCA at 900 Spring Street, Silver Springs, MD 20910 or online at http://www.nrmca.org/. The NRMCA certification must be good for a 2-year period. When this method of certification is used the following documentation must be submitted to the Engineer:
    a. A copy of the current NRMCA Certificate of Conformance, the concrete mix design, along with copies of the truck list, batch plant scale certification, admixture dispensing certification, and volumetric water batching devices (including water meters) verification.
2. Independent evaluation certified by a Professional Engineer using NRMCA checklist. The Professional Engineer must be licensed under title 18 RCW, State of Washington, qualified in civil engineering. The independent certification using the NRMCA checklist must be good for a 2 year period. When this method of certification is used the following documentation must be submitted to the Engineer.
    a. A copy of the Professional Engineer's stamped and sealed NRMCA Verification of Inspection and Application for Certificate page from the NRMCA checklist, the concrete mix design, along with copies of the truck list, batch plant scale certification, admixture dispensing certification, and volumetric water batching devices (including water meters) verification.
3. Inspection conducted by the Plant Manager, defined as the person directly responsible for the daily plant operation, using the NRMCA Plant Certification checklist. The Plant Manager certification must be done before the start of a project, and every 6 months throughout the life of the project, and comply with the following requirements:
    a. The Agreement to Regularly Check Scales and Volumetric Batching Dispensers page in the NRMCA Plant Certification checklist must be signed by the Plant Manager and notarized.
    b. The signed and notarized Agreement to Regularly Check Scales and Volumetric Batching Dispensers page and a copy of the NRMCA Plant Certification checklist cover page showing the plant designation, address, and Company operating plant must all be submitted to the Engineer with the concrete mix design, along with copies of the truck list, batch plant scale certification, admixture dispensing certification, and volumetric water batching devices (including water meters) verification.
    c. The NRMCA Plant Certification checklists must be maintained by the Plant Manager and are subject to review at any time by the Owner.
    d. Volumetric water batching devices (including water meters) must be verified every 90 Days.

For central-mixed concrete, the mixer must be equipped with a timer that prevents the batch from discharging until the batch has been mixed for the prescribed mixing time. A mixing time of 1 minute is required after all materials and water have been introduced into the drum. Shorter mixing time may be allowed if the mixer performance is tested per AASHTO M 157

Annex A1 Concrete Uniformity Requirements. Tests must be conducted by an independent testing lab or by a commercial concrete producer's lab. If the tests are performed by a producer's lab, the Engineer or a representative will witness all testing.

For shrink-mixed concrete, the mixing time in the stationary mixer must not be less than 30 seconds or until the ingredients have been thoroughly blended.

For transit-mixed or shrink-mixed concrete, the mixing time in the transit mixer must be a minimum of 70 revolutions at the mixing speed designated by the manufacturer of the mixer. Following mixing, the concrete in the transit mixer may be agitated at the manufacturer's designated agitation speed. A maximum of 320 revolutions (total of mixing and agitation) will be permitted before discharge.

All transit-mixers must be equipped with an operational revolution counter and a functional device for measurement of water added. All mixing drums must be free of concrete buildup and the mixing blades must comply with the minimum specifications of the drum manufacturer. A copy of the manufacturer's blade dimensions and configuration must be on file at the concrete producer's office. All clearly visible metal data plates attached to each mixer and agitator must display the maximum concrete capacity of the drum or container for mixing and agitating and the rotation speed of the drum or blades for both the agitation and mixing speeds. Mixers and agitators must always operate within the capacity and speed-of-rotation limits set by the manufacturer. Any mixer, when fully loaded, must keep the concrete uniformly mixed. All mixers and agitators must be capable of discharging the concrete at a steady rate. Only those transit-mixers which comply with the above requirements will be allowed to deliver concrete to any Owner project covered by these Specifications.

In transit-mixing, mixing must start within 30 seconds after the cement is added to the aggregates.

Central-mixed concrete, transported by truck mixer/agitator, must not undergo more than 250 revolutions of the drum or blades before discharging. To remain below this limit, the suppler may agitate the concrete intermittently within the prescribed time limit. When water or admixtures are added after the load is initially mixed, an additional 30 revolutions will be required at the recommended mixing speed.

For each project, at least biannually, or as required, the Plant Manager will examine mixers and agitators to check for any buildup of hardened concrete or worn blades. If this examination reveals a problem, or if the Engineer wishes to test the quality of the concrete, slump tests may be performed with samples taken at approximately the 1/4 and 3/4 points as the batch is discharged. The maximum allowable slump difference must be as follows:

If the average of the 2 slump tests is < 4 inches, the difference must be < 1 inch or if the average of the 2 slump tests is >4 inches, the difference must be < 1-1/2 inches.

If the slump difference exceeds these limits, the equipment must not be used until the faulty condition is corrected. However, the equipment may continue in use if longer mixing times or smaller loads produce batches that pass the slump uniformity tests.

All concrete production facilities will be subject to verification inspections at the discretion of the Engineer. Verification inspections are a check for current scale certifications, accuracy of water metering devices, accuracy of the batching process, and verification of coarse aggregate quality.

If the concrete producer fails to pass the verification inspection, the following actions will be taken:

a. For the first violation, a written warning will be provided.
b. For the second violation, the Engineer will provide written notification and the Owner will assess a price reduction equal to 15 percent of the invoice cost of the concrete supplied from the time of the infraction until the deficient condition is corrected.
c. For the third violation, the concrete Supplier is suspended from providing concrete until all such deficiencies causing the violation have been permanently corrected and the plant and equipment have been reinspected and meet all prequalification requirements.
d. For the fourth violation, the concrete Supplier must be disqualified from supplying concrete for 1 year from the date of disqualification. At the end of the suspension period the concrete Supplier may request the facilities be inspected for prequalification.

6-02.3(4)B JOB SITE MIXING

For small quantities of concrete, the Contractor may mix concrete on the Job Site provided the Contractor has requested in writing and received written permission from the Engineer. The Contractor's written request must include a mix design, batching and mixing procedures, and a list of the equipment performing the Job Site mixing. All Job Site mixed concrete must be mixed in a mechanical mixer.

If the Engineer permits, hand mixing of concrete will be permitted for pipe collars, pipe plugs, fence posts, or other items approved by the Engineer, provided the hand mixing is done on a water tight platform in a way that distributes materials evenly throughout the mass. Mixing must continue long enough to produce a uniform mixture. Hand mixed batches must not exceed 1/2 cubic yard.

Concrete mixed at the Job Site is never permitted for placement in water.

6-02.3(4)C CONSISTENCY

The maximum slump for concrete is:

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1. 3.5 inches for vibrated concrete placed in all bridge decks, bridge approach slabs, and flat slab bridge superstructures.
2. 4.5 inches for all other vibrated concrete.
3. 7 inches for non-vibrated concrete (includes Class 4000P and 4000W).
4. 9 inches for shafts when using Class 4000P, provided the water-cement ratio does not exceed 0.44 and a water reducer is used meeting the requirements of Section 9-23.4.

When a high range water reducer is used, the maximum slump listed in 1, 2 and 3 above may be increased an additional 2 inches.

6-02.3(4)D TEMPERATURE AND TIME FOR PLACEMENT

Concrete temperatures must remain between 55 °F and 90 °F while it is being placed. Precast concrete that is heat cured per Section 6-02.3(25)D must remain between 50 °F and 90 °F while being placed. The batch of concrete must be discharged at the Project Site no more than 1-1/2 hours after the cement is added to the concrete mixture. The time to discharge may be extended to 1-3/4 hours if the temperature of the concrete being placed is less than 75 °F. With the approval of the Engineer and as long as the temperature of the concrete being placed is below 75 °F, the maximum time to discharge may be further extended to 2 hours. When conditions are such that the concrete may experience an accelerated initial set, the Engineer may require a shorter time to discharge. The time to discharge may be extended upon written request from the Contractor. This discharge time extension will be considered case by case and requires the use of specific retardation admixtures and the approval of the Engineer.

6-02.3(5) ACCEPTANCE OF CONCRETE

6-02.3(5)A GENERAL

Lean concrete and commercial concrete will be accepted based on a certificate of compliance to be provided by the Supplier as specified in Section 6-02.3(5)B.

All other concrete will be accepted based on conformance to the requirement for temperature, slump, air content for concrete placed above finished groundline, and the specified compressive strength at 28 Days for sublots as tested and determined by the Owner.

A sublot is defined as the material represented by an individual strength test. An individual strength test is the average compressive strength of cylinders from the same sample of material.

Each sublot will be deemed to have met the specified compressive strength requirement when both of the following conditions are met:

a. Individual strength tests do not fall below the specified strength by more than 12.5 percent or 500 psi, whichever is least.
b. An individual strength test averaged with the 2 preceding individual strength tests meets or exceeds specified strength (for the same class and exact mix I.D. of concrete on the same Contract).

When compressive strengths but the individual strength tests do not fall below the specified strength, the Engineer may core at locations determined by the Engineer.

When compressive strengths fail to satisfy one or both of the above requirements, the Contractor may:

1. Request acceptance based on the Contractor/Suppliers strength test data for cylinders made from the same truckload of concrete as the Owner cylinders provided:
   a. The Contractor's test results are obtained from testing cylinders fabricated, handled, and stored for 28 Days per AASHTO T 23 and tested per AASHTO T 22. The test cylinders must be the same size cylinders as those cast by the Owner.
   b. The technician fabricating the cylinders is qualified by either ACI, Grade 1 or WAQTC to perform this Work.
   c. The laboratory performing the tests per AASHTO T 22 has an equipment calibration/certification system, and a technician training and evaluation process per AASHTO R-18.
   d. Both the Contractor and Owner have at least 15 test results from the same mix to compare. The Contractor's results could be used if the Contractor's computed average of all their test results is within 1 standard deviation of the Owner's average test result. The computed standard deviation of the Contractor's results must also be within ± 200 psi of the Owner's standard deviation.
2. Request acceptance of in-place concrete strength based on core results. This method is not used if the Engineer determines coring would be harmful to the integrity of the Structure. Cores, if allowed, will be obtained by the Contractor per AASHTO T 24 and delivered to the Owner for testing per AASHTO T 22. If the concrete in the Structure will be dry under service conditions, the core will be air dried at a temperature of between 60 °F and 80 °F and at a relative humidity of less than 60 percent for 7 Days before testing, and will be tested air dry.

Acceptance for each sublot by the core method requires that the average compressive strength of 3 cores be at least 85 percent of the specified strength with no 1 core less than 75 percent of the specified strength. When the Contractor requests strength analysis by coring, the results obtained will be accepted by both parties as conclusive and supersede all other strength data for the concrete sublot.

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If the Contractor elects to core, cores must be obtained 50 Days after initial concrete placement. The Engineer will concur in the locations to be cored. The Contractor is responsible for repair of cored areas. The cost incurred in coring and testing these cores, including repair of core locations, are borne by the Contractor.

6-02.3(5)B CERTIFICATION OF COMPLIANCE

The concrete producer must provide a certificate of compliance for each truckload of concrete. The certificate of compliance must verify that the delivered concrete complies with the mix design, and must include:

1. Manufacturer plant (batching facility)
2. Owner Contract number
3. Date
4. Time batched
5. Truck number
6. Initial revolution counter reading
7. Quantity (quantity batched this load)
8. Type of concrete by class and producer design mix number
9. Cement producer, type, and mill certification number (The mill test number as required by Section 9-01.2 is the basis for acceptance of cement.)
10. Fly ash (if used) brand and type
11. Approved aggregate gradation designation
12. Mix design weight per cubic yard and actual batched weights for:
    a. Cement
    b. Fly ash (if used)
    c. Coarse concrete aggregate and moisture content (each size)
    d. Fine concrete aggregate and moisture content
    e. Water (including free moisture in aggregates)
    f. Admixtures brand and total quantity batched:
        1) Air-entraining admixture
        2) Water reducing admixture
        3) Other admixture

For concretes that use combined aggregate gradation, the certificate of compliance must include the aggregate components and moisture contents for each size instead of the aggregate information described above.

The certificate of compliance must be signed by a responsible representative of the concrete producer, affirming the accuracy of the information provided. Instead of providing a machine produced record containing all above information, the concrete producer may use the Owner-provided printed forms, which must be completed for each load of concrete delivered to the project.

For commercial concrete, the certificate of compliance must include, as a minimum, the batching facility, date, and quantity batched per load.

6-02.3(5)C CONFORMANCE TO MIX DESIGN

Cement, coarse and fine aggregate weights must be within the following tolerances of the mix design:

Mix Material	Upper Tolerance	Lower Tolerance
Batch Volumes less than or equal to 4 cubic yards		
Cement	+5%	-1%
Aggregate	+10%	-2%
Batch Volumes more than 4 cubic yards		
Cement	+5%	-1%
Aggregate	+2%	-2%

If the total cementitious material weight includes different components, these component weights must be within the following tolerances:

1. Portland cement weight plus 5 percent or minus 1 percent of that specified in the mix design.
2. Fly ash and ground granulated blast furnace slag weight ± 5 percent of that specified in the mix design.

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3. Microsilica weight ± 10 percent of that specified in the mix design.

Water must not exceed the maximum water specified in the mix design.

6-02.3(5)D TEST METHODS

Acceptance testing will be performed by the Owner. The test methods to be used with this Specification are:

Standard	Test
AASHTO T 22	Compressive Strength of Cylindrical Concrete Specimens
AASHTO T 23	Making and Curing Concrete Test Specimens in the Field
AASHTO T 119	Slump of Hydraulic Cement Concrete
WAQTC TM 2	Sampling Freshly Mixed Concrete
AASHTO T 152	Air Content of Freshly Mixed Concrete by the Pressure Method
AASHTO T 231	Capping Cylindrical Concrete Specimens
AASHTO T 309	Temperature of Freshly Mixed Portland Cement Concrete

6-02.3(5)E POINT OF ACCEPTANCE

Determination of concrete properties for acceptance will be made based on samples taken, as follows.

Concrete samples must be collected from the end of the placement system at the point of placement. If a tremie is used, concrete samples must be collected at the entrance point to the tremie.

It is the Contractor's responsibility to provide adequate and representative samples of the fresh concrete to a location designated by the Engineer for testing concrete properties and making of cylinder specimens. Samples must be provided as directed in Sections 1-06.1 and 1-06.2. Once the Contractor has turned over the concrete for acceptance testing, no more mix adjustment will be allowed. The concrete will either be accepted or rejected.

6-02.3(5)F WATER-CEMENT RATIO CONFORMANCE

The actual water-cement ratio must be determined from the certified proportions of the mix, adjusting for on–the-job additions. No water may be added after acceptance testing or after placement has begun, except for concrete used in slip forming. For slip formed concrete, water may be added during placement but must not exceed the maximum water-cement ratio in the mix design, and must comply with the requirements for consistency as described in Section 6-02.3(4)C. If water is added, an air and temperature test must be taken before resuming placement to ensure that Specification conformance has been maintained.

6-02.3(5)G SAMPLING AND TESTING FREQUENCY FOR TEMPERATURE, CONSISTENCY, AND AIR CONTENT

Concrete properties must be determined from concrete as delivered to the project and as accepted by the Contractor for placement. The Owner will test for acceptance of concrete for slump, temperature, and air content, if applicable, as follows:

Sampling and testing will be performed before concrete placement from the first truck load. Concrete must not be placed until tests for slump, temperature, and entrained air (if applicable) have been completed by the Engineer, and the results indicate that the concrete is within acceptable limits. Except for the first load of concrete, up to 1/2 cubic yard may be placed before testing for acceptance. Sampling and testing will continue for each load until 2 successive loads comply with all applicable acceptance test requirements. After 2 successive tests indicate that the concrete is within specified limits, the sampling and testing frequency may decrease to 1 for every 5 truckloads. Loads to be sampled will be selected per the random selection process as outlined in WAQTC FOP for TM 2.

When the results for any subsequent acceptance test indicates that the concrete as delivered and approved by the Contractor for placement does not conform to the specified limits, the sampling and testing frequency will be resumed for each truck load. Whenever 2 successive subsequent tests indicate that the concrete is within the specified limits, the random sampling and testing frequency of 1 for every 5 truckloads may resume.

Sampling and testing for placing 1 class of concrete consisting of 50 cubic yards or less will be as listed above, except:

1. Sampling and testing will continue until 1 load meets all acceptance requirements, and
2. After 1 set of tests indicate that the concrete is within specified limits, the remaining concrete to be placed may be accepted by visual inspection.

6-02.3(5)H SAMPLING AND TESTING FOR COMPRESSIVE STRENGTH AND INITIAL CURING

Acceptance testing for compressive strength must be conducted at the same frequency as the acceptance tests for temperature, consistency, and air content.

The Contractor must provide and maintain cure boxes for curing concrete cylinders. The Contractor must also provide, maintain, and operate all necessary power sources and connections needed to operate the curing box. Concrete cylinders must be cured in a cure box per AASHTO T 23. The cure boxes must maintain a temperature between 60 °F and 80 °F for

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concrete with specified strengths less than 6000 psi and between 68 °F and 78 °F for concrete with specified strengths of 6000 psi and higher. A minimum/maximum thermometer must be installed to measure the internal temperature of the cure box. The thermometer must be readable from outside of the box and be capable of recording the high and low temperatures in a 24-hour period. The cure boxes must create an environment that prevents moisture loss from the concrete specimens. The top must have a working lock and the interior must be rustproof. A moisture-proof seal must be provided between the lid and the box. The cure box must be the appropriate size to accommodate the number of concrete acceptance cylinders necessary or the Contractor must provide additional cure boxes. Once concrete cylinders are placed in the cure box, the cure box must not be moved until the cylinders have been cured per these Specifications. When concrete is placed at more than 1 location simultaneously, multiple cure boxes must be provided.

The Contractor must protect concrete cylinders in cure boxes from excessive vibration and shock waves during the curing period as specified in Section 6-02.3(6)D.

6-02.3(5)I REJECTING CONCRETE

The Engineer, before sampling, may reject any batch or load of concrete that appears defective in composition; such as in cement content or aggregate proportions. Rejected material must not be incorporated in the Structure.

6-02.3(5)J CONCRETE WITH NON-CONFORMING STRENGTH

Concrete with cylinder compressive strengths (fc) that fail to comply with acceptance level requirements must be evaluated for structural adequacy. If the material is found to be adequate, payment must be adjusted using the following formula:

$$\text{Pay adjustment} = 2(f'c - fc)(UP)(Q) / f'c$$

Where:

f ′c = Specified minimum compressive strength at 28 Days.

fc = Compressive strength at 28 days as determined by AASHTO Test Methods.

UP = Unit Contract price per cubic yard for the class of concrete involved.

Q = Quantity of concrete represented by an acceptance test based on the required frequency of testing.

Concrete that fails to comply with minimum acceptance levels using the coring method will be evaluated for structural adequacy. If the material is found to be adequate, payment must be adjusted using the following formula:

$$\text{Pay adjustment} = 3.56(.85f'c - f\ \text{cores})(UP)(Q) / f'c$$

Where:

f ′c = Specified minimum concrete compressive strength at 28 Days.

f cores = Compressive strength of the cores as determined by AASHTO T-22.

UP = Unit Contract price per cubic yard for the class of concrete involved.

Q = Quantity of concrete represented by an acceptance test based on the required frequency of testing.

Where these Specifications designate payment for the concrete except on a per cubic yard basis, the unit Contract price of concrete must be taken as $300 per cubic yard for concrete Class 4000, 5000, and 6000. For concrete Class 3000, the unit Contract Price for Concrete must be $160 per cubic yard.

6-02.3(6) PLACING CONCRETE

The Contractor must not place concrete:

1. On frozen or ice-coated ground or subgrade.
2. Against or on ice-coated forms, reinforcing steel, structural steel, conduits, precast members, or construction joints.
3. Under rainy conditions placing of concrete must be stopped before the quantity of surface water is sufficient to affect or damage surface mortar quality or cause a flow or wash the concrete surface.
4. In any foundation until the Engineer has approved its depth and character.
5. In any form until the Engineer has approved it and placing any reinforcing in it.
6. In any Work area when vibrations from nearby Work may harm the concrete's initial set or strength.

When a foundation excavation contains water, the Contractor must pump it dry before placing concrete. If this is impossible, an underwater concrete seal must be placed that complies with Section 6-02.3(6)B. This seal must be thick enough to resist any uplift.

All foundations, forms, and contacting concrete surfaces must be moistened with water just before the concrete is placed. Any standing water on the foundation, on the concrete surface, or in the form must be removed.

The Contractor must place concrete in the forms promptly after mixing, as specified in Section 6-02.3(4)D. Concrete placement must be continuous, with no interruption longer than 30 minutes between adjoining layers unless the Engineer approves a longer time. Each layer must be placed and consolidated before the preceding layer takes initial set. After initial

set, the forms must not be jarred, and projecting ends of reinforcing bars must not be disturbed. The submittal to the Engineer must include justification that the concrete mix design will remain fluid for interruptions longer than 30 minutes between placements.

In girders or walls, concrete must be placed in continuous, horizontal layers 1.5 to 2.5 feet deep. Consolidation must leave no line of separation between layers. In each part of a form, the concrete must be deposited as near its final position as possible.

Any method for placing and consolidating must not segregate aggregates or displace reinforcing steel. Any method must leave a compact, dense, and impervious concrete with smooth faces on exposed surfaces. Plastering is not permitted. Any section of defective concrete must be removed at the Contractor's expense.

To prevent aggregates from separating, the length of any conveyor belt used to transport concrete must not exceed 300 feet. If the mix needs protection from sun or rain, the Contractor must cover the belt. When concrete pumps are used for placement, a Contractor's representative must, before use on the first placement of each day, visually inspect the pumps water chamber for water leakage. Do not use a pump that allows free water to flow past the piston.

If a concrete pump is used as the placing system, the pump priming slurry must be discarded before placement. Initial acceptance testing may be delayed until the pump priming slurry has been eliminated from the concrete being pumped. Eliminating the priming slurry from the concrete may require that several cubic yards of concrete are discharged through the pumping system and discarded. Use of a concrete pump requires a reserve pump or other backup equipment at the site.

If the concrete will drop more than 5 feet, it must be deposited through a sheet metal or other approved conduit. If the form slopes, the concrete must be lowered through approved conduit to keep it from sliding down one side of the form. Do not use aluminum conduits or tremies to pump or place concrete.

Before placing concrete for bridge decks on steel spans, the Contractor must release the falsework under the bridge and let the span swing free on its supports. Concrete in flat slab bridges must be placed in one continuous operation for each span or series of continuous spans.

Concrete for bridge decks and the stems of T-beams or box-girders must be placed in separate operations if the stem of the beam or girder is more than 3 feet deep. First the beam or girder stem must be filled to the bottom of the slab fillets. Bridge deck concrete must not be placed until enough time has passed to allow the earlier concrete to shrink (at least 12 hours). If stem depth is 3 feet or less, the Contractor may place concrete in one continuous operation if the Engineer approves.

Between expansion or construction joints, concrete in Structures such as beams, girders, bridge decks, piers, columns, walls, and traffic and pedestrian barriers must be placed in a continuous operation.

Do not place traffic or pedestrian barrier until after the bridge decks are complete for the entire Structure. Do not place concrete barriers until the falsework has been released and the span supports itself. The Contractor may choose not to release the deck overhang falsework before the barrier placement. The Contractor must submit calculations to the Engineer indicating the loads induced into the girder webs due to the barrier weight and any live load placed on the Structure does not exceed the design capacity of the girder component. This analysis is not required for bridges with concrete superstructures. Do not place barrier, curb, or sidewalk on steel or prestressed concrete girder bridges until the bridge deck reaches a compressive strength of at least 3,000 psi.

The Contractor may construct traffic and pedestrian barriers by the slip form method. However, the barrier may not deviate more than 1/4 inch when measured by a 10-foot straight edge held longitudinally on the front face, back face, and top surface. Electrical conduit within the barrier must be constructed as specified in Section 8-30.

When placing concrete in arch rings, the Contractor must ensure that the load on the falsework remains symmetrical and uniform.

Unless the Engineer approves otherwise, arch ribs in open spandrel arches must be placed in sections. Small key sections between large sections must be filled after the large sections have shrunk.

6-02.3(6)A WEATHER AND TEMPERATURE LIMITS TO PROTECT CONCRETE

6-02.3(6)A1 HOT WEATHER PROTECTION

If concrete is to be placed between June 1 and September 30, the Contractor must prepare and submit a Project Site specific Hot Weather Concrete Placement and Curing Plan as specified in Section 1-05.3. The Plan must be submitted to the Engineer 15 Working Days before the scheduled placement of concrete. Concrete must not be placed during this period until the Project Site specific Hot Weather Concrete Placement and Curing Plan has been submitted and approved by the Engineer. The Plan must include the following elements, which the Contractor must implement when the temperature thresholds of this Section are exceeded:

1. Methods to control the temperature of forms, reinforcement, and other materials in contact with fresh concrete.
2. Methods to control the temperature of fresh concrete.
3. Methods to control evaporation of freshly placed concrete, including evaporation from wind.
4. Methods to control evaporation from finished concrete during curing.
5. Methods of controlling temperature of finished concrete during curing.
6. Method of recording the internal temperature of the concrete during curing.

The Contractor must provide concrete within the specified temperature limits by:

a. Shading or cooling aggregate piles . Sprinkling of fine aggregate piles with water is not allowed. If sprinkling of the coarse aggregates is used, the piles moisture content must be monitored and the mixing water adjusted for the free water in the aggregate. When removing the coarse aggregate, it must be removed from at least 1 foot above the bottom of the pile.

b. Refrigerating mixing water; or replacing all or part of the mixing water with crushed ice, provided the ice is completely melted by placing time.

If the concrete would probably exceed 90 °F using normal methods, concreting must be suspended until the temperature of fresh concrete delivered to the Project Site can be maintained below 90 °F. Concrete with a temperature of 90 °F or more must not be placed and will be rejected by the Engineer.

If air temperature exceeds 90 °F, the Contractor must use water spray or other approved methods to cool all concrete-contact surfaces to less than 90 °F. These surfaces include forms, reinforcing steel, steel beam flanges, and any others that touch the mix. The Contractor must reduce the time between mixing and placing to a minimum and must not allow mixer trucks to remain in the sun while waiting to discharge concrete. Chutes, conveyors, and pump lines must be shaded.

If bridge decks are placed while air temperature exceeds 90 °F, the Contractor must:

1) Cover the top layer of reinforcing steel with clean, wet burlap immediately before concrete placement.
2) Sprinkle cool water on the forms and reinforcing steel just before the placement if the Engineer requires it.
3) Finish the concrete slab without delay.
4) Provide at the Project Site water-fogging equipment to be used if needed after finishing to prevent plastic cracks.

If the evaporation rate where the concrete is being placed is 0.10 pounds per square foot of surface per hour or more as determined from the Surface Evaporation from Concrete table below, the Contractor must surround the fresh concrete with an enclosure. This enclosure will protect the concrete from wind blowing across its surface until the curing method is applied. If casting deck concrete that is 80 °F or hotter, the Contractor must install approved equipment at the Project Site to show relative humidity and wind velocity.

The Contractor is solely responsible for protecting concrete from inclement weather during the entire curing period. Permission provided by the Engineer to place concrete during hot weather will in no way ensure acceptance of the Work by the Owner. Should the concrete placed under such conditions prove unsatisfactory in any way, the Engineer will still have the right to reject the Work although the plan and the Work were carried out with the Engineer's permission.

All costs associated with the development, submittal and implementation of the Hot Weather Concrete Placement and Curing Plan are incidental to the various concrete Bid Items and no separate payment will be made.

6-02.3(6)A2 COLD WEATHER PROTECTION

If concrete is to be placed between October 1 and May 31, the Contractor must prepare and submit a Project Site specific Cold Weather Concrete Placement and Curing Plan as specified in Section 1-05.3. The Plan must be submitted to the Engineer 15 Working Days before the scheduled placement of concrete. Concrete must not be placed during this period until the Project Site specific Cold Weather Concrete Placement and Curing Plan has been submitted and approved by the Engineer. The Plan must detail how the Contractor will adequately cure the concrete and prevent the internal concrete temperature from falling below 50 °F internally or 35 °F at the surface. The Plan must be implemented when the temperature thresholds of this Section are exceeded.

If ambient air temperature is predicted to be 35 °F, or less, the Contractor must implement the approved Project Site Specific Cold Weather Concrete Placement and Curing Plan. The weather forecast is based on predictions from the Western Region Headquarters of the National Weather Service. This forecast can be found at http://www.wrh.noaa.gov/. Failure to implement the approved Project Site specific Cold Weather Concrete Placement and Curing Plan will be cause to reject the concrete.

To achieve adequate curing, the internal temperature of the concrete must not be allowed to drop below 50 °F during the entire curing period or 7 Days, whichever is greater. The concrete surface temperature must not be allowed to fall below 35 °F during this time. Extra protection must be provided for areas especially vulnerable to freezing, such as exposed top surfaces, corners and edges, thin sections, and concrete placed into steel forms. Concrete placement will only be allowed if the Contractor's Project Site specific Cold Weather Concrete Placement and Curing Plan has been implemented and accepted by the Engineer.

The Contractor must not mix nor place concrete while the air temperature is below 35 °F, unless the water or aggregates (or both) are heated to provide concrete at least 70 °F. The aggregate must not exceed 150 °F. If the water is heated to more than 150 °F, it must be mixed with the aggregates before the cement is added. Any equipment and methods must heat the materials evenly. Concrete placed in shafts and piles is exempt from such preheating requirements.

The Contractor may warm stockpiled aggregates with dry heat or steam, but not by applying flame directly or under sheet metal. If the aggregates are in bins, steam or water coils or other heating methods may be used if aggregate quality is not affected. Live steam heating is not permitted on or through aggregates in bins. If using dry heat, the Contractor must increase mixing time enough to allow the super-dry aggregates to absorb moisture.

The Contractor must provide and maintain a maturity meter sensor, continuously recording time and temperature during the curing period, in the concrete at a location specified by the Engineer for each concrete placement. The Contractor must also provide recording thermometers or other approved devices to monitor the surface temperature of the concrete. During

curing, data from the maturity meter and recording thermometer must be readily available to the Engineer. The Contractor must record time and temperature data on hourly intervals. Data must be provided to the Engineer upon request.

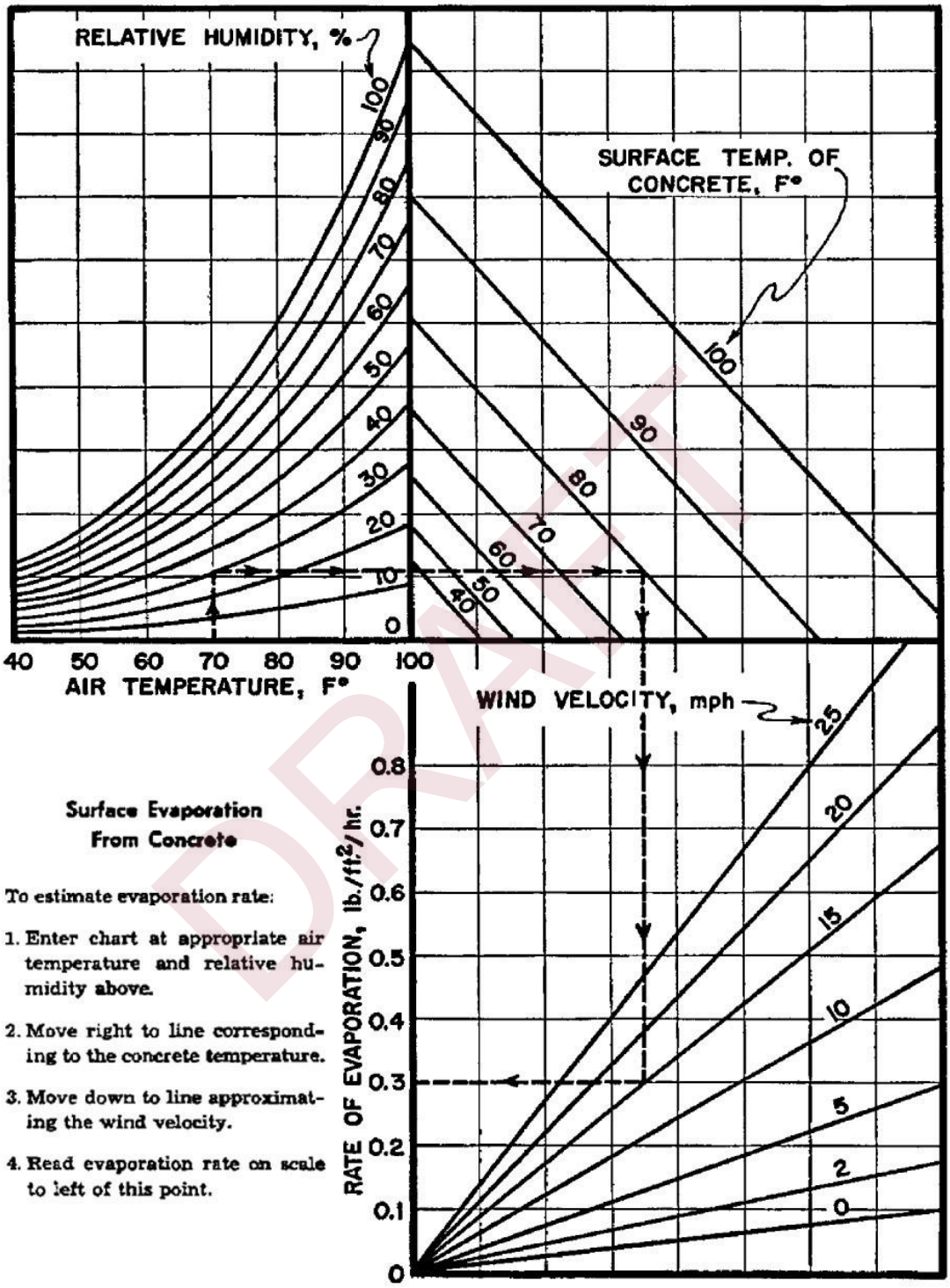
Starting immediately after placement, the concrete temperatures measured by the maturity meter and recording thermometer must be maintained at or above 50 °F and the relative humidity must be maintained above 80 percent. These conditions must be maintained for a minimum of 7 Days or for the cure period required by Section 6-02.3(11), whichever is longer. During this time, if the temperature falls below 50 °F on the maturity meter or recording thermometer, no curing time is awarded for that day. Should the Contractor fail to adequately protect the concrete and the temperature of the concrete falls below 50° F internally or 35 °F at the surface during curing, the Engineer may reject the concrete. Concrete that has frozen during the curing period will be rejected.

The Contractor is solely responsible for protecting concrete from inclement weather during the entire curing period. Permission provided by the Engineer to place concrete during cold weather will in no way ensure acceptance of the Work by the Owner. Should the concrete placed under such conditions prove unsatisfactory in any way, the Engineer will still have the right to reject the Work although the plan and the Work were carried out with the Engineer's permission.

All costs associated with the development, submittal, any resubmittals, and implementation of the Cold Weather Concrete Placement and Curing Plan are incidental to the various concrete Bid Items and no separate payment will be made.

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Surface Evaporation from Concrete



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6-02.3(6)B PLACING CONCRETE IN FOUNDATION SEALS

See Section 2-08.3(3).

6-02.3(6)C DEWATERING CONCRETE SEALS AND FOUNDATIONS

See Section 2-08.3(4).

6-02.3(6)D PROTECTION AGAINST VIBRATION

Freshly placed concrete must not be subjected to excessive vibration and shock waves during the curing period until it has reached a 2000 psi minimum compressive strength for structural concrete and lower-strength classes of concrete. After the first 5 hours from the time the concrete has been placed and consolidated, the Contractor must keep all vibration producing operations at a safe horizontal distance from the freshly placed concrete by following either the prescriptive safe distance method or the monitoring safe distance method. These requirements to protect freshly placed concrete against vibration do not apply for plant cast concrete, nor must they apply to the vibrations caused by the traveling public.

6-02.3(6)D1 PRESCRIPTIVE SAFE DISTANCE METHOD

After the concrete has been placed and consolidated, the Contractor must keep all vibration producing operations at a safe horizontal distance from the freshly placed concrete as follows:

Minimum Compressive Strength, f 'c	Safe Horizontal Distance[1]	
	EQUIPMENT CLASS L[2]	EQUIPMENT CLASS H[3]
< 1000 psi	75 ft	125 ft
1000 psi to < 1400 psi	30 ft	50 ft
1400 psi to 2000 psi	15 ft	25 ft

NOTES:

1. The safe horizontal distance must be reduced to 10 feet for small rubber tire construction equipment like backhoes under 50,000 pounds, concrete placing equipment, and legal Highway vehicles if such equipment travels at speeds of:
   a. ≤ 5 mph on relatively smooth roadway surfaces or
   b. ≤ 3 mph on rough roadway surfaces (i.e. with potholes)
2. Equipment Class L (Low Vibration) must include tracked dozers under 85,000 pounds, track vehicles, trucks (unless excluded above), hand-operated jack hammers, cranes, auger drill rig, caisson drilling, vibratory roller compactors under 30,000 pounds, and grab-hammers.
3. Equipment Class H (High Vibration) must include pile drivers, vibratory hammers, machine-operated impact tools, pavement breakers, and other large pieces of equipment.

After the concrete has reached a minimum compressive strength specified above, the safe horizontal distance restrictions no longer apply.

6-02.3(6)D2 MONITORING SAFE DISTANCE METHOD

The Contractor may monitor the vibration producing operations to decrease the safe horizontal distance requirements of the prescriptive safe distance method. If this method is chosen, all construction operations that produce vibration or shock waves in the vicinity of freshly placed concrete must be monitored by the Contractor with monitoring equipment sensitive enough to detect a minimum peak particle velocity (PPV) of 0.10 inches per second. Monitoring devices must be placed on or adjacent to the freshly placed concrete when the measurements are taken. After the concrete placement, the Contractor must stop all vibration or shock producing operations in the vicinity of the newly placed concrete when the monitoring equipment detects excessive vibration and shock waves defined as exceeding the following PPV's:

Minimum Compressive Strength, f 'c	Maximum PPV
< 1000 psi	0.10 in/sec
1000 psi to < 1400 psi	1.0 in/sec
1400 psi to 2000 psi	2.0 in/sec

After the concrete has reached a minimum compressive strength specified above, the safe horizontal distance restrictions no longer apply.

6-02.3(6)E TOLERANCES

Unless noted otherwise, concrete construction tolerances must be in accordance with this Section. Tolerances in this Section do not apply to cement concrete pavement.

Deviation from plane: ±0.5 inch in 10 feet.

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Deviation from plumb or specified batter: ±0.5 inch in 10 feet, but not to exceed a total of ±1.5 inches.

Vertical deviation of top surfaces (except roadway surfaces): ±0.75 inch.

Thickness of bridge decks and other structural slabs not at grade: ±0.25 inch.

Length, width and thickness of elements such as columns, beams, crossbeams, diaphragms, corbels, piers, abutments and walls, including dimensions to construction joints in initial placements: +0.5 inch, -0.25 inch.

Length, width and thickness of spread footing foundations: +2 inches, -0.5 inch.

Horizontal location of the as-placed edge of spread footing foundations: The greater of ±2% of the horizontal dimension of the foundation perpendicular to the edge and ±0.5 inch. However, the tolerance must not exceed ±2 inches.

Location of opening, insert or embedded item at concrete surface: ±0.5 inch.

Cross-sectional dimensions of opening: ±0.5 inch.

Bridge deck, bridge approach slab, and bridge traffic barrier expansion joint gaps with a specified temperature range, measured at a stable temperature: ±0.25 inch.

Horizontal deviation of centerline of bearing pad, oak block or other bearing assembly:±0.125 inch.

Horizontal deviation of centerline of supported element from centerline of bearing pad, oak block or other bearing assembly ±0.25 inch.

Vertical deviation of top of bearing pad, oak block or other bearing assembly: ±0.125 inch.

6-02.3(7) CONCRETE EXPOSED TO SEA WATER

If sea water will contact a completed concrete Structure, the Contractor must:

1. Mix the concrete for at least 2 minutes.
2. Control water content to produce concrete that will be as impermeable as possible.
3. Consolidate the concrete as the Engineer requires, avoiding the formation of any stone pockets.
4. Place only clean, rust-free reinforcement bars in the concrete.
5. Coat form surfaces heavily with shellac and any approved form release agent.
6. Leave forms intact for at least 30 Days after concrete placement or longer if the Engineer requires to prevent sea water from contacting the concrete.
7. Leave the surface of concrete just as it comes from the forms.
8. Provide special handling for any concrete piles used in sea water to avoid even slight deformation cracks.

The Engineer must decide the range of disintegration possible by exposure to sea water. This range must extend from a point below the level of extreme low tide up to a point above the level of extreme high tide. Wave action and other conditions will also affect the Engineer's decision on this range. The Contractor must not locate construction joints within this range without Engineer approval. All concrete within this range must be poured in the dry.

6-02.3(8) CONCRETE EXPOSED TO ALKALINE SOILS OR WATER

The requirements for concrete in seawater must also apply to concrete in alkaline soils or water. The Contractor must:

1. Let the concrete set at least 30 Days (longer if possible) before allowing soil or water to contact it directly.
2. Vibrate each batch of concrete immediately after it has been placed into the forms, using enough vibrating tampers to do this effectively.
3. Hand tamp, if necessary, to produce smooth, dense outside surfaces.

6-02.3(9) VIBRATION OF CONCRETE

The Contractor must supply enough vibrators to consolidate any concrete (except that placed underwater) according to the requirements of this Section. Each vibrator must:

1. Be designed to operate while submerged in the concrete.
2. Vibrate at a rate of at least 7,000 pulses per minute.
3. Receive the Engineer's approval on its type and method of use.

Immediately after concrete is placed, vibration must be applied in the fresh batch at the point of deposit. In doing so, the Contractor must:

a. Space the vibrators evenly, no farther apart than twice the radius of the visible effects of the vibration.

b. Ensure vibration intensity is great enough to visibly affect a weight of 1-inch slump concrete across a radius of at least 18 inches.

c. Insert the vibrators slowly to a depth that will effectively vibrate the full depth of each layer, penetrating into the previous layer on multilayer pours.

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d. Protect partially hardened concrete (i.e. non-plastic, which prevents vibrator penetration when only its own weight is applied) by preventing the vibrator from penetrating it or making direct contact with steel that extends into it.

e. Not allow vibration to continue in one place long enough to form pools of grout.

f. Continue vibration long enough to consolidate the concrete thoroughly, but not so long as to segregate it.

g. Withdraw the vibrators slowly when the process is complete.

h. Not use vibrators to move concrete from one point to another in the forms.

When vibrating and finishing top surfaces that will be exposed to weather or wear, the Contractor must not draw water or laitance to the surface. In high lifts, the top layer must be shallow and made up of a concrete mix as stiff as can be effectively vibrated and finished.

To produce a smooth, dense finish on outside surfaces, the Contractor must hand tamp the concrete.

6-02.3(10) BRIDGE DECKS AND BRIDGE APPROACH SLABS

6-02.3(10)A PREOPERATIONAL MEETING

A pre-operational meeting must be held 5 to 10 Working Days before placing concrete to discuss construction procedures, personnel, and equipment to be used. Those attending must include:

1. (Representing the Contractor) The superintendent and all foremen in charge of placing the concrete and finishing it,
2. (Representing the Owner) The Engineer, key inspections, and a design representative.

If the project includes more than 1 deck or slab, and if the Contractor's key personnel change between concreting operations, or at request of the Engineer, an additional conference must be held just before each deck or slab is placed.

The Contractor must not place bridge decks until the Engineer agrees that:

a. Concrete producing and placement rates will be high enough to meet placing and finishing deadlines.

b. Finishers with enough experience have been used.

c. Adequate finishing tools and equipment are at the site.

d. Curing procedures consistent with the Specification requirements are used.

6-02.3(10)B SCREED RAIL SUPPORTS

The Contractor must place screed rails outside the finishing area. When screed rails cannot be placed outside the finishing area, they must rest on adjustable supports that can be removed with the least possible disturbance to the screeded concrete. The supports must rest on structural members or on forms rigid enough to resist deflection. Supports must be removable to at least 2 inches below the finished surface. For staged constructed bridge decks, the finishing machine screed rails must not be supported on the completed portion of deck and must not deflect with the portion of structure under construction.

Screed rails and their supports must be strong enough and stiff enough to allow the finishing machine to operate effectively on them. All screed rails must be placed and secured for the full length of the deck/slab before the concreting starts. If the Engineer approves in advance, the Contractor may move rails ahead onto previously set supports while concreting progresses. However, such movable rails and their supports must not change the set elevation of the screed.

On steel truss and girder spans, screed rails and bulkheads may be placed directly on transverse steel floor beams, with the strike-board moving at right angles to the centerline of the roadway.

6-02.3(10)C FINISHING EQUIPMENT

The finishing machine must be self-propelled and be capable of forward and reverse movement under positive control. The finishing machine must be equipped with a rotating cylindrical single or double drum screed not exceeding 60 inches in length. The finishing machine must have the adjustments to produce the required cross-section, line, and grade. Provisions must be made for the raising and lowering of all screeds under positive control. The upper vertical limit of screed travel must allow the screed to clear the finished concrete surface.

For bridge deck widening of 20 feet or less, and for bridge approach slabs, or where Job Site conditions do not allow using the conventional configuration finishing machines described above, the Contractor may propose using a hand-operated motorized power screed such as a "Texas" or "Bunyan" screed. This screed must be capable of finishing the bridge deck and bridge approach slab to the same standards as the finishing machine. The Contractor must not start placing bridge deck or bridge approach slab concrete until receiving the Engineer's approval of this screed and the placing procedures.

On bridge decks, the Contractor may use hand-operated strike boards only when the Engineer approves special conditions where self-propelled or motorized hand-operated screeds cannot be used. These boards must be sturdy and able to strike off the full placement width without intermediate supports. Strike-boards, screed rails, and any specially made auxiliary equipment must receive the Engineer's approval before use. All finishing requirements in these Specifications apply to hand-operated finishing equipment.

6-02.3(10)D CONCRETE PLACEMENT, FINISHING, AND TEXTURING

Before placing bridge approach slab concrete, the subgrade must be constructed as specified in Section 2-09 and Section 5-05.3(6).

Before any concrete is placed, the finishing machine must be operated over the entire length of the deck/slab to check screed deflection. Concrete placement may start only if the Engineer approves after this test.

Immediately before placing concrete, the Contractor must check and adjust, if necessary, all falsework and wedges to minimize settlement and deflection from the added mass of the concrete deck/slab. The Contractor must also install devices, such as telltales, by which the Engineer can readily measure settlement and deflection.

The Contractor must schedule the concrete placement so it can be completely finished during daylight. Finishing after dark is permitted if the Engineer approves and if the Contractor provides adequate lighting.

The placement operation must cover the full width of the roadway or the full width between construction joints. The Contractor must locate any construction joint over a beam or web that can support the deck/slab on either side of the joint. The joint must not occur over a pier unless shown on the Drawings. Each joint must be formed vertically and in true alignment. The Contractor must not release falsework or wedges supporting pours on either side of a joint until each side has aged as these Specifications require.

Placement of concrete for bridge decks and bridge approach slabs must comply with Section 6-02.3(6).The Engineer must approve the placement method. In placing the concrete, the Contractor must:

1. Place it without segregation against concrete placed earlier, as near as possible to its final position, approximately to grade, and in shallow, closely spaced piles.
2. Consolidate it around reinforcing steel by using vibrators before strike-off by the finishing machine.
3. Not use vibrators to move concrete.
4. Not re-vibrate any concrete surface areas where workers have stopped before screeding.
5. Remove any concrete splashed onto reinforcing steel in adjacent segments before concreting them.
6. Tamp and strike off the concrete with a template or strike-board moving slowly forward at an even speed.
7. Maintain a slight excess of concrete in front of the cutting edge across the entire width of the placement operation.
8. Make enough passes with the strike-board without over-finishing and bringing excessive quantities of mortar to the surface to create a surface true and ready for final finish.
9. Leave a thin, even film of mortar on the concrete surface after the last pass of the strike-board.

Workers must complete all post-screeding operations without walking on the concrete. This may require work bridges spanning the full width of the slab.

After removing the screed supports, the Contractor must fill the voids with concrete (not mortar).

If necessary, as determined by the Engineer, the Contractor must float the surface left by the finishing machine to remove roughness, minor irregularities, and seal the surface of the concrete. Floating must leave a smooth and even surface. Float finishing must be kept to a minimum number of passes so air bubbles in the concrete are not released. The floats must be at least 4 feet long. Each transverse pass of the float must overlap the previous pass by at least half the length of the float. The first floating must be at right angles to the strike-off. The second floating must be at right angles to the centerline of the span. A smooth riding surface must be maintained across construction joints.

Expansion joints must be finished with a 1/2 inch-radius edger.

After floating, but while the concrete remains plastic, the Contractor must test the entire deck/deck slab for flatness while allowing for crown, camber, and vertical curvature. The testing must be done with a 10-foot straight edge held on the surface. The straight edge must be advanced in successive positions parallel to the centerline, moving not more than 1/2 the length of the straight edge each time it advances. This procedure must be repeated with the straight edge held perpendicular to the centerline. An acceptable surface must be free from deviations of more than 1/8 inch under the 10-foot straight edge.

If the test reveals depressions, the Contractor must fill them with freshly mixed concrete, strike off, consolidate, and refinish them. High areas must be cut down and refinished. Retesting and refinishing must continue until an acceptable, deviation-free surface is produced. The hardened concrete must comply with all smoothness requirements of these Specifications even though the tests require corrective Work.

The Contractor must texture the bridge deck and bridge approach slab by combing the final surface perpendicular to the centerline. Made of a single row of metal tines, the comb must leave striations in the fresh concrete approximately 3/16 inch deep by 1/8 inch wide and spaced approximately 1/2 inch apart. The Engineer will decide actual depths at the site. If the comb has not been approved, the Contractor must obtain the Engineer's approval by demonstrating it on a test section.

The Contractor may operate the combs manually or mechanically, either singly or with several placed end to end. The timing and method used must produce the required texture without displacing larger particles of aggregate. Texturing must end 2 feet from curb lines. This 2-foot untextured strip must be hand-finished with a steel trowel.

If the Drawings call for an overlay to be constructed under the same Contract, such as hot mix asphalt, latex modified concrete, epoxy concrete, or similar, the Contractor must produce the final finish by dragging a strip of damp, seamless burlap lengthwise over the full width of the deck/slab or by brooming it lightly. A burlap drag must equal the deck/slab in width. Approximately 3 feet of the drag must contact the surface, with the least possible bow in its leading edge. It must be kept wet and free of hardened lumps of concrete. When it fails to produce the required finish, the Contractor must replace it. When not in use, it must be lifted clear of the slab.

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After the deck/slab has cured, the surface must not vary more than 1/8 inch under a 10-foot straight edge placed parallel and perpendicular to the centerline.

The Contractor must cut high spots down with a diamond-faced, saw-type cutting machine. This machine must cut through mortar and aggregate without breaking or dislodging the aggregate or causing spalls.

Low spots must be built up using a grout or concrete with a strength equal to or greater than the required 28 day strength of the deck/slab. The method of build-up must be submitted to the Engineer for acceptance as specified in Section 1-05.3.

The surface texture on any area cut down or built up must match closely that of the surrounding bridge deck or bridge approach slab area. The entire bridge deck and bridge approach slab must provide a smooth riding surface.

6-02.3(10)E SIDEWALK ON STRUCTURES

Concrete for sidewalk must be well compacted, struck off with a strike-board, and floated with a wooden float to achieve a surface that does not vary more than 1/8 inch under a 10-foot straight edge. Use an edging tool to finish all sidewalk edges and expansion joints. The final surface must have a granular texture that will not turn slick when wet.

6-02.3(10)F BRIDGE APPROACH SLAB ORIENTATION AND ANCHORS

Bridge approach slabs must be constructed full bridge deck width from outside usable shoulder to outside usable shoulder at an elevation to match the Structure. Unless otherwise shown on the Plans, the pavement end of the bridge approach slab must be constructed normal to the roadway centerline. The bridge approach slabs must be modified as shown on the Drawings to accommodate the grate inlets at the bridge ends if the grate inlets are required.

Bridge approach slab anchors must be installed as shown on the Drawings, and the anchor rods, couplers, and nuts must conform to Section 9-06.4(1). The steel plates must conform to ASTM A 36. All metal parts must receive 1 coat of paint conforming to Section 9-08.2 Item 18-B, (1) Primer or be galvanized per AASHTO M232. The pipe must be any non-perforated PE or PVC pipe of the diameter specified in the Drawings. Polystyrene must conform to Section 9-04.6. The anchors must be installed parallel both to profile grade and centerline of roadway. The Contractor must secure the anchors to ensure they will not be misaligned during concrete placement. For Method B anchor installations, the epoxy bonding agent used to install the anchors must be Type IV conforming to Section 9-26.1. The compression seal must be as noted in the Contract documents. Dowel bars must be installed in the bridge approach slabs as specified in the Standard Plans, Drawings and Section 5-05.3(10).

The compression seal must be a 2-1/2-inch wide gland selected from the current Qualified Products List.

After curing bridge approach slabs as specified in Section 6-02.3(11), the bridge approach slabs may be opened to traffic when a minimum compressive strength of 3,000 psi is achieved.

6-02.3(11) CURING CONCRETE

After placement, concrete surfaces must be cured as follows:

1. Bridge decks (except those made of concrete Class 4000D), flat slab bridge Superstructures, bridge sidewalks, roofs of cut and cover tunnels: curing compound covered by white, reflective type sheeting or continuous wet curing. Curing by either method must be for at least 10 Days.
2. Class 4000D concrete (regardless of Structure type): 2 coats of curing compound and continuous wet cure using heavy quilted blankets or burlap for 14 Days.
3. Bridge approach slabs (Class 4000A concrete): 2 coats of curing compound and continuous wet cure using heavy quilted blankets or burlap for 10 Days.
4. All other concrete surfaces (except traffic barriers and rail bases): continuous moisture for at least 3 Days. When continuous moisture or wet curing is required, the Contractor must keep the concrete surfaces wet with water during curing.

The Contractor may provide continuous moisture by watering a covering of heavy quilted blankets, by keeping concrete surfaces wet with water continuously and covering with a white reflective type sheeting, or by wetting the outside surfaces of wood forms. Runoff water must be collected and disposed of in accordance with all applicable regulations. Do not allow runoff water to enter any lakes, streams, or other surface waters.

When curing Class 4000D and 4000A, 2 coats of curing compound that complies with Section 9-23.2 must be applied within 15 minutes after tinning any portion of the bridge approach slab. The surface must be covered with presoaked heavy quilted blankets or burlap as soon as the concrete has set enough to allow covering without damaging the finish. Soaker hoses are required and must be placed on top of burlap or blankets. Charge soaker hoses with water frequently to keep the entire deck covering wet during curing.

For all other concrete requiring curing compound, the Contractor must apply 2 coats that comply with Section 9-23.2 and are manufactured specifically for colored concrete when applicable, to the fresh concrete. The compound must be applied immediately after finishing. Application of the second coat must run at right angles to that of the first. The 2 coats must total at least 1 gallon per 150 square feet and must obscure the original color of the concrete. If any curing compound spills on construction joints or reinforcing steel, the Contractor must clean it off before the next concrete placement.

If the Drawings call for an asphalt overlay on the bridge approach slab, the Contractor must use clear curing compound, Type 1D, Class B, applying at least 1 gallon per 150 square feet to the concrete surface. Otherwise, the Contractor must use white pigmented curing compound, Type 2, agitating it thoroughly just before and during application. If other materials are to

be bonded to the surface, the Contractor must remove the curing compound by sandblasting or acceptable high pressure water washing.

The Contractor must have back-up spray equipment on the site, enough workers, and a bridge from which they will apply the curing compound. The Engineer may require the Contractor to demonstrate, at least 1 Day before the scheduled concrete placement, that the crew and equipment can apply the compound acceptably.

The Contractor must cover the top surfaces with white, reflective sheeting, leaving it in place for at least 10 days. Throughout this period, the sheeting must be kept in place by taping or weighting the edges where they overlap.

The unit Contract prices must include all concrete curing costs.

6-02.3(11)A CURING AND FINISHING CONCRETE TRAFFIC AND PEDESTRIAN BARRIER

The Contractor must supply enough water and workers to cure and finish concrete barrier as required in this Section.

6-02.3(11)A1 FIXED FORM BARRIER

The edge chamfers must be formed by attaching chamfer strips to the barrier forms.

After troweling and edging a barrier and while the forms remain in place, the Contractor must:

1. Brush the top surface with a fine bristle brush.
2. Cover the top surface with heavy, quilted blankets.
3. Spray water on the blankets and forms at intervals short enough to keep them thoroughly wet for 3-Days.

After removing the forms, the Contractor must:

a. Remove all lips and edgings with sharp tools or chisels.
b. Fill all holes with mortar conforming to Section 9-20.4(2).
c. True up corners of openings.
d. Remove concrete projecting beyond the true surface by stoning or grinding.
e. Cover the barrier with heavy, quilted blankets (not burlap).
f. Keep the blankets continuously wet for at least 7-Days.

The Contractor may do the finishing Work described in steps a. through d. above during the second (the 7-Day) curing period if the entire barrier is kept covered except the immediate Work area. Otherwise, no finishing Work may be done until at least 10 Days after pouring.

After the 10-Day curing period, the Contractor must remove from the barrier all form-release agent, mud, dust, and other foreign substances in either of 2 ways: by light sandblasting and washing with water, or by spraying with a high-pressure water jet. The water jet equipment must use clean fresh water and must produce at the nozzle at least 1,500 psi with a discharge of at least 3 gpm. The water jet nozzle must have a 25 degree tip and must be held no more than 9 inches from the surface being washed.

After cleaning, the Contractor must use brushes to rub mortar conforming to Section 9-20.4(2) at a ratio of 1:1 cement/aggregate ratio into air holes and small crevices on all surfaces except the brushed top. As soon as the mortar takes its initial set, the Contractor must rub it off with a piece of sacking or carpet. The barrier must then be covered with wet blankets for at least 48 hours.

Do not use curing compounds on fixed-form concrete barrier. The completed surface of the concrete must be even in color and texture.

6-02.3(11)A2 SLIP FORM BARRIER

The edge radius must be formed by attaching radius strips to the barrier slip form.

The Contractor must finish slip form barrier by steel troweling to close all surface pockmarks and holes and, for plain surface barrier, lightly brushing the front and back face with vertical strokes and the top surface with transverse strokes.

After finishing, the Contractor must cure the slip form barrier by using either method A, curing compound, or method B, wet blankets, described below.

Method A. Under the curing compound method, the Contractor must:

1. Spray 2 coats of clear curing compound (Type 1D) on the concrete surface after the free water has disappeared. Coverage of combined coats must equal at least 1 gallon per 150 square feet.
2. Before the morning after applying the curing compound, cover the barrier with white, reflective sheeting for at least 10 Days.
3. After the 10 Day curing period, remove the curing compound as necessary by light sandblasting or by spraying with a high-pressure water jet to produce an even surface appearance. The water jet equipment must use clean fresh water and must produce at the nozzle at least 2,500 psi with a discharge of at least 4 gpm. The water jet nozzle must have a 25-degree tip and must be held no more than 9 inches from the surface being cleaned. The Contractor may propose to use a curing compound/concrete sealer. The Engineer will evaluate the proposal and if found acceptable will accept the proposal in writing. As a minimum, the Contractor's proposal must include:

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a. Product identity
b. Manufacturer's recommended application rate
c. Method of application and necessary equipment
d. Material Safety Data Sheet (MSDS)
e. Sample of the material for testing

Allow 14 Working Days for the Engineer to evaluate the proposal and to test the material.

Method B. Under the wet cure method, the Contractor must:

a. Provide an initial cure period by continuous fogging or mist spraying for at least the first 24 hours.
b. After the initial cure period, cover the barrier with a heavy quilted blanket.
c. Keep the blankets continuously wet for at least 10 Days. No additional finishing is required at the end of the curing period.

6-02.3(12) CONSTRUCTION JOINTS

6-02.3(12)A CONSTRUCTION JOINTS IN NEW CONSTRUCTION

If the Engineer approves, the Contractor may add, delete, or relocate construction joints shown on the Drawings. Any request for such changes must be in writing, accompanied by a drawing that depicts them. The Contractor must bear any added costs that result from such changes.

All construction joints must be formed neatly with grade strips or other approved methods. The Owner will not accept irregular or wavy pour lines. All joints must be horizontal, vertical, or perpendicular to the main reinforcement. The Contractor must not use an edger on any construction joint, and must remove any lip or edging before making the adjacent pour.

If the Drawings require a roughened surface on the joint, the Contractor must strike it off to leave grooves at right angles to the length of the member. The grooves must be 1/2 inch to 1 inch wide, 1/4 inch to 1/2 inch deep, and spaced equally at twice the width of the groove. If the first strike-off does not produce the required roughness, the Contractor must repeat the process before the concrete reaches initial set. The final surface must be clean and without laitance or loose material.

If the Drawings do not require a roughened surface, the Contractor must include shear keys at all construction joints. These keys must provide a positive, mechanical bond. Shear keys must be formed depressions and the forms must not be removed until the concrete has been in place at least 12 hours. Forms must be slightly beveled to ensure ready removal. Raised shear keys are not allowed.

Shear keys for the tops of beams, at tops and bottoms of boxed girder webs, in diaphragms, and in crossbeams must:

1. Be formed with 2" x 8" wood blocks.
2. Measure 8 inches lengthwise along the beam or girder stem.
3. Measure 4 inches less than the width of the stem, beam, or crossbeam, measured transverse of the stem.
4. Be spaced at 16 inches center to center.

Unless the Drawings show otherwise, in other locations not named above, shear keys must equal approximately 1/3 of the joint area and must be approximately 1-1/2 inches deep.

Before placing fresh concrete against cured concrete, the Contractor must thoroughly clean and saturate the cured surface. All loose particles, dust, dirt, laitance, oil, or film of any sort must be removed by methods as approved by the Engineer. The cleaned surface must be saturated with water for a minimum of 4 hours before the fresh concrete is placed.

Before placing the reinforcing mat for footings on seals, the Contractor must remove all scum, laitance, and loose gravel and sediment; clean the construction joint at the top of the seals; and chip off any high spots on the seals that would prevent the footing steel from being placed in the position required by the Drawings.

6-02.3(12)B CONSTRUCTION JOINTS BETWEEN EXISTING AND NEW CONSTRUCTION

If the Contract requires a roughened surface on the joint, the Contractor must thoroughly roughen the existing surface to a uniformly distributed 1/4-inch minimum amplitude surface profile, with peaks spaced at a maximum of 1 inch, by methods as approved by the Engineer.

If the Contract does not require a roughened surface on the joint, the Contractor must remove all loose particles, dust, dirt, laitance, oil, or film of any sort by methods as approved by the Engineer.

Before placing fresh concrete against existing concrete, the Contractor must thoroughly clean and saturate the existing surface. All loose particles, dust, dirt, laitance, oil, or film of any sort must be removed by methods as approved by the Engineer. The cleaned surface must be saturated with water for a minimum of 4 hours before the fresh concrete is placed.

6-02.3(13) EXPANSION JOINTS

This Section outlines the requirements of specific expansion joints shown on the Drawings. The Drawings may require other types of joints, seals, or materials than those described here.

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Joints made of a vulcanized, elastomeric compound with neoprene as the only polymer must be installed with an approved lubricant adhesive as recommended by the manufacturer. The length of a seal must match that required in the Drawings without splicing or stretching.

Open joints must be formed with a template made of wood, metal, or other suitable material. Insertion and removal of the template must be done without chipping or breaking the edges or otherwise injuring the concrete.

Any part of an expansion joint running parallel to the direction of expansion must provide a clearance of at least 1/2 inch, produced by inserting and removing a spacer strip, between the 2 surfaces. The Contractor must ensure that the surfaces are precisely parallel to prevent any wedging from expansion and contraction.

All poured rubber joint sealer and any required primer must be as specified in Section 9-04.2(2).

6-02.3(14) FINISHING CONCRETE SURFACES

All concrete must show a smooth, dense, uniform surface after the forms are removed. If it is porous, the Contractor must pay for repairing it. The Contractor must clean and refinish any stained or discolored surfaces that may have resulted from their Work or from construction delays.

Sections A and B below describe 2 classes of surface finishing.

6-02.3(14)A CLASS 1 SURFACE FINISH

The Contractor must apply a Class 1 finish to all surfaces of concrete members to the limits designated in the Drawings.

The Contractor must comply with steps 1 through 8 below. When steel forms have been used and when the surface of filled holes matches the texture and color of the area around them, the Contractor may omit steps 3 through 8. To create a Class 1 surface, the Contractor must:

1. Remove all bolts and all lips and edgings where form members have met.
2. Fill all holes greater than 1/4 inch and float to an even, uniform finish with mortar conforming to Section 9-20.4(2) at a 1:2 cement/aggregate ratio.
3. Thoroughly wash the surface of the concrete with water.
4. Brush on a mortar conforming to Section 9-20.4(2) at a 1:1 cement/aggregate ratio, working it well into the small air holes and other crevices in the face of the concrete.
5. Brush on no more mortar than can be finished in 1 day.
6. Rub the mortar off with burlap or a piece of carpet as soon as it takes initial set (before it reaches final set).
7. Fog-spray water over the finish as soon as the mortar paint has reached final set.
8. Keep the surface damp for at least 2 days.

If the mortar becomes too hard to rub off as described in step 6, the Contractor must remove it with a Carborundum stone and water. Random grinding is not permitted.

6-02.3(14)B CLASS 2 SURFACE FINISH

The Contractor must apply a Class 2 finish to all above-ground surfaces not receiving a Class 1 finish unless otherwise specified in the Contract. Surfaces covered with fill do not require a surface finish.

To produce a Class 2 finish, the Contractor must remove all bolts and all lips and edgings where form members have met and fill all form tie holes.

6-02.3(14)C PIGMENTED SEALER FOR CONCRETE SURFACES

Concrete barrier surfaces must be finished as specified in Section 6-02.3(11)A. All other surfaces specified in the Drawings to receive pigmented sealer must receive a Class 2 surface finish and a light brush sandblasting in order that complete neutralization of the surface and subsequent penetration of the pigmented sealer is achieved. All curing agents and form release agents must be removed. The surface must be dry, clean and prepared per the manufacturer's written instructions. The Contractor must submit 4 copies of the manufacturer's written instructions.

The Contractor must not apply pigmented sealer from a batch greater than 12 months past the initial date of color sample approval of that batch by the Engineer.

The pigmented sealer color or colors for specific concrete surfaces must be as specified in the Contract.

The pigmented sealer must be spray applied per the manufacturer's written instructions for application, air temperature required for sealer application and curing, qualification of applicator, rate of application, and number of coats to apply. Pigmented sealer must not be applied until the concrete has cured for at least 28 days. Pigmented sealer must not be applied on damp surfaces, nor must it be applied when the air is misty, or otherwise unsatisfactory for the work, in the opinion of the manufacturer or the Engineer. The final appearance must have an even and uniform color acceptable to the Engineer.

For concrete surfaces such as columns, retaining walls, pier walls, abutments, concrete fascia panels, and noise barrier wall panels, the pigmented sealer must extend to 1 foot below the finish groundline, unless otherwise shown on the Drawings.

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6-02.3(15) DATE NUMERALS

Standard date numerals must be placed where shown on the Drawings. The date must be for the year in which the Structure is completed. When traffic barrier is placed on an existing Structure, the date must be for the year in which the original Structure was completed. Unit Contract prices must cover all costs relating to these numerals.

6-02.3(16) PLANS FOR FALSEWORK AND FORMWORK

The Contractor must submit all plans for falsework and formwork for acceptance as specified in Section 1-05.3, and as described in Section 6-02.3(16)A. The Contractor must also submit 2 sets of the falsework and formwork plans to the Engineer. Approval does not reduce the Contractor's responsibility for ensuring the adequacy of the formwork and falsework. All falsework and formwork must be constructed per approved falsework and formwork plans.

Except to place falsework foundation pads and piles, constructing any unit of falsework must not start until the Engineer has reviewed and approved the falsework plans for that unit. Falsework driven piling, temporary concrete footings, or timber mudsills may be placed as described in Section 6-02.3(17)D before approval at the Contractor's own risk, except for the following conditions:

1. The falsework is over or adjacent to roadways or railroads as described in Section 6-02.3(17)C, or
2. The falsework requires prior placement of shoring or cofferdams as described in Section 2-07 and Section 2-08.

Costs associated with changing falsework to bring it into compliance with the approved falsework plans will be at the Contractor's expense.

The Engineer will review the falsework and formwork plans and calculations, and if they are acceptable, and unless otherwise specified in the Contract, will obtain the required approvals as applicable.

Plan approval is not required for footing or retaining walls unless they are more than 4 feet high, excluding pedestal height.

The design of falsework and formwork must be based on:

a. Applied loads and conditions no less severe than those described in Section 6-02.3(17)A.
b. Allowable stresses and deflections no greater than those described in Section 6-02.3(17)B.
c. Special loads and requirements no less severe than those described in Section 6-02.3(17)C.
d. Conditions required by other Sections of 6-02.3(17)

Plan approval can be done by the Engineer for footings and walls 4 feet to 8 feet high, excluding pedestal height, provided:

1) Concrete placement rate is 4 feet per hour or less.
2) Facing is 3/4 inch plywood with grade as specified in Section 6-02.3(17)J.
3) Studs, with plywood face grain perpendicular, are 2" x 4" spaced at 12 inches.
4) Walers with 3,000-pound safe working load ties spaced at 24 inches are 2" x 4" spaced at 24 inches.

Plan approval can be done by the Engineer for manufactured certified steel round column forming for column heights up to 20 feet. Concrete placement rate must not exceed 10 feet per hour. Bracing requirements must be per manufacturer's recommendations or submitted according to Section 6-02.3(16).The falsework and formwork plans must be scale drawings showing the details of proposed construction, including sizes and properties of all members and components; spacing of bents, posts, studs, wales, stringers, wedges and bracing; rates of concrete placement, placement sequence, direction of placement, and location of construction joints; identifying falsework devices and safe working load; and identifying any bolts or threaded rods used with the devices including their diameter, length, type, grade, and required torque. Show in the falsework plans the proximity of falsework to utilities or any nearby Structures including underground Structures. Formwork accessories must be identified according to Section 6-02.3(17)H. All assumptions, dimensions, material properties, and other data used in making the structural analysis must be noted on the drawing.

The Contractor must furnish the associated design calculations to the Engineer for examination as a condition for approval. The design calculations must show the stresses and deflections in load supporting members. Construction details which may be in the form of sketches on the calculation sheets must be in the falsework or formwork drawings as well. Falsework or formwork plans will not be approved where it is necessary to refer to the calculation sheets for information needed for complete understanding of the falsework and formwork plans or how to construct the falsework and formwork.

All falsework and formwork plans and design calculations submitted to Engineer must be prepared by or under the direct supervision of a Professional Engineer, licensed under Title 18 RCW, State of Washington, in the branch of Civil or Structural Engineering.

Design calculations and each sheet of falsework and formwork plans must comply with the Shop Drawing and Professional Engineer submittal requirements of Section 1-05.3.

6-02.3(16)A NONPREAPPROVED FALSEWORK AND FORMWORK PLANS

As specified in Section 1-05.3, the Contractor must submit all non-preapproved falsework and formwork plans, and design calculations, for review and acceptance.

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Reviewed falsework and formwork plans will be returned to the Contractor within the time allowed according to Section 1-05.3. The time allowed starts when the Contractor's transmittal and submittal including all required copies of the falsework and/or formwork plans and calculations, catalog data, and other technical information are received.

Drawings returned to the Contractor for correction must be corrected and resubmitted as a clean submittals, with no previous Engineer stamps and comments, to the Engineer for review and acceptance.

The Contractor may change approved falsework and formwork plans, provided sufficient time is allowed for the Engineer's review and approval before construction is started on the changed portions. Such additional time cannot be more than that which was originally allowed per Section 1-05.3. After a plan or drawing is accepted and returned to the Contractor, all changes that the Contractor proposed must be submitted to the Engineer for review and approval.

6-02.3(17) FALSEWORK AND FORMWORK

Formwork and falsework are both structural systems. Formwork contains the lateral pressure exerted by concrete placed in the forms. Falsework supports the vertical and/or the horizontal loads of the formwork, reinforcing steel, concrete, and live loads during construction.

The Contractor must set falsework to produce in the finished structure the lines and grades described in the Drawings. The setting of falsework must allow for shrinkage, settlement, falsework girder camber, and any structural camber the Drawings or the Engineer require.

Concrete forms must be mortar tight, true to the dimensions, lines, and grades of the structure. Curved surfaces shown on the Drawings must be constructed as curved surfaces and not chorded, except as allowed in Section 6-02.3(17)J. Concrete formwork must be of sufficient strength and stiffness to prevent overstress and excess deflection as defined in Section 6-02.3(17)B. The rate of depositing concrete in the forms must not exceed the placement rate in the approved formwork plan. The interior form shape and dimensions must also ensure that the finished concrete conforms with the Drawings.

If the new structure is near or part of an existing one, the Contractor must not use the existing structure or completed elements of the new structure to suspend or support falsework unless the Contract states otherwise. With approval by the Engineer, the bridge deck and the diaphragm forms from prestressed girder and T-beam bridge widenings or stage construction, and the bridge deck forms from steel plate girder bridge widenings or stage construction, may be supported from the existing structure or previous stage. See Section 6-02.3(17)E for additional conditions.

On bridge decks, do not use forms designed to stay in place made of steel or precast concrete panels.

For post-tensioned Structures, both falsework and forms must be designed to carry the additional loads caused by the post-tensioning operations. The Contractor must construct supporting falsework in a way that leaves the superstructure free to contract and lift off the falsework during post-tensioning. Forms that will remain inside box girders to support placing the bridge deck concrete must, by design, resist girder contraction as little as possible. See Section 6-02.3(26) for additional conditions.

6-02.3(17)A DESIGN LOADS

The design load for falsework consists of the sum of dead and live vertical loads, and a design horizontal load. The minimum total design load for any falsework must be at least 100 pounds per square foot for combined live and dead load regardless of Structure thickness.

The entire superstructure cross-section, except traffic barrier, is considered placed at one time for purposes of determining support requirements and designing falsework girders for their stresses and deflections, except as follows:

For concrete box girder bridges, the girder stems, diaphragms, crossbeams, and connected bottom slabs, if the stem wall is placed more than 5 days before the top slab, may be considered to be self-supporting between falsework bents when the top slab is placed, provided that the distance between falsework bents does not exceed 4 times the depth of the portion of the girder placed in the preceding concrete placements.

Falsework bents must be designed for the entire live load and dead load, including all load transfer that takes place during post-tensioning, and braced for the design horizontal load.

Dead loads must include the weight of all successive placements of concrete, reinforcing steel, forms and falsework, and all load transfer that takes place during post-tensioning. The weight of concrete with reinforcing steel must be assumed to be not less than 160 pounds per cubic foot.

Live loads must consist of the actual mass of any equipment to be supported by falsework applied as concentrated loads at the points of contact, and a minimum uniform load of not less than 25 pounds per square foot. applied over the entire falsework plan area supported, plus a minimum load of not less than 75 pounds per linear foot applied at the outside edge of deck overhangs.

The design horizontal load to be resisted by the falsework bracing system in any direction must be the sum of all identifiable horizontal loads due to equipment, construction sequence, side-sway caused by geometry or eccentric loading conditions, or other causes, and an allowance for wind plus an additional allowance of 1 percent of the total dead load to provide for unexpected forces. In no case must the design horizontal load be less than 3 percent of the total dead load.

The minimum horizontal load to be allowed for wind on each heavy-duty steel shoring tower having a vertical load carrying capacity exceeding 30 kips per leg must be the sum of the products of the wind impact area, shape factor, and the applicable wind pressure value for each height zone. The wind impact area is the total projected area of all elements in the tower face normal to the applied wind. The shape factor for heavy-duty steel shoring towers must be taken as 2.2. Determine wind pressure values from the following table:

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Wind Pressure on Heavy-Duty Steel Shoring Towers

Height Zone (Feet Above Ground)	Wind Pressure Value	
	Adjacent to Traffic	At Other Locations
0-30	20-psf	15-psf
30-50	25-psf	20-psf
50-100	30-psf	25-psf
Over 100	35-psf	30-psf

The minimum horizontal load to be allowed for wind on all other types of falsework, including falsework girders and forms supported on heavy-duty steel shoring towers, must be the sum of the products of the wind impact area and the applicable wind pressure value for each height zone. The wind impact area is the gross projected area of the falsework support system, falsework girders, forms and any unrestrained portion of the permanent Structure, except the areas between falsework posts or towers where diagonal bracing is not used. Determine wind pressure values from the following table.

Wind Pressure on All Other Types of Falsework

Height Zone (Feet Above Ground)	Wind Pressure Value	
	For Members Over and Bents Adjacent to Traffic Openings	At Other Locations
0-30	2.0 Q psf	1.5 Q psf
30-50	2.5 Q psf	2.0 Q psf
50-100	3.0 Q psf	2.5 Q psf
Over 100	3.5 Q psf	3.0 Q psf

NOTE: Determine the value of Q in the above tabulation as follows:

Q = 1 + 0.2W; but Q must not be more than 10.

Where W is the width of the falsework system, in feet, measured normal to the direction of the wind force being considered.

The falsework system must also be designed so it will be sufficiently stable to resist overturning before placing the concrete. The minimum factor of safety against falsework overturning in all directions from the assumed horizontal load for all stages of construction is 1.25. If the required resisting moment is less than 1.25 times the overturning moment, the difference must be resisted by bracing, cable guys, or other means of external support.

Design of falsework includes the vertical component, whether positive or negative, of bracing loads imposed by the design horizontal load. Design of falsework must investigate the effects of any horizontal displacement due to stretch of the bracing. This is particularly important when using cable or rod bracing systems.

If the concrete is to be post-tensioned, the falsework must be designed to support any increased or redistributed loads caused by the prestressing forces.

6-02.3(17)B ALLOWABLE DESIGN STRESSES AND DEFLECTIONS

The maximum allowable stresses listed in this Section are based on the use of identifiable, undamaged, high-quality materials. Stresses must be appropriately reduced if lesser quality materials are to be used.

These maximum allowable stresses include all adjustment factors, such as the short term load duration factor. The maximum allowable stresses and deflections used in the design of the falsework and formwork must be as follows:

6-02.3(17)B1 DEFLECTION

Deflection resulting from dead load and concrete pressure for exposed visible surfaces, 1/360 of the span.

Deflection resulting from dead load and concrete pressure for unexposed non-visible surfaces, including the bottom of the deck slab between girders, 1/270 of the span.

In the foregoing, the span length must be the center line to center line distance between supports for simple and continuous spans, and from the center line of support to the end of the member for cantilever spans. For plywood supported on members wider than 1-1/2 inches, the span length must be taken as the clear span plus 1-1/2 inches. Also, dead load must include the weight of all successive placements of concrete, reinforcing steel, forms and falsework self-weight. Only the self-weight of falsework girders may be excluded from the calculation of the above deflections provided that the falsework girder deflection is compensated for by the installation of camber strips.

Where successive placements of concrete are to act compositely in the completed Structure, deflection control becomes extremely critical. Maximum deflection of supporting members is 1/500 of the span for members constructed in several

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successive placements, such as concrete box girder and concrete T-beam girder Structures. Falsework components must be sized, positioned, and/or supported to minimize progressive increases in deflection of the Structure which would preload the concrete or reinforcing steel before it becomes fully composite.

6-02.3(17)B2 TIMBER

Each species and grade of timber/lumber used in constructing falsework and formwork must be identified in the Drawings. The allowable stresses and loads must not exceed the lesser of stresses and loads given in the table below or factored stresses for designated species and grade in Table 7.3 of the Timber Construction Manual, latest edition, by the American Institute of Timber Construction.

Type of Stress	Allowable Load
Compression perpendicular to the grain reduced to 300 psi for use when moisture content is 19 percent or more (areas exposed to rain, concrete curing water, green lumber).	450 psi
Compression parallel to the grain but not to exceed 1,500 psi.	480,000 psi / $(L/d)^2$
Flexural stress for members with a nominal depth greater than 8 inches.	1,800 psi
Flexural stress for members with a nominal depth of 8 inches or less.	1,500 psi
The maximum horizontal shear.	140 psi
AXIAL tension.	1,200 psi
The maximum modulus of elasticity (E) for timber.	1,600,000 psi

Where:

L = the unsupported length

d = the least dimension of rectangular columns, or the width of a square of equivalent cross-sectional area for round columns, or the depth of beams.

The allowable stress for compression perpendicular to the grain, and for horizontal shear must not be increased by any factors such as short duration loading. Additional requirements are found in other parts of Section 6-02.3(17). Criteria for the design of lumber and timber connections are found in Section 6-02.3(17)I.

Plywood for formwork must be designed per the methods and stresses allowed in the APA Design/Construction Guide for Concrete Forming as published by the American Plywood Association, Tacoma, Washington. As concrete forming is a special application for plywood, use wet stresses and then adjusted for forming conditions such as duration of load, and experience factors. Concrete pour pressures must be per Section 6-02.3(17)J.

6-02.3(17)B3 STEEL

For identified grades of steel, design stresses must not exceed those specified in the Steel Construction Manual, latest edition, by the American Institute of Steel Construction, except as follows:

Type of Stress	Allowable Load
Compression, flexural but not to exceed $0.6F_y$	12,000,000 psi / (Ld/bt)
The modulus of elasticity (E) must be	29,000,000 psi

When the grade of steel cannot be positively identified as with salvaged steel and if rivets are present, design stresses must not exceed the following:

Type of Stress	Allowable Load
Yield point f_y	30,000 psi
Tension, axial, and flexural	16,000 psi
Compression, axial except L/r must not exceed 120	14,150 - 0.37$(KL/r)^2$ psi
Shear on gross section of the web of rolled shapes	9,500 psi
Web crippling for rolled shapes	22,500 psi
Compression, flexural but not to exceed 16,000 psi and L/b not greater than 39	16,000 - 5.2$(L/b)^2$ psi
The modulus of elasticity (E) must be	29,000,000 psi

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Where:

L = the unsupported length

d = the least dimension of rectangular columns, or the width of a square of equivalent cross-sectional area for round columns, or the depth of beams

b = the flange width

t = the thickness of the compression flange

r = the radius of gyration of the compression flange about the weak axis of the member

Fy = the specified minimum yield stress, psi, for the grade of steel used

L = the unsupported length

All dimensions are expressed in inches.

6-02.3(17)C FALSEWORK AND FORMWORK AT SPECIAL LOCATIONS

In addition to the minimum requirements specified in Sections 6-02.3(17)A and 6-02.3(17)B, falsework towers or posts supporting beams directly over roadways or railroads which are open to traffic or the public must be designed and constructed so the falsework will be stable if subjected to impact by vehicles. Do not use damaged materials, unidentifiable material, salvaged steel or steel with burned holes or questionable weldments for falsework described in this Section. For this Specification the following public or private facilities must also be considered as roadways: pedestrian pathways and other Structures such as bridges, walls, and buildings.

The dimensions of the clear openings to be provided through the falsework for roadways, railroads, or pedestrian pathways must be as specified in the Contract.

Falsework posts or shoring tower systems which support members that cross over a roadway or railroad are considered as adjacent to roadways or railroads. Other falsework posts or shoring towers are considered as adjacent to roadways or railroads only if the following conditions apply:

1. Located in the row of falsework posts or shoring towers nearest to the roadway or railroad; and
2. Horizontal distance from the traffic side of the falsework to the edge of pavement is less than the total height of the falsework and forms; or
3. The total height of the falsework and forms is greater than the horizontal clear distance between the base of the falsework and a point 10 feet from the centerline of track.

The Contractor must provide any additional features for the Work needed to ensure that the falsework will be stable for impact by vehicles; providing adequate safeguards, safety devices, protective equipment, and any other needed actions to protect property and the life, health, and safety of the public; and must comply with the provisions in Section 1-07.23 and Section 6-02.3(17)M. The falsework design at special locations, must incorporate the minimum requirements detailed in this Section, even if protected by concrete median barrier.

The vertical load used for the design of falsework posts and towers which support the portion of the falsework over openings, must be the greater of the following:

a. 150 percent of the design load calculated as specified in Section 6-02.3(17)B, but not including any increased or redistributed loads caused by the post-tensioning forces; or

b. 100 percent of the design load plus the increased or redistributed loads caused by the post-tensioning forces.

Each falsework post or each shoring tower leg adjacent to roadways or railroads consists of either steel with a minimum section modulus about each axis of 9.5 inches cubed or sound timbers with a minimum section modulus about each axis of 250 inches cubed.

Each falsework post or shoring tower leg adjacent to roadways or railroads must be mechanically connected to its supporting footing at its base, or otherwise laterally restrained, to withstand a force of not less than 2,000 pounds applied at the base of the post or tower leg in any direction except toward the roadway or railroad track. Posts or tower legs must be connected to the falsework cap and stringer by mechanical connections capable of resisting a load in any horizontal direction of not less than 1,000 pounds.

For falsework spans over roadways and railroads, all falsework stringers must be mechanically connected to the falsework cap or framing. The mechanical connections must be capable of resisting a load in any direction, including uplift on the stringer, of not less than 500 pounds. All associated connections must be installed before traffic is allowed to pass beneath the span.

When timber members are used to brace falsework bents located adjacent to roadways or railroads, all connections must be bolted through the members using 5/8-inch diameter or larger bolts.

Use concrete traffic barriers to protect all falsework adjacent to traveled roadways. The falsework must be located so falsework footings, mudsills, or piles are at least 2 feet clear of the traffic barrier and all other falsework members must also be at least 2 feet clear of the traffic barrier. Traffic barrier used to protect falsework must not be fastened, guyed, or blocked to any falsework but must be fastened to the pavement according to details shown on the Drawings. The installation of concrete traffic barrier must be completed before falsework erection is begun. The traffic barrier at the falsework must not be removed

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until approved by the Engineer. Falsework openings provided for the Contractor's own use, not for public use, must also use concrete traffic barrier to protect the falsework, except the minimum clear distance between the barrier and falsework footings, mudsills, piles, or other falsework members must be at least 3 inches.

Falsework bents within 20 feet of the center line of a railroad track must be braced to resist the required horizontal load or 2,000 pounds whichever is greater.

Pedestrian openings through falsework must be paved or surfaced with full width continuous wood walks which must be wheel chair accessible and must be kept clear. Pedestrians must be protected from falling objects and water falling from construction above. Overhead protection for pedestrians must extend at least 4 feet beyond the edge of the bridge deck. Drawings and details of the overhead protection and pathway must be submitted with the falsework plans for review and approval. Pedestrian openings through falsework must be illuminated by temporary lighting, constructed and maintained by the Contractor. The temporary lighting must be constructed per local electrical code requirements. The temporary lighting must be steady burning 60 watt, 120 volt lamps with molded waterproof lamp holders spaced at 25-foot centers maximum. All costs relating to pedestrian pathway paving, wood walks, overhead protection, maintenance, operating costs, and temporary pedestrian lighting are incidental to applicable adjacent items of Work.

6-02.3(17)D FALSEWORK SUPPORT SYSTEMS: PILING, TEMPORARY CONCRETE FOOTINGS, TIMBER MUDSILLS, MANUFACTURED SHORING TOWERS, CAPS, AND POSTS

The Contractor must support all falsework on either driven piling, temporary concrete footings, or timber mudsills. Temporary concrete footings must be designed as reinforced concrete which may be cast in place or precast. All components for a falsework support system must be sized for the maximum design loads and allowable stresses described in the preceding Sections.

The falsework drawings must include a superstructure placing diagram showing the concrete placing sequence, direction of placements, and construction joint locations. When a sequence for placing concrete is shown on the Drawings or Specifications, no deviation will be permitted.

If the Drawings call for piling or foundation shafts to support permanent Structures, the Contractor may not use mudsills or temporary concrete footings for falsework support unless the underlying soil passes the settlement test described in this Section.

6-02.3(17)D1 PILING

When using piling to support the falsework, the Contractor's falsework plans must specify the minimum required bearing and depth of penetration for the piling. Also, the falsework drawings must show the maximum horizontal distance that the top of a falsework pile may be pulled to position it under its cap. The falsework plans must show the maximum allowable deviation of the top of the pile, in its final position, from a vertical line through the point of fixity of the pile. The calculations must account for pile stresses due to combined axial and flexural stress and secondary stresses.

Untreated timber piling must be banded before driving. The falsework plans must identify lengths, minimum tip diameter, and expected diameter at groundline. The Contractor must comply with the requirements of Section 9-10.1. The maximum allowable load for timber piles is 45 tons. Steel piling must be identified in the falsework plans. If steel pipe piling is used, the pipe diameter and wall thickness must be identified in the falsework plans. Steel piling must comply with the requirements of Section 9-10.5. Use the formulas in Section 6-05.3(12) must to determine the bearing capacity of the falsework piling. If the Engineer approves, the pile bearing capacity may instead be determined by test loading the piling to twice the falsework design load. The Contractor must provide the Engineer an opportunity to witness these tests and provide a plan of the test and cross-sections showing the locations and elevations of the proposed tests to the Engineer for approval.

6-02.3(17)D2 TEMPORARY CONCRETE FOOTINGS AND TIMBER MUDSILLS

Timber mudsills or temporary concrete footings may be used in place of driven piling, provided tests show that the soil can support twice the falsework design load and that the mudsill or temporary concrete footing will not settle more than 1/4 inch when loaded with the design load. The tests must be done at the falsework site, at the same elevation of the mudsill, and conducted under conditions representative of the actual Job Site conditions. The acceptable tests for various soil types are:

1. Granular Soil. The Contractor must conduct on-site tests according to AASHTO T 235. The Contractor must provide the Engineer an opportunity to witness these tests and provide a plan of the test and cross-sections showing the locations and elevations of the proposed tests to the Engineer for approval.
2. Fine Grained or Organic Soil. The Contractor must employ a Geotechnical Engineer to investigate the foundation soils and certify in writing each mudsill or temporary footing will comply with the load-settlement requirements described above. The allowable bearing capacities, elevations and locations of specific falsework mudsills must be listed in the certification. Soils information used to determine the soil bearing capacity and settlement must be submitted with the written certification to the Engineer for review and approval.

Timber mudsills or temporary concrete footings for falsework must be designed to carry the loads imposed on them without exceeding the estimated soil bearing capacity and specified maximum settlement. Where mudsills or temporary footings are used in the vicinity of permanent spread footings, the allowable mudsill bearing pressure must be less than that of the permanent footings. This is because elevation difference, smaller bearing area, and the lack of surrounding overburden provides a lower bearing capacity than the permanent spread footings. The mudsills must be designed for bearing capacities at the location they are to be used. Timber mudsills or temporary concrete footings must be designed as unyielding

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foundations under full design loads. The soil pressure bearing values assumed in the design of the falsework, normally not more than 3,000 pounds per sq. ft., must be shown in the falsework drawings. The minimum edge distances from the edge of the post or shoring tower leg to the edge or end of the mudsill member must be shown in the falsework drawings. Timber mudsills and temporary concrete footings must be designed such that member deflections do not exceed 1/4 inch and that member allowable stresses are not exceeded.

Full cross-sectional views of all falsework on timber mudsills or temporary concrete footings to be placed in side slopes or above excavations must be shown in the falsework drawings. Footings or mudsills stepped or placed above an excavation must have all related geometry and slope stability items identified in the falsework plan. Details and calculations for any shoring system to support the embankment or excavation must be included.

Mudsills or temporary concrete footings placed in benches in slopes must be set back from the face of the slope 1/2 the mudsill or temporary concrete footing width, but not less than 1 foot. The bench including the setback must be level in its narrow dimension. Slopes between benches measured from the top of slope at one bench to the toe of slope at the next bench below must be no steeper than 1-1/2 horizontal to 1 vertical.

Falsework must be founded on a solid footing, safe against undermining, protected from softening, and capable of supporting the loads imposed. Preparing the soil to receive the temporary footing is important to ensure that the falsework does not experience localized settlement that could cause falsework failure. In preparing the soil for a timber mudsill or temporary concrete footing, the Contractor must:

a. Place it on dry soil either undisturbed or compacted to 95 percent of maximum density, as determined by the compaction control tests in Section 2-11 and submitted to the Engineer for review.
b. Place mudsills or footings level with full contact bearing on the soil with no voids. Place each distribution plate or corbel member between the post or tower leg and the mudsill members such that there is full contact bearing.
c. Place a compacted layer of fine material under the mudsill if it is supported by rock or coarse sand and gravel.
d. Provide the Engineer with a sample of any off-site material to be used under the mudsill.
e. Allow up to 5 Working Days for the Engineer's approval before using the off-site material.
f. Provide erosion control measures to protect the soil of the mudsill or footing from undermining and softening.

Anticipated total settlements and incremental settlements of falsework and forms due to successive concrete placements must be shown in the falsework plans. These must include falsework footing settlement and joint take-up. Total anticipated settlements must not exceed 1 inch including joint take-up. When using mudsills, the Contractor must prepare for the possibility of reshoring with such devices as screw jacks or hydraulic jacks and adjustment of wedge packs. The placing of concrete must be discontinued if unanticipated settlement occurs, including settlements that deviate more than ± 3/8 inch from those indicated on the approved falsework drawing. Concrete placement must not resume until corrective measures satisfactory to the Engineer are provided. If satisfactory corrective measures are not provided before initial set of the concrete in the affected area, placing of concrete must be discontinued at a location determined by the Engineer. All unacceptable concrete must be removed as determined by the Engineer.

Where the maximum leg load exceeds 30 kips, foundations for individual steel towers must be designed and constructed to provide uniform settlement at each tower leg for all loading conditions.

6-02.3(17)D3 BENTS, SHORING TOWERS, PILING, POSTS, AND CAPS

Drawings for falsework bents or shoring tower systems, including manufactured tower systems must have plan, cross-section, and elevation view scale drawings showing all geometry. Show in the falsework plans the proximity of falsework to utilities or any nearby Structures including underground Structures. The ground elevation, cross-slopes, relation of stringers to one another, and dimensions to posts or piling must be shown in the falsework plans. Column, pile, or tower heights must be indicated. Member sizes, wall thickness and diameter of steel pipe columns or piles must be shown in the falsework plans. Location of wedges, minimum bearing area and type of wedge material must be identified in the falsework plans. Bracing size, location, material and all connections must be described in the falsework plans.

Show the relationship of the falsework bents or shoring tower systems to the permanent Structure's pier and footing. Load paths must be as direct as possible. Loads must be applied through the shear centers of all members to avoid torsion and buckling conditions. Where loads cause twisting, biaxial bending, or axial loading with bending, the affected members must be designed for combined stresses and stability.

Posts or columns must be constructed plumb with tops and bottoms carefully cut to provide full end bearing. Caps must be installed at all bents supported by posts or piling unless approved falsework plans specifically allow otherwise. Caps must be fastened to the piling or posts. The falsework must be capable of supporting non-uniform or localized loading without adverse effect. For example, the loading of cantilevered ends of stringers or caps must not cause a condition of instability in the adjacent unloaded members.

Timber posts and piling must be fastened to the caps and mudsills by through-bolted connections, drift pins, or other approved connections. The minimum diameter of round timber posts must be shown in the falsework plans. Timber caps and timber mudsills must be checked for crushing from columns or piling under maximum load.

Steel posts and piling must be welded or bolted to the caps, and must be bolted or welded to the foundation. Steel members must be checked for buckling, web yielding, and web crippling.

Must use wedges to allow formwork to be taken up and released uniformly. Wedges must be oak or close-grained Douglas fir. Cedar wedges or shims must not be used anywhere in a falsework or forming system. Must use wedges at the top or bottom of shores, but not at both top and bottom. After the final adjustment of the shore elevation is complete, the wedges must be fastened securely to the sill or cap beam. Only 1 set of wedges, with 1 optional block, must be used at one location. Use screw jacks or other approved devices under arches to allow incremental release of the falsework.

Sand jacks may be used to support falsework and are used for falsework lowering only. Sand jacks must be constructed of steel with snug fitting steel or concrete pistons. Sand jacks must be filled with dry sand and the jack protected from moisture throughout its use. They must be designed and installed in such a way to prevent the unintentional migration or loss of sand. All sand jacks must be tested per Section 6-02.3(17)G.

When falsework is over or adjacent to roadways or railroads, all details of the falsework system which contribute to the horizontal stability and resistance to impact must be installed when each element of the falsework is erected and must remain in place until the falsework is removed. For other requirements see Section 6-02.3(17)C.

Transverse construction joints in the superstructure must be supported by falsework at the joint location. The falsework must be constructed in such a manner that subsequent pours will not produce additional stresses in the concrete already in place.

6-02.3(17)D4 MANUFACTURED SHORING TOWER SYSTEMS AND DEVICES

Manufactured proprietary shoring tower systems must be identified in the falsework plans by make and model and safe working load capacity per leg. The safe working load for shoring tower systems must be based on a minimum 2 1/2:1 factor of safety.

The safe working load capacity, anticipated deflection or settlement, make and model must be identified in the falsework plans for manufactured devices such as: single shores, overhang brackets, support bracket and jack assemblies, friction collars and clamps, hangers, saddles, and sand jacks. The safe working load for shop manufactured devices must be based on a minimum ultimate strength safety factor of 2:1. The safe working load for field produced devices and all single shores must be based on a minimum ultimate strength safety factor of 3:1.

The safe working load of all devices must not be exceeded. The design loads must be as defined by Section 6-02.3(17)A. The maximum allowable free end deflection of deck overhang brackets under working loads applied must not exceed 3/16 inch measured at the edge of the concrete slab regardless of the fact that the deflection may be compensated for by precambering or of setting the elevations high. The Contractor must comply with all manufacturer's Specifications including those relating to bolt torque, placing washers under nuts and bolt heads, cleaning and oiling of parts, and the reuse of material. Devices which are deteriorated, bent, warped, or have poorly fitted connections or welds, must not be installed.

Shoring tower or device capacity as shown on catalogs or brochures published by the manufacturer is considered as the maximum load which the shoring can safely support under ideal conditions. These maximum values must be reduced for adverse loading conditions; such as horizontal loads, eccentricity due to unbalanced spans or placing sequence, and uneven foundation settlement.

Depending on load-carrying capacity, steel shoring systems are classified as pipe-frame systems, intermediate strength systems, and heavy-duty systems. The 2 types of pipe-frame shoring base frames in general use are the ladder type and the cross-braced type. In the ladder type, frame rigidity is provided by horizontal struts between the vertical legs, whereas in the cross-braced type rigidity is provided by diagonal cross-bracing between the legs.

Copies of catalog data and/or other technical data must be furnished with the falsework plans to verify the load-carrying capacity, deflection, and manufacturer's installation requirements of any manufactured product or device proposed for use. Upon request by the Engineer, the Contractor must furnish manufacturer certified test reports and results showing load capacity, deflection, test installation conditions, and identify associated components and hardware for shoring tower systems or other devices. In addition to manufacturer's requirements, the criteria specified in the following Sections for manufactured proprietary shoring tower systems and devices must be complied with when preparing falsework plans, calculations, and installing these shoring tower systems and devices as falsework.

Alternative criteria and/or systems may be approved if a written statement on the manufacturer's letter head, signed by the shoring or device manufacturer (not by a material Supplier or the Contractor) is submitted to the Engineer for approval and addresses the following:

1. Identity of the specific Contract on which the alternative criteria and/or system will apply.
2. Description of the alternative criteria and/or system.
3. Technical data and test reports.
4. The conditions under which the alternative criteria may be followed.
5. That a design based on the alternative criteria will not overstress or over deflect any shoring component or device nor reduce the required safety factor.

Where the falsework drawings detail a manufactured product and the manufacturer's safe working load, load versus deflection curves, factor of safety, and installation requirements cannot be found in any catalog, the Engineer may require load testing per Section 6-02.3(17)G to verify the safe working load and deflection characteristics.

Tower leg loads must not exceed the limiting values under any loading condition or sequence. Frame extensions and any reduced capacity must be shown in the falsework plans. Screw jacks must fit tight in the leg assemblies without wobble. Screw

jacks must be plumb and straight. Shoring towers must be installed plumb, and load distribution beams must be arranged such that vertical loads are distributed to all legs for all successive concrete placements. There must be no eccentric loads on shoring tower heads unless the heads have been designed for such loading. Shoring towers must remain square or rectangular in plan view and must not be skewed. There must be no interchanging of parts from one manufactured shoring system to another. Do not use bent or faulty components.

For manufactured shoring towers that allow ganging of frames, the number of ganged frames must be limited to 1 frame per opposing side of a tower, and the total number of legs per ganged tower must not exceed 8 legs. Ganged frames must be installed per the manufacturer's published standards using the manufacturer's components. Do not use other gang arrangements.

For manufactured steel shoring tower systems, the Contractor must have bracing designed and installed for horizontal loads and falsework overturning per Section 6-02.3(17)A. Minimum bracing criteria and allowable leg loads are described in the following paragraphs.

All shoring tower systems and bracing must be thoroughly inspected by the Contractor for plumb vertical support members, secure connections, and straight bracing members immediately before, at intervals during, and immediately after every concrete placement. For manufactured shoring tower systems, the maximum allowable deviation from the vertical is 1/8 inch in 3 feet. If this tolerance is exceeded, concrete must not be placed until adjustments have brought the shoring towers within the acceptable tolerance.

6-02.3(17)D5 CROSS-BRACED TYPE BASE FRAMES

The maximum allowable load per leg for cross-braced type base frame shoring is limited by the height of the extension frame and the type of screw jack, swivel or fixed head, used at the top of the frame. The maximum load on 1 leg of a frame must not exceed 4 times the load on the other leg under any loading condition or sequence. The maximum load on 1 of the 2 frames making up a tower must not exceed 4 times the load on the opposite frame under any loading condition or sequence. If swivel-head screw jacks are used, the allowable leg loads must not exceed that specified in the following table:

Maximum Allowable Leg Load in Pounds			
Extension Frame Height	2′-0"	3′-0"	4′-0"
Screw height 12" or less	11,000	11,000	10,000
Screw height exceeds 12"	8,200	8,200	8,000

If fixed-head screw jacks are used at the top of the extension frame, the maximum allowable load per leg must be 11,000 pounds for all extension frame heights up to 5 feet with screw jack height extensions of 12 inches or less. Fixed-head screw jacks exceeding 12 inches must use the values in the table above. Screw jack extensions must not exceed the manufacturer's published recommendations. Extension frames must be braced. Side cross-braces are required for extension heights up to 2 feet. Both side and end cross-braces are required from over 2'-0" to 5'-0" extension heights.

Supplemental bracing must be installed on shoring towers 20 feet or more in height and must connect rows of towers to each other so rows of frames are continuously cross-braced in 1 plane. Supplemental bracing must be installed as follows:

1. In the transverse direction (the direction parallel to the frame) 1 horizontal brace and 1 diagonal brace must be attached to each tower face, for every 3 frames of shoring height, including an extension frame if used. The lowest horizontal brace must be located near the top of the third tower frame, and any additional horizontal braces spaced no farther than 3 frames apart. The diagonal braces must be on opposite tower faces, and must run in opposite directions across the plane of the tower row.
2. In the longitudinal direction (the direction perpendicular to the frames), when shoring height is 4 frames or more, a horizontal brace must be installed on 1 face of each tower, with the lowest brace located no higher than the top of the fourth frame and any additional horizontal braces spaced no farther than 4 frames apart. When shoring height is 6 frames or more, diagonal cross-bracing must be installed in the longitudinal direction similar to the transverse direction.
3. When roadway grade, soffit profile, or superelevation exceeds 4 percent slope for any height of shoring tower, a continuous brace parallel to the slope must be attached to each frame extension or screw jack of the tower within 6 inches of the top. These braces must be in addition to bracing previously described.

The bracing must be fastened securely to each frame leg and must be located within 6 inches of the frame member intersections. Do not attach the ends of diagonal braces to shoring frames at locations where towers have little or no load. Diagonal brace ends must be attached to tower frames near the top and bottom at locations where significant gravity load is maintained throughout all construction sequences, such as directly below box girder outside webs precluding lift-off due to the vertical component of the brace reaction. Supplemental bracing must be shown in the falsework drawings. The connection details, including the method of connection and exact location of the connecting devices per the manufacturer's recommendations and must be shown in the falsework drawings.

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6-02.3(17)D6 LADDER TYPE BASE FRAMES

Ladder type base frame shoring must be limited to the following maximum loads and conditions, regardless of any conflicting information which may be found in manufacturer's catalogs or brochures:

1. If the shoring system consists of a single tier of braced base frames, leg loads must not exceed 10,000 pounds.
2. If the shoring system consists of 2 or 3 tiers of base frames, leg loads must not exceed 7,500 pounds.
3. If an extension staff is used, the maximum allowable leg load must be reduced to 6,000 pounds.
4. The maximum load on 1 leg of a frame must not exceed 4 times the load on the other leg under any loading condition or sequence. The maximum load on 1 of the 2 frames making up a tower must not exceed 4 times the load on the opposite frame under any loading condition or sequence.

Maximum allowable leg loads as shown above must apply when fixed-head screw jacks are used, or when swivel-head jacks are used at either the top or bottom of the tower. A screw jack extension must not exceed 12 inches. Swivel-head screw jacks must not be used at both the top and bottom of ladder-type frames. For any combination of ladder-type base frames or base frames with staff extensions, the total height of the shoring must not exceed 20 feet, including screw jack extensions.

When roadway grade, soffit profile, or superelevation exceeds 4 percent slope for heights of shoring towers 20 feet or less, a continuous brace parallel to the slope must be attached to each staff extension or screw jack of the tower within 6 inches of the top. These braces must be attached per conditions described previously for cross-braced frames.

6-02.3(17)D7 INTERMEDIATE STRENGTH SHORING

Steel shoring, consisting of cross-braced tubular members capable of carrying up to 25 kips per tower leg, is considered intermediate strength shoring. The use of a 25-kip type falsework shoring system must comply with the following conditions and limitations:

1. If swivel-head screw jacks are used at either the top or bottom of the tower, the maximum allowable load must be reduced to 20 kips per tower leg.
2. The screw-jack extensions must not exceed 14 inches.
3. Extension frames must be braced. Side cross-braces are required for all extension-frame heights. End cross-braces (braces across the face of the extension frame) must be provided for extension frame heights of 3 feet or more.
4. The maximum load on 1 leg of a frame, or on 1 frame of a tower must not exceed 4 times the load on the opposite leg or frame under any loading condition or sequence.
5. Shoring towers 20 feet or more in height must have supplemental bracing installed per the criteria for bracing "Cross-braced Type Base Frames," except that no supplemental bracing will be required in the longitudinal direction (the direction perpendicular to the frame).
6. When roadway grade, soffit profile, or superelevation exceeds 4 percent slope for any height of shoring tower, a continuous brace parallel to the slope must be attached to each frame extension or screw jack of the tower within 6 inches of the top. These braces must be in addition to bracing required in item 5.

The use of 25-kip shoring, when designed and erected in conformance with the above criteria, is acceptable for tower heights up to 5 frames plus a fully-extended extension frame plus the maximum allowable screw-jack adjustment. For any proposed use exceeding this limiting height, the Contractor must furnish a statement signed by the shoring manufacturer covering the specific installation. The statement must provide assurance that the shoring will carry the loads to be imposed without overstressing any shoring component or reducing the required safety factor.

6-02.3(17)D8 HEAVY-DUTY SHORING SYSTEMS

Shoring capable of carrying up to 100 kips per tower leg is considered heavy-duty shoring. The following criteria applies to these systems.

If tower legs, including any extension unit, are used as single-post shores braced in one direction only, the shores must be analyzed as individual steel columns.

If the total height of the shoring does not exceed the height of a single tower unit, including any extension unit, and if both the base and extension units are fully braced in both directions per the manufacturer's recommendations, individual tower legs may be considered as capable of carrying the safe working load recommended by the manufacturer without regard to the load on adjacent legs.

If the shoring consists of 2 or more units stacked 1 above the other, either with or without an extension unit, the differential leg loading within a tower unit must not exceed the following limitations:

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Differential Leg Loading

Maximum load on any leg in the tower unit	Maximum to Minimum load ratio
10 kips or less	10-1
10 kips to 50 kips	6-1
50 kips to 75 kips	5-1
75 kips or more	4-1

A complete stress analysis of steel beams used as continuous caps over 2 or more tower units must be performed to determine the effect of continuity on tower leg loads. Resulting moment shear must be added to or subtracted from the simple beam reaction to obtain the actual leg load and may produce a significant load differential.

Heavy-duty shoring must be diagonally braced or otherwise externally supported at the top unless the towers are stable against overturning as defined in Section 6-02.3(17)A. When designing external bracing, including cable bracing, attention must be given to the bracing connection to the falsework. Connections must be designed to transfer horizontal and vertical forces from the falsework to the bracing system without overstressing any tower component. All external bracing, attachment locations, and connection details must be shown in the falsework plans.

6-02.3(17)E STRINGERS, BEAMS, JOISTS, BRIDGE DECK SUPPORT, AND DECK OVERHANGS

All stringers, beams, joists, and bridge deck support must be designed for the design loads, deflections, and allowable stresses described in the preceding Sections 6-02.3(17)A, 6-02.3(17)B, and 6-02.3(17)C and for the following conditions.

At points of support, stringers, beams, joists, and trusses must be restrained against rotation about their longitudinal axis. The effect of biaxial bending must be investigated where falsework beams are not set plumb and the Structure cross-slope exceeds 3 percent.

For box girder and T-beam bridges, the centerline of falsework beams or stringers must be located within 2 feet of the bridge girder stems and preferably directly under the stems or webs. Stringers supporting formwork for concrete box girder and T-beam slab overhangs must be stiff enough so the differential deflection due to the bridge deck pour is no more than 3/16 inch between the outside edge of the bridge deck and the exterior web even if camber strips can compensate for the deflection.

Friction must not be relied on for lateral stability of beams or stringers. If the compression flange of a beam is not laterally restrained, the allowable bending stress must be reduced to prevent flange buckling. If flange restraint is provided and since it is impossible to predict the direction in which a compression flange will buckle, positive restraint must be provided in both directions. Flange restraint must be designed for a minimum load of 2 percent of the calculated compression force in the beam flange at the point under consideration.

Use camber strips to compensate for falsework take-up and deflection, vertical alignment, and the anticipated Structure dead load deflection shown on the camber diagram in the Drawings. Camber is the adjustment to the profile of a load-supporting beam or stringer so the completed Structure will have the lines and grades shown on the Drawings. The dead load camber diagram shown on the Drawings is the predicted Structure dead load deflection due to self-mass. This dead load camber must be increased by:

1. Quantity of anticipated falsework take up.
2. Anticipated deflection of the falsework beam or stringer under the actual load imposed.
3. Any vertical curve payment.

Camber strips must be fastened by nailing to the top of wood members, or by clamping or banding in the case of steel members. Camber strips must have sufficient contact bearing area to prevent crushing under total load. As a general rule, camber strips are not required unless the total camber adjustment exceeds 1/4 inch for exterior falsework stringers and 1/2 inch for interior stringers.

On concrete box girder Structures, the forms supporting the bridge deck must rest on ledgers or similar supports and must not be supported from the bottom slab except as provided below. The form supports must be fastened within 18 inches of the top of the web walls, producing a clear span between web walls. The bridge deck forms may be supported or posted from the bottom slab if the following conditions are met:

a. Permanent access, shown on the Drawings, is provided to the cells, and the centerline to centerline distance between web walls is greater than 10 feet.

b. Falsework stringers designed for total load, stresses and deflections per Section 6-02.3(17)A and 6-02.3(17)B are located directly below each row of posts.

c. Posts have adequate lateral restraint.

d. All forms, including the bridge deck forms, posts, and bracing are completely removed.

The falsework and forms on concrete box girder Structures supporting a sloping web and deck overhang must consist of a lateral support system designed to resist all rotational forces acting on the stem, including those caused by placing deck slab concrete, bridge deck formwork mass, finishing machine, and other live loads. Stem reinforcing steel must not be stressed by

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constructing the bridge deck slab placement. Overhang brackets must not be used for the support of bridge deck forms from sloping web concrete box girder bridges.

Deck slab forms between girders or webs must be constructed such that there is no differential settlement relative to the girders. The support systems for form panels supporting concrete deck slabs and overhangs on girder bridges (such as steel plate girders and prestressed girders) must be designed as falsework. Falsework supporting deck slabs and overhangs on girder bridges must be supported directly by the girders so there will be no differential settlement between the girders and the deck forms during placement of deck concrete.

6-02.3(17)F BRACING

All falsework bracing systems must be designed to resist the horizontal design load in all directions with the falsework in either the loaded or unloaded condition. All bracing, connection details, specific locations of connections, and hardware used must be shown in the falsework plans. Falsework diagonal bracing must be thoroughly analyzed with particular attention given to the connections. The allowable stresses in the diagonal braces may be controlled by the joint strength or the compression stability of the diagonal. Timber bracing for timber falsework bents must have connections designed as specified in Section 6-02.3(17)I. Any damaged cross-bracing, such as split timber members must be replaced. Steel strapping must avoid making sharp angles or right-angle bends. A means of preventing accidental loss of tension must be provided for steel strapping. See Sections 6-02.3(17)A, 6-02.3(17)B, and 6-02.3(17)C for design loads and allowable stresses.

Bracing must not be attached to concrete traffic barrier, guardrail posts, or guardrail.

To prevent falsework beam or stringer compression flange buckling, cross-bracing members and connections must be designed to carry tension and compression. All components, connection details and specific locations must be shown in the falsework plans. Bracing, blocking, struts, and ties required for positive lateral restraint of beam flanges must be installed at right angles to the beam in plan view. If possible, bracing in adjacent bays must be set in the same transverse plane. However, if because of skew or other considerations, it is necessary to offset the bracing in adjacent bays, the offset distance must not exceed twice the depth of the beam.

All falsework and bracing must be inspected by the Contractor for plumbness of vertical support members, secure connections, tight cables, and straight bracing members immediately before, during, and immediately after every concrete placement.

Bracing must be provided to withstand all imposed loads during erection of the falsework and all phases of construction for falsework adjacent to any roadway, sidewalk, or railroad track open to the public. All details of the falsework system which contribute to horizontal stability and resistance to impact, including the bolts in bracing, must be installed when each element of the falsework is erected and must remain in place until the falsework is removed. The falsework plans must show provisions for any supplemental bracing or methods to be used to conform to this requirement during each phase of erection and removal. Wind loads must be included in the design of such bracing or methods. Loads, connections, and materials for falsework adjacent to roadways, must also be as specified in Section 6-02.3(17)C.

6-02.3(17)F1 CABLE OR TENSION BRACING SYSTEMS

When cables, wire rope, steel rod, or other types of tension bracing members are used as external bracing to resist horizontal forces, or as temporary bracing to support bents while falsework is being erected or removed adjacent to traffic, all elements of the bracing system must be shown on the falsework plans. Bracing must not be attached to concrete traffic barrier, guardrail posts, or guardrail. Any damaged bracing, such as frayed and kinked guying systems must be replaced. Wire rope must avoid making sharp angles or right-angle bends and a means of preventing accidental loss of tension must be provided. The following information must be submitted to the Engineer for approval:

1. Cable diameter, rod, or tension member size, and allowable working load.
2. Location and method of attaching the cable, rod, or tension member to the falsework. The connecting device must be designed to transfer both horizontal and vertical forces to the cable without overstressing any falsework component.
3. The type of cable connectors or fastening devices (such as U-bolt clips or plate clamps) to be used and the efficiency factor for each type. If cables are to be spliced, the splicing method must be shown.
4. Method of tightening cables, rods, or tension members after installation if tightening is necessary to ensure their effectiveness. Method of preventing accidental loosening.
5. Anchorage details, including the size and mass of concrete anchor blocks, the assumed coefficient of friction for surface anchorages, and the assumed lateral soil bearing capacity for buried anchorages.
6. Method of pre-stretching or preloading cable or tension members.
7. Determination of the potential stretch or elongation of the tension member under the design load and if the resulting lateral deflection will cause excessive secondary stresses in the falsework.

Copies of manufacturer's catalog or brochure showing technical data pertaining to the type of cable to be used must be furnished with the falsework plans. Technical data must include the cable diameter, the number of strands and the number of wires per strand, ultimate breaking strength or recommended safe working strength, and any other information to identify the cable.

Absent sufficient technical data to identify the cable, or if it is old and worn, the Contractor must perform cable breaking tests to establish the safe working load for each reel of cable furnished. For static guy cable the minimum factor of safety must be 3:1. The Contractor must provide the Engineer an opportunity to witness these tests.

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When cable bracing is used to prevent the overturning of heavy-duty shoring, attention must be given to the connections by which forces are transferred from the shoring to the cables. Cable restraint must be designed to act through the cap system to prevent the inadvertent application of forces which the shoring is not designed to withstand. Cables must be attached to any tower component.

Do not use cable splices made by lapping and clipping with Crosby type clamps. Other splicing methods may be used; however, at each location where the cable is spliced, cable strength must be verified by a load test.

When cables are used as external bracing to resist overturning of a falsework system, the horizontal load to be carried by the cables must be calculated as follows:

a. When used with heavy-duty shoring systems, cables must be designed to resist the difference between 1.25 times the total overturning moment and the resistance to overturning provided by the individual falsework towers.

b. When used with pipe-frame shoring systems where supplemental bracing is required, cables must be designed to resist the difference between 1.25 times the total overturning moment and the resistance to overturning provided by the shoring system as a whole.

c. When used as external bracing to prevent overturning of all other types of falsework, including temporary support during erection and removal of falsework at traffic openings, cables must be designed to resist 1.25 times the total overturning moment.

Determine the maximum allowable cable design load using these criteria:

1) If the cable is new, or is in uniformly good condition, and if it can be identified by reference to a manufacturer's catalog or other technical publication, the allowable load must be the ultimate strength of the cable as specified by the manufacturer, multiplied by the efficiency of the cable connector, and divided by a safety factor of 3, i.e. safe working load = breaking strength x connector efficiency/safety factor.

2) If the cable is used but still in serviceable condition, or is new or nearly new but cannot be found in a manufacturer's catalog, the Contractor must perform load breaking tests. The cable design load must not exceed the breaking strength, as determined by the load test, multiplied by the connector efficiency factor, and divided by a safety factor of 3.

3) If the cable is used and still in serviceable condition, or is a new or nearly new cable which cannot be identified, and if load breaking tests are not performed, the cable design load must not exceed the safe working load described in the wire rope capacities table multiplied by the cable connector efficiency.

Cable connectors must be designed using criteria described in the following table Efficiency of Wire Rope Connections and in Section 6-02.3(17)F2. Cable safe working loads are provided in the table Wire Rope Capacities.

Efficiency of Wire Rope Connections

Type of Connection	Connector Efficiency
Wire Rope	100%
Sockets — Zink Type	100%
Wedge Sockets	70%
Clips — Crosby Type with Thimble	80%
Knot and Clip (Contractors Knot)	50%
Plate Clamp — 3 Bolt Type with Thimble	80%
Spliced Eye and Thimble:	—
1/4" and smaller	100%
3/8" to 3/4"	95%
7/8" to 1"	88%
1 1/8" to 1-1/2"	82%
1 5/8" to 2"	75%
2 1/8" and larger	70%

NOTE: Efficiencies of wire rope connections are as compared to safe loads on wire rope.

Wire Rope Capacities

Diameter Inches	Weight Lbs/Ft	Safe Load Lbs
1/4	0.10	1,050
5/16	0.16	1,500
3/8	0.23	2,250
7/16	0.31	3,070

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Diameter Inches	Weight Lbs/Ft	Safe Load Lbs
1/2	0.40	4,030
9/16	0.51	4,840
5/8	0.63	6,330
3/4	0.95	7,930
7/8	1.29	10,730
1	1.60	15,000
1 1/8	2.03	18,600
1 1/4	2.50	23,000
1 3/8	3.03	25,900
1 1/2	3.60	30,700
1 5/8	4.23	35,700
1 3/4	4.90	41,300

NOTE; Wire rope capacity safe loads are in pounds for new plow steel hoisting rope, 6 strands of 19 wires, hemp center (safety factor of 6).

6-02.3(17)F2 APPLYING WIRE ROPE CLIPS

The only correct method of attaching U-bolt wire rope clips to rope ends is to place the base (saddle) of the clip against the live end of the rope, while the “U” of the bolt presses against the dead end.

The clips are usually spaced about 6 rope diameters apart to give adequate holding power. Use a wire-rope thimble in the loop eye to prevent kinking when wire rope clips are used. The correct number of clips for safe application, and spacing distances, are shown below:

Number of Clips and Spacing for Safe Application

Improved Plow Steel Rope Diameter Inches	Number of Clips		Minimum Spacing (Inches)
	Drop Forged	Other Material	
3/8	2	3	3
1/2	3	4	3 1/2
5/8	3	4	4
3/4	4	5	4 1/2
7/8	4	5	5 1/4
1	5	6	6
1 1/8	6	6	6 3/4
1 1/4	6	7	7 1/2
1 3/8	7	7	8 1/4
1 1/2	7	8	9

6-02.3(17)F3 ANCHOR BLOCKS

Concrete anchor blocks and connections used to resist forces from external bracing must be shown in the falsework plans. Concrete anchor blocks must be proportioned to resist both sliding and overturning. When designing anchor block stability, the mass of the anchor block must be reduced by the vertical component of the cable or brace tension to obtain the net or effective mass to be used in the anchorage computations. The coefficient of friction assumed in the design must not exceed the following:

Surface	Friction Coefficient
Anchor block set on sand	0.40
Anchor block set on clay	0.50
Anchor block set on gravel	0.60
Anchor block set on pavement	0.60

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NOTE: Multiply the friction coefficient by 0.67 if it is likely the supporting material is wet or will become wet during the construction period.

The method of connecting the cable or brace to the anchor block is part of the anchor block design. The connection must be designed to resist both horizontal and vertical forces.

6-02.3(17)F4 TEMPORARY BRACING FOR BRIDGE GIRDERS DURING ERECTION

Steel girders must be braced as specified in Section 6-03.3(7)A.

Prestressed concrete girders must be braced sequentially during girder erection. The bracing must be designed and detailed by the Contractor and must be shown in the falsework/formwork plans submitted to the Engineer for approval. The Contractor must furnish, install, and remove the bracing at no additional cost to the Owner.

At a minimum, the Contractor must brace girders at each end and at midspan to prevent lateral movement or rotation. This bracing must be placed before the release of each girder from the erection equipment. If the bridge is constructed with cast-in-place concrete diaphragms, the bracing may be removed once the concrete in the diaphragms has been placed and cured for a minimum of 24 hours.

6-02.3(17)F5 TEMPORARY BRACING FOR BRIDGE GIRDERS DURING DIAPHRAGM AND BRIDGE DECK CONCRETE PLACEMENT

Prestressed concrete girders must be braced to resist forces that would cause rotation or torsion in the girders caused by the placing of precast concrete deck panels and concrete for the bridge deck.

Bracing must be designed and detailed by the Contractor and must be shown in the falsework/formwork plans submitted to the Engineer for approval. These braces must be furnished, installed, and removed by the Contractor at no additional cost to the Owner. The Contractor may consider the bracing effects of the diaphragms in developing the falsework/formwork plans. The Contractor must account for the added load from concrete finishing machines and other construction loadings in the design of the bracing.

Falsework support brackets and braces must not be welded to structural steel bridge members or to steel reinforcing bars.

6-02.3(17)G TESTING FALSEWORK DEVICES

The Contractor must establish the load capacity and deflection or settlement of all friction collars and clamps, brackets, hangers, saddles, sand jacks, and similar devices using a recognized independent testing Laboratory approved by the Engineer. Laboratory tests must use the same materials and design that will be used on the project. Test loads must be applied to the device in the same manner that the device will experience loading on the project. Any bolts or threaded rods used with the device must be identified as to diameter, length, type, grade, and torque. Any wedges, blocks, or shims used with the device on the project must also be tested with the device. Any adjustable jack system used as a part of a device must be tested with the device and must have its maximum safe working extended height identified. Devices must not be tested in contact with the permanent Structure. Use independent members with the same properties as the permanent Structure to test device connections.

At least 14 Days before the test, the Contractor must submit a test procedure and scale drawing for the Engineer's approval showing how the device will be tested and how data will be collected. The Contractor must provide the Engineer an opportunity to witness these tests.

The approved independent testing Laboratory must provide a certified test report which must be signed and dated. The test report must clearly identify the device tested including trademarks and model numbers; identify all parts and materials used, including grade of steel, or lumber, member section dimensions; location, size, and the maximum tested extended height of any adjustable jacks; indicate condition of materials used in the device; indicate the size, length and location of all welds; indicate how much torque was used with all bolts and threaded rods. The report must describe how the device was tested, report the results of the test, provide a scale drawing of the device showing the location of where deflections or settlements were measured, and show where load was applied. Deflections or settlements must be measured at load increments and the results must be clearly graphed and labeled. Before installation of falsework devices named in this Section, the Contractor must submit the certified test reports to the Engineer for review and approval.

The safe working load for shop manufactured devices named in this Section must be derived by dividing the ultimate strength by a safety factor of 2.0. Determine the safe working load for field produced or field modified devices, including using timber blocks or wedges with the device, by dividing the ultimate strength by a safety factor of 3.0. Working load must include masses of all successive concrete placements, falsework, forms, all load transfer that takes place during post-tensioning, and any live loads; such as workers, roadway finishing machines, and concrete delivery systems. The maximum allowable free end deflection of deck overhang brackets with combined dead and live working loads applied is 3/16 inch even though deflection may be compensated for by pre-cambering or setting the elevations high. The Contractor must comply with all manufacturer's Specifications; including those relating to bolt torque, cleaning and oiling of parts, and the reuse of material. Devices which are deteriorated, bent, warped or have poorly fitted connections or welds, must not be installed.

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6-02.3(17)H FORMWORK ACCESSORIES

Formwork accessories such as form ties, form anchors, form hangers, anchoring inserts, and similar hardware must be specifically identified in the formwork plans including the name and size of the hardware, manufacturer, safe working load, and factor of safety. The grade of steel must also be indicated for threaded rods, coil rods, and similar hardware. Do not use wire form ties.

Welding or clamping formwork accessories to Contract Plan reinforcing steel is not allowed. Do not use driven types of anchorages for fastening forms or form supports to concrete, or Contractor manufactured J hooks. Field drilling of holes in prestressed girders is not allowed.

Taper ties may be used provided the following conditions are met:

1. The structure is not designed to resist water pressure, such as pontoons, floating dolphins, or detention vaults.
2. After the taper tie is removed, plugs designed and intended for plugging taper tie holes must be installed at each face of concrete. The plug must be installed a minimum of 1-1/2" clear from the face of concrete.
3. After the plug is installed, the hole must be cleaned of all grease, contamination and foreign matter.
4. Holes on the exposed faces of concrete must be patched and finished to match the surrounding concrete

The following table from ACI 347R-88 provides minimum safety factors for formwork accessories. The hardware proposed must comply with these minimum ultimate strength requirements or the manufacturer's minimum requirements, whichever provides the greater factor of safety. The Contractor must attach copies of the manufacturer's catalog cuts and/or test data of hardware proposed, to the formwork plans and submit the falsework and formwork plans and calculations for review and approval per Section 6-02.3(16). Where catalog cuts and/or test data are not available, testing must be performed as specified in Section 6-02.3(17)G.

Minimum Safety Factors of Formwork Accessories[1]

Accessory	Safety Factor	Type of Construction
Form Tie	2.0	All applications.
Form Anchor	2.0	Formwork supporting form mass and concrete pressures only.
Form Anchor	3.0	Formwork supporting masses of forms, concrete, construction live loads, and impact.
Form Hangers	2.0	All applications.
Anchoring Inserts	2.0	Placed in previous opposing concrete placement to act as an anchor for form tie.

NOTE:

1. Safety factors are based on ultimate strength of the formwork accessory.

The bearing area of external holding devices must be adequate to prevent excessive bearing stress on form lumber. Form ties and form hangers must be arranged symmetrically on the supporting members to minimize twisting or rotation of the members. Form tie elongation must not exceed the allowable deflection of the wale or member it supports. Inserts, bolts, coil rods, and other fasteners must be analyzed and designed for appropriately combined bending, shear, torsion, and tension stresses. The formwork must not be attached to Contract Plan rebar or rebar cages. However, the Contractor may install additional reinforcing steel for formwork anchorage.

Frictional resistance is not considered as contributing to the stability of any connection or connecting device, except those designed as friction connectors such as U-bolt friction-type connectors.

Form anchors and anchoring inserts must be designed considering concrete strength at time of loading, available embedment, location in the member, and any other factors affecting their working strength, and must be installed in concrete per the manufacturer's published requirements. Form anchors and anchoring inserts embedded in previous concrete placements must not be loaded until the concrete has reached the required design strength. The required design strength of concrete for loading of an anchor must be shown on the formwork drawing if it is assumed that the anchor will be loaded before the concrete has reached its 28-Day strength.

Installation of permanent concrete inserts, such as form ties hangers, or embedded anchor assemblies, must allow removal of all metal to at least 1/2 inch below the concrete surface. Holes must be patched as specified in Section 6-02.3(14). During removal of the outer unit, the bond between the concrete and the inner unit or rod must not be broken.

6-02.3(17)I TIMBER CONNECTIONS

Timber connections must be designed per the methods, stresses, and loads allowed in the Timber Construction Manual, Current Edition by the American Institute of Timber Construction (AITC). Timber falsework and formwork connections must be designed using wet condition stresses for all installations West of the Cascade Range crest line and by criteria provided in the following Sections. Frictional resistance is not considered as contributing to the stability of any timber connection.

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6-02.3(17)I1 BOLTED CONNECTIONS

Tabulated values in the AITC Timber Construction Manual, Current Edition are based on square posts. For a round post or pile, the main member thickness must be the side of a square post having the same cross-sectional area as the round post used.

The AITC Table 6.20 for Douglas Fir-Larch bolt Group 3 and for Hem-Fir bolt Group 8 show design values for bolts to be used when the load is applied either parallel or perpendicular to the direction of the wood grain. When the load is applied at an angle to the grain, as is the case with falsework bracing, the design value for the main member must be obtained from the Hankinson formula described in the AITC manual.

Design values in the AITC Table 6.20 apply only to 3 member joints (bolt in double-shear) in which the side members are each 1/2 the thickness of the main member. This joint configuration is not typical of bridge falsework where side members are usually much smaller than main members. For 2 member joints (single shear bolt condition), the AITC Table 6.20 values must be adjusted by a single shear load factor as follows:

1. 0.75 for installations East of the Cascade Range crest line, except as described in item 3 below;
2. 0.50 for installations West of the Cascade Range crest line; and
3. 0.50 for load acting at an angle to the bolt axis, as is the case with longitudinal bracing when falsework bents are skewed.

Except for connections in falsework adjacent to or over railroads or roadways, threaded rods and coil rods may be used in place of bolts of the same diameter with no reduction in the tabulated values. At openings for roadways and railroads, all connections must be bolted using 5/8-inch diameter or larger through bolts.

Bolt holes must be a minimum 1/32 inch to a maximum 1/8 inch larger than the bolt diameter. A washer not less than a standard cut washer must be installed between the wood and the bolt head and between the wood and the nut to distribute the bearing stress under the bolt head and nut and to avoid crushing the fibers. Instead of standard cut washers, metal plates or straps with dimensions at least equal to that of a standard cut washer may be substituted.

When steel bars or shapes are used as diagonal bracing, the tabulated design values described in AITC Table 6.20 for the main members loaded parallel to grain (P value) are increased 75 percent for joints made with bolts 1/2-inch or less in diameter, 25 percent for joints made with bolts 1-1/2-inch in diameter, and proportionally for intermediate diameters. No increase in the tabulated values is allowed for perpendicular-to-grain loading (Q value).

Clearance requirements for end, edge, and bolt spacing distance must be as shown below. All distances are measured from the end or side of the wood member to the center of the bolt hole. For members subject to load reversals, use the larger controlling distances for design. For parallel-to-grain loading, use the minimum distances for full design load:

a. In tension, minimum end distance must be 7 times the bolt diameter;
b. In compression, minimum end distance must be 4 times the bolt diameter; and
c. In tension or compression, the minimum edge distance must be 1.5 times the bolt diameter.

For perpendicular-to-grain loading, the minimum distance for full design load:

1) Minimum end distance must be 4 times the bolt diameter;
2) Edge distance toward which the load is acting must be at least 4 times the bolt diameter; and
3) Distance on the opposite edge must be at least 1.5 bolt diameters.

Minimum clearance (spacing) between adjacent bolts in a row must be 4 times the bolt diameter, measured center-to-center of the bolt holes.

When more than 2 bolts are used in a line parallel to the axis of the side member, additional requirements must be followed as described in the AITC manual.

6-02.3(17)I2 LAG SCREW CONNECTIONS

Design values for lag screws subject to withdrawal loading are found in AITC Table 6.27. Values for wood having a specific gravity of 0.51 for Douglas Fir-Larch or 0.42 for Hem-Fir must be assumed when using the table. The withdrawal values are in pounds per inch of penetration of the threaded part of the lag screw into the side grain of the member holding the point, with the axis of the screw perpendicular to that member. The maximum load on a screw must not exceed the allowable tensile strength of the screw at the root section.

AITC recommends against subjecting lag screws to end-grain withdrawal loading. However, if this condition cannot be avoided, the design value must be 75 percent of the corresponding value for withdrawal from the side grain.

Use values in the Group II wood species column must for Douglas Fir-Larch and the Group III wood species column must for Hem-Fir. When the load is applied at an angle to the grain, as is the case with falsework bracing, the design value must be obtained from the Hankinson formula described in the AITC manual.

When lag screws are subjected to a combined lateral and withdrawal loading, as would be the case with longitudinal bracing when the falsework bents are skewed, the effect of the lateral and withdrawal forces are determined separately. The withdrawal component of the applied load must not exceed the allowable value in withdrawal. The lateral component of the applied load must not exceed the allowable lateral load value.

Lag screws must be inserted in lead holes as follows:

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1. The clearance hole for the shank must have the same diameter as the shank, and the same depth of penetration as the length of unthreaded shank.
2. The lead hole for the threaded portion must have a diameter equal to 60 to 75 percent of the shank diameter and a length equal to at least the length of the threaded portion. The larger percentile figure in each range must apply to screws of the greater diameters used in Group II wood species.
3. The threaded portion of the screw must be inserted in its lead hole by turning with a wrench, not by driving with a hammer.
4. To facilitate insertion, use soap or other lubricant on the screws or in the lead hole.

6-02.3(17)I3 DRIFT PIN AND DRIFT BOLT CONNECTIONS

When drift pins or drift bolts are used, determine the required length and penetration using the following criteria. The lateral load-carrying capacity of drift pins and drift bolts driven into the side grain of a wood member must be limited to 75 percent of the design values for a common bolt of the same diameter and length in the main member. For drift pin connections, the pin penetration into the connected members must be increased to compensate for the absence of a bolt head and nut. For drift bolts or pins driven into the end grain of a member, the lateral load-carrying capacity must be limited to 60 percent of the allowable side grain load (perpendicular to grain value) for an equal diameter bolt with nut. To develop this allowable load the drift bolt or pin must penetrate at least 12 diameters into the end grain. To fully develop the allowable load of the drift bolts or pins, they must be driven into predrilled holes, 1/16 inch less in diameter than the drift pin or bolt diameter.

The criteria described in the AITC Timber Construction Manual, Current Edition must apply to drift bolt or pin connection allowable loads for the following conditions:

1. Withdrawal resistance; and
2. When there are more than 2 drift bolts or pins in a joint, allowable loads must be further reduced by applying applicable modification factors described in the AITC Table 6.3.

6-02.3(17)I4 NAILED AND SPIKED JOINTS

Joints using nails or spikes must conform to AITC. For side grain withdrawal, use the values in AITC Table 6.35 for wood having a specific gravity of 0.51 for Douglas Fir-Larch and a specific gravity of 0.42 for Hem-Fir. Do not use end grain withdrawal. For lateral loading, use the values in AITC Table 6.36 for wood species Group II for Douglas Fir-Larch and wood species Group III for Hem-Fir. Diameters listed in the tables apply to fasteners before application of any protective coating.

When more than 1 nail or spike is used in a joint, the total design value for the joint in withdrawal or lateral resistance must be the sum of the design values for the individual nails or spikes.

The tabulated design values for lateral loads are valid only when the nail penetrates into the main member at least 11 diameters for Douglas Fir-Larch and 13 diameters for Hem-Fir. Note the values are maximum values for the type and size of fastener shown. The tabulated values must not be increased even if the actual penetration is exceeded.

When main member penetration is less than 11 diameters for Douglas Fir-Larch and 13 diameters for Hem-Fir, determine the design value by straight-line interpolation between 0 and the tabulated load, except that penetration must not be less than 1/3 of that specified.

Double-headed or duplex nails used in falsework and formwork construction are shorter than common wire nails or box nails of the same size designation. They have less penetration into the main member and therefore their load-carrying capacity must be adjusted accordingly.

Nail and spike minimum spacing in timber connections must be as follows:

1. The average center-to-center distance between adjacent nails, measured in any direction, must not be less than the required penetration into the main member for the size of nail being used.
2. The minimum end distance in the side member, and the minimum edge distance in both the side member and the main member, must not be less than 1/2 of the required penetration.

Allowable values for withdrawal and lateral load resistance are reduced when using toe nails, as follows:

a. For withdrawal loading, the design load must not exceed 2/3 of the value described in the applicable design table; and
b. For lateral loading, the design load must not exceed 5/6 of the value described in the applicable design table.

Toe nails are recommended to be driven at an approximate angle of 30 degrees with the piece and started approximately 1/3 of the length of the nail from the end or side of the piece.

6-02.3(17)I5 TIMBER CONNECTION ADJUSTMENT FOR DURATION OF LOAD

Tabulated values for timber fasteners are for normal duration of load and may be increased for short duration loading, except for connections used in falsework and formwork for post tensioned Structures and staged construction sequences. Duration of load adjustment for timber connections is not allowed for all post tensioned Structures and for staged construction sequences where delayed and/or staged loading occurs for any type of concrete Structure. The adjustment for duration of load as described in this Section applies only to design values for timber connectors, such as nails, bolts, and lag screws. Allowable stresses for timber and structural steel components used in the connection, as described in Section 6-02.3(17)B, are maximums and must not be increased.

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Tabulated values for nails, bolts, and lag screws may be adjusted by the following duration-of-load factors:

1. 1.25 for falsework design governed by the minimum design horizontal load or greater (3 percent or greater of the dead load).
2. 1.33 for falsework design governed by wind load.
3. 2.00 for falsework design governed by impact loading.

6-02.3(17)J FACE LUMBER, STUDS, WALES, AND METAL FORMS

Elements of this Section must be designed for the loads, allowable stresses, deflections, and conditions described in the entirety of Section 6-02.3(17).

Forms battered or inclined above the concrete will tend to lift up as concrete is placed and must have positive anchorage or counterweights designed to resist uplift and must be shown on the formwork plans. Where the concrete pouring sequence causes fresh concrete to be significantly higher along one side of tied forms than the opposite side, a positive form anchorage system must be designed capable of resisting the imbalance of horizontal thrust, and prevent the dislocation and sliding of the entire form unit.

Wooden forms must be faced with smooth sanded, exterior plywood. This plywood must comply with the requirements of the National Bureau of Standards, U.S. Product Standard PS 1, and the Design Specification of the American Plywood Association (APA). Each full sheet must bear the APA stamp. The Contractor must list in the form plans the grade and class of plywood. If the Engineer approves the manufacturer's certification of structural properties, the Contractor may use plywood that does not carry the APA stamp. Do not use plywood panels stamped shop or shop cutting.

Plyform is an APA plywood specifically designed and manufactured for concrete forming. Plyform differs from conventional exterior plywood grades in strength and the exterior face panels are sanded smooth and factory oiled. Likewise, there is a significant difference between grades designated Class 1, Class 2, and Structural I Plyform.

The grades of plywood for various form applications must be as follows:

1. Traffic and Pedestrian Barriers that will not receive an architectural surface treatment: must use APA grade High Density Overlaid (HDO) Plyform Class I. But if the Contractor coats the form to prevent it from leaving joint and grain marks on the surface, plywood that meets or exceeds APA grades B-B Plyform Class I or B-C (Group I species) may be used. Under this option, the Contractor must provide for the Engineer's approval a 4-foot square, test panel of concrete formed with the same plywood and coating as proposed in the form plans. This panel must include 1 form joint along its centerline. The Contractor must apply coating material, according to the manufacturer's instructions, before applying chemical release agents.
2. Other Exposed Surfaces all but those on traffic and pedestrian barriers: Use plywood that complies with or exceed the requirements of APA grades B-B Plyform Class I or B-C (Group I series). If 1 face is less than B quality, the B, or better, face must contact the concrete.
3. Unexposed Surfaces, such as the undersides of bridge decks between girders, or the interiors of box girders, and traffic and pedestrian barriers where surfaces will receive an architectural treatment: May use APA grade CDX, provided the Contractor complies with stress and deflection requirements stated elsewhere in these Specifications.

Form joints on an exposed surface must be in a horizontal or vertical plane. But in wingwalls and box girders, side form joints must be placed at right angles and parallel to the roadway grade. Joints parallel to studs or joists must be backed by a stud or joist. Joints at right angles to studs and joists must be backed by a stud or other backing the Engineer approves. Perpendicular backing is not required if studs or joists are spaced:

a. 9 inches or less on center and covered with 1/2-inch plywood, or

b. 12 inches or less on center and covered with 3/4-inch plywood.

The face grain of plywood must run perpendicular to studs or joists unless shown otherwise on the Contractor's formwork plans and approved by the Engineer. Proposals to deviate from the perpendicular orientation must be accompanied by supporting calculations of the stresses and deflections.

Forming for all exposed curved surfaces must comply with the shape of the curve shown on the Drawings and must not be chorded except as follows. On any retaining wall that follows a horizontal circular curve, the wall stems may be a series of short chords if:

1) The chords within the panel are the same length, unless otherwise approved by the Engineer.

2) The chords do not vary from a true curve by more than 1/2 inch at any point.

3) All panel points are on the true curve.

Where architectural treatment is required, the angle point for chords in wall stems must fall at vertical rustication joints.

For exposed surfaces of abutments, wingwalls, piers, retaining walls, and columns, the Contractor must build forms of plywood at least 3/4 inch thick with studs no more than 12 inches on center. The Engineer may approve exceptions, but deflection of the plywood, studs, or wales must never exceed 1/360 of the span, or 1/270 of the span for unexposed surfaces, including the bottom of the deck slab between girders.

All form plywood must be at least 1/2 inch thick. On sharply curved surfaces the Contractor may use 1/4 inch plywood if it is backed firmly with heavier material.

Round columns or rounded pier shafts must be formed with a self-supporting metal shell form or form tube that leaves a smooth, non-spiraling surface. Wood forms are not permitted.

Metal forms must not be used elsewhere unless the Engineer is satisfied with the surface and approves in writing. The Engineer may withdraw approval for metal forms at any time. If permitted to use a combination of wood and metal in forms, the Contractor must coat the forms so the texture produced by the wood matches that of the metal. Do not use aluminum for metal forms.

For design, the Contractor must assume that on vertical surfaces concrete exerts 150 pounds per sq. ft., per foot of depth. However, when the depth is reached where the rate of placement controls the pressure, the following table applies:

Rate of Placing Feet per Hour	Pressure, Pounds per Square Foot for Temperature of Concrete as Shown	
	60 °F	70 °F and above
2	470	375
3	640	565
4	725	625
5	815	690
6	900	750
7	990	815
8	1,075	875
9	1,165	935
10	1,250	1,000
15	1,670	1,300

The pressures in the above table have been increased to provide an allowance for the vibration and impact.

All corners must be beveled 3/4 inch. However, footings, footing pedestals, and seals need not be beveled unless required in the Drawings.

All forms must be as mortar-tight as possible with no water standing in them as the concrete is placed.

The Contractor must apply a parting compound on forms for exposed concrete surfaces. This compound must be a chemical release agent that permits the forms to separate cleanly from the concrete. The compound must not penetrate or stain the surface, or must not attract dirt or other foreign matter. After the forms are removed, the concrete surface must be dust-free and have a uniform appearance. The Contractor must apply the compound at the manufacturer's recommended rate to produce a surface free of dusting action and yet provide easy removal of the forms.

If an exposed concrete surface will be sealed, the release agent must not contain silicone resin. Before applying the agent, the Contractor must provide the Engineer a written statement from the manufacturer stating whether the resin in the base material is silicone or non-silicone.

The Contractor must select a parting compound from the current Qualified Products List, or submit to the Engineer a sample of the parting compound at least 10 Working Days before its use. Approval or disapproval must be based on Laboratory test results.

The Engineer may reject any forms that will not produce a satisfactory surface.

6-02.3(17)K CONCRETE FORMS ON STEEL SPANS

Concrete forms on all steel Structures must be removable and must not remain in place. Where needed, the forms must have openings for truss or girder members. Each opening must be large enough to leave at least 1-1/2 inches between the concrete and steel on all sides of the steel member after the forms have been removed. Unit Contract prices cover all costs related to these openings.

The Contractor must not weld any part of the form to any steel member.

The compression member or bottom connection of cantilever formwork support brackets must bear either within 6 inches maximum vertically of the bottom flange or within 6 inches maximum horizontally of a vertical web stiffener. The Contractor's bridge deck form system must be designed to prevent rotation of the steel girder. This can be achieved by temporary struts and ties or other methods the Contractor shows to be effective. Do not use partial depth cantilever formwork support brackets that do not conform to the above requirements, unless the Contractor submits details showing the additional formwork struts and ties used to brace the steel girder against web distortion caused by the partial depth bracket, and receives the Engineer's approval of the submittal.

If the Engineer permits bolt holes in the web to support form brackets, the holes must be shop drilled unless otherwise approved by the Engineer. The Contractor must fill the holes with fully torqued AASHTO M 164 bolts per Section 6-03.3(33). Each bolt head must be placed on the exterior side of the web. Do not make holes in the flanges.

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6-02.3(17)L FINISHING MACHINE SUPPORT SYSTEM

Before using any finishing machine, the Contractor must obtain the Engineer's approval of detailed drawings that show the system proposed to support it. The Contractor must not attach this or any other equipment support system to the sides or suspend it from any girder unless the Engineer permits. The Engineer will not allow such a method if it will unduly change stress patterns or create too much stress in the girder.

6-02.3(17)M RESTRICTED OVERHEAD CLEARANCE SIGN

The Contractor must notify the Engineer not less than 15 Working Days before the anticipated start of each falsework and girder erection operation whenever such falsework or girders will reduce clearances available to traffic. Falsework openings must not be more restrictive to traffic than shown on the Drawings.

Where the height of vehicular openings through falsework is less than 15 feet, a W 12-2 "Low Clearance Symbol Sign" must be erected on the shoulder in advance of the falsework and 2 or more W 12-301 and/or W 12-302 signs must be attached to the falsework to provide accurate usable clearance information over the entire falsework opening. The posted low clearance must include an allowance for anticipated falsework girder deflection, rounded-up to the next whole inch, due to design dead load, including all successive concrete pours. Use W 12-302 signs to designate prominent clearance restrictions and limits of usable clearance. Where the clearance is less than the legal height limit (14'-0"), a W 12-2 sign must be erected in advance of the nearest intersecting road or wide point in the road at which a vehicle can detour or turn around. A W 13-501 sign indicating the distance to the low clearance must be installed below the advance sign. The Engineer will furnish the above noted signs and the Contractor must erect and maintain them, all as specified in Section 1-10.3(3).

When erecting falsework that restricts overhead clearance above a railroad track, the Contractor must place restricted overhead clearance signs as soon as the restriction occurs. Sign details are shown on the Standard Drawings. Unit Contract prices cover all costs relating to these signs.

6-02.3(17)N REMOVAL OF FALSEWORK AND FORMS

If the Engineer does not specify otherwise, the Contractor may remove forms based on an applicable row of criteria in the table below. Both compressive strength and minimum time criteria must be met if both are listed in the applicable row. The minimum time must be from the time of the last concrete placement in the forms. In no case must the Contractor remove forms or falsework without the Engineer's approval.

Concrete Placed In	Percent of Specified Minimum Compressive Strength[1]	Minimum Compressive Strength[1]	Minimum Time
Side forms not supporting the concrete weight, including columns, walls, crossbeams, nonsloping box girder webs, abutments, and traffic and pedestrian barriers.	--	--	3 days
	or		
	--	1,400 psi	18 hours
Side forms of footings, pile caps, and shaft caps.[2]	--	--	18 hours
Crossbeams, sloping box girder webs, struts, inclined columns, inclined walls and other forms that support the concrete weight.	80	--	5 days
Bridge decks supported on wood or steel stringers or on steel or prestressed concrete girders.[3]	80	--	10 days
Box girders, T-beam girders, and flat-slab superstructure.[3]	80	--	14 days
Arches.[3]	80	--	21 days

NOTE:

1. Strength must be proved by test cylinders made from the last concrete placed into the form. The cylinders must be cured according to AASHTO T 23.
2. Curing compound must be immediately applied to the sides when forms are removed.

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3. Where continuous spans are involved, the time for all spans will be determined by the last concrete placed affecting any span.

Before releasing supports from beneath beams and girders, the Contractor must remove forms from columns to enable the Engineer to inspect the column concrete.

Curing must comply with Section 6-02.3(11). The concrete surface must not become dry during form removal if removed during the cure period.

Before placing forms for traffic and pedestrian barriers, the Contractor must completely release all falsework under spans.

Before releasing forms under concrete subjected to temperatures colder than 50 °F, the Contractor must first prove that the concrete meets desired strength — regardless of the time that has elapsed.

The Engineer may approve leaving in place forms for footings in cofferdams or cribs. This decision will be based on whether removing them would harm the cofferdam or crib and whether the forms will show in the finished Structure.

All cells of a box girder Structure which have permanent access must have all forms completely removed, including the bridge deck forms. All debris and all projections into the cells must be removed. Unless otherwise shown on the Drawings, the bridge deck interior forms in all other cells where no permanent access is available, may be left in place.

Falsework and forms supporting sloping exterior webs must not be released until the bridge deck and deck overhang concrete has obtained its removal strength and number of days criteria in the table above. Stem reshoring must not be used.

Open joints shown on the Drawings must have all forms completely removed, including Styrofoam products and form anchors, allowing the completed Structure to move freely.

If the Contractor intends to support or suspend falsework and formwork from the bridge Structure while the falsework and formwork is being removed, the Contractor must submit a falsework and formwork removal plan and calculations for review and approval. The falsework and formwork removal plan must include the following:

a. The location and size of any cast-in-place falsework lowering holes and how the holes are to be filled.
b. The location, capacity, and size of any attachments, beams, cables, and other hardware used to attach to the Structure or support the falsework and formwork.
c. The type, capacity and factor of safety, weight, and spacing of points of reaction of lowering equipment.
d. The weight at each support point of the falsework and formwork being lowered.

All other forms must be removed whether above or below the level of the ground or water. Sections 6-02.3(7) and 6-02.3(8) govern form removal for concrete exposed to sea water or to alkaline water or soil. The forms inside of hollow piers, girders, or abutments must be removed through openings shown on the Drawings or approved by the Engineer.

6-02.3(17)O EARLY CONCRETE TEST CYLINDER BREAKS

The Contractor is responsible for fabrication, curing, and testing of the early cylinders. Early cylinders are defined as all cylinders tested in advance of the design age of 28 days whose purpose is to determine the in-place strength of concrete in a Structure before applying loads or stresses. The Contractor must retain a testing laboratory to perform this Work. Testing laboratories' equipment must be calibrated within 1 year before testing and testers must be ACI certified or qualified per AASHTO R 18.

The concrete cylinders must be molded per AASHTO T 23 from concrete last placed in the forms and representative of the quality of concrete placed in that pour.

The cylinders must be cured per AASHTO T 23.

The concrete cylinders must be tested for compressive strength per AASHTO T 22. The number of early cylinder breaks is per the Contractor's need and as approved by the Engineer.

The Contractor must furnish the Engineer with all test results, proof of equipment calibration, and tester's certification. The test results will be reviewed and accepted before any forms are removed. The Contractor must not remove forms without the approval of the Engineer.

All costs in connection with furnishing cylinder molds, fabrication, curing, and testing of early cylinders must be in the unit Contract prices for the Bid Items of Work involved.

6-02.3(18) PLACING ANCHOR BOLTS

The Contractor must comply with the following requirements in setting anchor bolts in piers, abutments, or pedestals:

1. If set in the wet concrete, the bolts must be accurately placed before the concrete is placed.
2. If the bolts are set in drilled holes, hole diameter must exceed bolt diameter by at least 1 inch. Grouting must comply with Section 6-02.3(20).
3. If the bolts are set in pipe, grouting must comply with Section 6-02.3(20).
4. If freezing weather occurs before bolts can be grouted into sleeves or holes, they must be filled with an approved non-evaporating, antifreeze solution.

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6-02.3(19) BRIDGE BEARINGS

6-02.3(19)A BRIDGE BEARING ASSEMBLIES

For all fixed, sliding, or rolling bearings, the Contractor must:

1. Machine all sliding and rolling surfaces true, smooth, and parallel to the movement of the bearing.
2. Polish all sliding surfaces.
3. Anchor expansion bearings securely, setting them true to line and grade.
4. Avoid placing concrete in such a way that it might interfere with the free action of any sliding or rolling surface.

Grout placement under steel bearings must comply with Section 6-02.3(20).

6-02.3(20) GROUT FOR ANCHOR BOLTS AND BRIDGE BEARINGS

Grout must conform to Section 9-20.3(2)

Grout must be a workable mix with viscosity suitable for the intended application.

If the Contractor elects to use a prepackaged grout, it must conform to Section 9-20.3(2) for bearing assemblies with bearing plates, and must conform to Section 9-20.3(3) for elastomeric bearing pads and fabric pad bearings without bearing plates, and a material sample and laboratory test data from an independent testing laboratory must be submitted to the Engineer for approval with the request for approval of material sources.

If the Contractor elects to use a neat cement grout it must conform to Section 9-20.3(4), and the mix proportions and laboratory test data from an independent test laboratory must be submitted to the Engineer for approval with the request for approval of material sources.

The Contractor must receive approval from the Engineer before using the grout.

Field grout cubes must be made per WSDOT Test Method 813 for either prepackaged grout or a Contractor provided mix when requested by the Engineer, but not less than 1 per bridge pier or 1 per day.

Before placing grout, the concrete on which it is to be placed must be thoroughly cleaned, roughened, and wetted with water to ensure proper bonding. The grout pad must be cured as recommended by the manufacturer or kept continuously wet with water for 3 days. The grout pad may be loaded when a minimum of 4000 psi compressive strength is attained.

Before placing grout into anchor bolt sleeves or holes, the cavity must be thoroughly cleaned and wetted to ensure proper bonding.

To grout bridge bearing masonry plates, the Contractor must:

1. Build a form approximately 4 inches high with sides 4 inches outside the base of each masonry plate.
2. Fill each form to the top with grout.
3. Work grout under all parts of each masonry plate.
4. Remove each form after the grout has hardened.
5. Remove the grout outside each masonry plate to the base of the masonry plate.
6. Bevel off the grout neatly to the top of the masonry.
7. Place no additional load on the masonry plate until the grout has set at least 72 hours.

After all grout under the masonry plate and in the anchor bolt cavities has attained a minimum strength of 4,000 psi, the anchor bolt nuts must be tightened to snug-tight. “Snug-tight” means either the tightness reached by a few blows from an impact wrench, or the full effort of a person using a spud wrench. Once the nut is snug-tight, the anchor bolt threads must be burred just enough to prevent loosening of the nut.

6-02.3(21) DRAINAGE OF BOX GIRDER CELLS

To drain box girder cells, the Contractor must provide and install, according to details in the Drawings, short lengths of nonmetallic pipe in the bottom slab at the low point of each cell. The pipe must have a minimum inside diameter of 4 inches. If the difference in plan elevation is 2 inches or less, the Contractor must install pipe in each end of the box girder cell. All drainage holes must be screened per the Drawings.

6-02.3(22) DRAINAGE OF SUBSTRUCTURE

The Contractor must use weep holes and gravel backfill that complies with Section 9-03.10(2) to drain fill material behind retaining walls, abutments, tunnels, and wingwalls. To maintain thorough drainage, weep holes must be placed as low as possible. Weep holes must be covered with geotextile meeting the requirements of Section 9-37.2, Table 2 Class C before backfilling. Geotextile screening must be bonded to the concrete with an approved adhesive. Gravel backfill must be placed and compacted as required in Section 2-10. If the Drawings require tiling; French or rock drains, or other drainage devices must be installed.

If underdrains are not installed behind the wall or abutment, all backfill within 18 inches of weep holes must comply with Section 9-03.10(4). Unless the Drawings require otherwise, all other backfill behind the wall or abutment must be gravel backfill for walls.

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6-02.3(23) OPENING TO TRAFFIC

Bridges with a bridge deck made of Portland cement concrete must remain closed to all traffic, including construction equipment, until the concrete has reached the 28 day specified compressive strength. Determine this strength by testing cylinders made of the same concrete as the deck slab and cured under the same conditions. A concrete deck bridge must never be opened to traffic earlier than 10 days after the deck concrete was placed and never without the written approval of the Engineer.

For load restrictions on bridges under construction, refer to Section 6-01.5.

6-02.3(24) REINFORCEMENT

Although the Drawings may include a bar list and bending diagram, these are used at the Contractor's risk. Determine reinforcement fabrication details from the information provided in the Drawings. Before delivery of the reinforcing bars, the Contractor must submit to the Engineer 2 informational copies of the supplemental bending diagrams.

6-02.3(24)A FIELD BENDING

If the Drawings call for field bending of steel reinforcing bars, the Contractor must bend them in keeping with the Structure configuration and the Drawings and Specifications. Bending steel reinforcing bars partly embedded in concrete per these requirements:

Field bending must not be done:

1. On bars size No. 14 or No. 18.
2. When air temperature is lower than 45 °F.
3. With hammer blows or pipe sleeves.
4. While bar temperature is 400 °F to 700 °F.

In field-bending steel reinforcing bars, the Contractor must:

a. Make the bend gradually.
b. Apply heat as described in Tables 2 and 3 for bending bar sizes No. 6 through No. 11 and for bending bar sizes No. 5 and smaller when the bars have been previously bent. Previously unbent bars of sizes No. 5 and smaller may be bent without heating.
c. Use a bending tool equipped with a bending diameter as listed in Table 1.
d. Limit any bend to a maximum of 135 degrees for bars smaller than size No. 9, and 90 degrees for bars size No. 9 and No. 11.
e. Straighten by moving a hickey bar, if used, progressively around the bend.

In applying heat for field-bending steel reinforcing bars, the Contractor must:

1) Use a method that will avoid damages to the concrete.
2) Insulate any concrete within 6 inches of the heated bar area.
3) Ensure, by using temperature-indicating crayons or other suitable means, that steel temperature never exceeds the maximum temperatures described in Table 2 below.
4) Maintain the steel temperature within the required range described in Table 2 below during the entire bending process.
5) Apply 2 heat tips simultaneously at opposite sides of bars larger than size No. 6 to assure a uniform temperature throughout the thickness of the bar. For size No. 6 and smaller bars, apply 2 heat tips, if necessary.
6) Apply the heat for a long enough time that within the bend area the entire thickness of the bar, including its center, reaches the required temperature.
7) Bend immediately after the required temperature has been reached.
8) Heat at least as much of the bar as Table 3 below requires.
9) Locate the heated section of the bar to include the entire bending length. and
10) Never cool bars artificially with water, forced air, or other means.

Bending Diameters for Field-Bending Reinforcing Bars

Bar Size	Bend Diameter/Bar Diameter Ratio	
	Heat Not Applied	Heat Applied
No. 4, No. 5	8	8
No. 6 through No. 9	Not Permitted	8
No. 10, No. 11	Not Permitted	10

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The minimum bending diameters for stirrups and ties for No. 4 and No. 5 bars when heat is not applied is specified in Section 9-07.

Preheating Temperatures for Field-Bending Reinforcing Bars Temperature (F)

Bar Size	Minimum	Maximum
No. 4	1,200	1,250
No. 5, No. 6	1,350	1,400
No. 7 through No. 9	1,400	1,450
No. 10, No. 11	1,450	1,500

Minimum Bar Length to be Heated (d = nominal diameter of bar)

Bar Size	Bend Angle		
	45 degrees	90 degrees	135 degrees
No. 4 through No. 8	8d	12d	15d
No. 9	8d	12d	Not Permitted
No. 10, No. 11	9d	14d	Not Permitted

6-02.3(24)B PROTECTION OF MATERIALS

The Contractor must protect reinforcing steel from all damage. When placed into the Structure, the steel must be free from dirt, loose rust or mill scale, paint, oil, and other foreign matter.

When transporting, storing, or constructing in close proximity to bodies of salt water, plain and epoxy-coated steel reinforcing bar must be kept in enclosures that provide protection from the elements.

If plain or epoxy-coated steel reinforcing bar is exposed to mist, spray, or fog that may contain salt, it must be flushed with fresh water before concrete placement.

When the Engineer requires protection for reinforcing steel that will remain exposed for a length of time, the Contractor must protect the reinforcing steel:

1. By cleaning and applying a coat of paint conforming to Section 9-08.2 Item 3, Formula A-9-73 over all exposed surfaces of steel, or
2. By cleaning and painting paint conforming to Section 9-08.2 Item 3, Formula A-9-73 on the first 6 inches of the steel bars protruding from the concrete and covering the bars with polyethylene sleeves.

The paint must have a minimum dry film thickness of 1-mil.

6-02.3(24)C PLACING AND FASTENING

The Contractor must position reinforcing steel as the Drawings require and must ensure that the steel does not move as the concrete is placed.

When spacing between bars is 1 foot or more, they must be tied at all intersections. When spacing is less than 1 foot, every other intersection must be tied. If the Drawings require bundled bars, they must be tied together with wires at least every 6 feet. All epoxy-coated bars in the top mat of the bridge deck must be tied at all intersections. Other epoxy-coated bars must also be tied at all intersections, but must be tied at alternate intersections when spacing is less than 1 foot in each direction. Wire used for tying epoxy-coated reinforcing steel must be plastic coated. Tack welding is not permitted on reinforcing steel.

Abrupt bends in the steel are permitted only when one steel member bends around another. Vertical stirrups must pass around main reinforcement or be firmly attached to it.

For slip formed concrete, the reinforcing steel bars must be tied at all intersections and cross braced to keep the cage from moving during concrete placement. Cross bracing must be with additional reinforcing steel. Cross bracing must be placed both longitudinally and transversely.

After reinforcing steel bars are placed in a traffic or pedestrian barrier and before slip form concrete placement, the Contractor must check clearances and reinforcing steel bar placement. This check must be accomplished by using a template or by operating the slip form machine over the entire length of the traffic or pedestrian barrier. All clearance and reinforcing steel bar placement deficiencies must be corrected by the Contractor before slip form concrete placement.

Use mortar blocks, or other approved devices, to maintain the concrete coverage required by the Drawings. The Mortar blocks must:

1. Have a bearing surface measuring not greater than 2 inches in either dimension.
2. Have a compressive strength equal to that of the concrete in which they are embedded.

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In slabs, each mortar cube must have either: a grooved top that will hold the reinforcing bar in place, or an embedded wire that protrudes and is tied to the reinforcing steel. If this wire is used around epoxy-coated bars, it must be coated with plastic.

Mortar blocks may be accepted based on a manufacturer's certificate of compliance.

Instead of mortar blocks, the Contractor may use metal or plastic chair supports to hold uncoated bars. Any surface of a metal chair support not covered by at least 1/2 inch of concrete must be one of the following:

a. Hot-dip galvanized after fabrication in keeping with AASHTO M 232 Class D.
b. Coated with plastic firmly bonded to the metal. This plastic must be at least 3/32 inch thick where it touches the form and must not react chemically with the concrete when tested in the SPU's Materials Laboratory. The plastic must not shatter or crack at or above -5 °F, or deform enough to expose the metal at or below 200 °F.
c. Stainless steel that comply with the requirements of ASTM A 493, Type 302. Stainless steel chair supports are not required to be galvanized or plastic coated.

Instead of mortar blocks, epoxy-coated reinforcing bars may be supported by one of the following:

1) Metal chair supports coated entirely with a dielectric material such as epoxy or plastic.
2) Other epoxy-coated reinforcing bars.
3) Plastic chair supports.

Plastic chair supports must be lightweight, non-porous, and chemically inert in concrete. Plastic chair supports must have rounded seatings, must not deform under load during normal temperatures, and must not shatter or crack under impact loading in cold weather. Plastic chair supports must be placed at spacings greater than 1 foot along the bar and must have at least 25 percent of their gross place area perforated to compensate for the difference in the coefficient of thermal expansion between plastic and concrete. The shape and configuration of plastic supports must allow complete concrete consolidation in and around the support.

In bridge decks, roadway and sidewalk slabs, the Contractor must place reinforcing steel mats carefully to provide the required concrete cover. A "mat" is 2 layers of steel. Top and bottom mats must be supported enough to hold both in their proper positions. If No. 4 bars make up the lower layer of steel in a mat, it must be blocked at not more than 3-foot intervals (or 4-foot intervals for bars No. 5 and larger). Wire ties to girder stirrups is not considered as blocking. To provide a rigid mat, the Contractor must add other supports and tie wires to the top mat as needed.

If a bar will interfere with a bridge drain, it must be bent in the field to bypass the drain.

Clearances must be at least as follows:

Clearance	Materials
4 inches between	Bars and the surface of any concrete masonry exposed to the action of salt or alkaline water.
3 inches between	Bars and the surface of any concrete deposited against earth without intervening forms.
2-1/2 inches between	Adjacent bars in a layer. Bridge deck bars and the top of the bridge deck.
2 inches between	Adjacent layers. Bars and the surface of concrete exposed to earth. Reinforcing bars and the faces of forms for exposed aggregate finish.
1-1/2 inches between	Bars and the surface of concrete when not specified otherwise in this Section or in the Plans. Barrier and curb bars and the surface of concrete.
1 inch between	Bridge deck bars and the bottom of the bridge deck. Slab bars and the top surface of the bottom slab of a cast-in-place concrete box girder.

Cover to ties and stirrups may be 1/2 inch less than the values specified for main bars but must not be less than 1 inch.

Reinforcing steel bars must not vary more than the following tolerances from their position shown on the Drawings.

Material	Allowable Variance
Members 10 inches or less in thickness	± 1/4 in
Members more than 10 inches in thickness	± 3/8 in
Drilled Shafts top of rebar cage elevation	+ 6-in/-3 in
Except:	
The distance between the nearest reinforcing steel bar surface and the top surface of the bridge deck slab	+ 1/4 in
Longitudinal spacing of bends and ends of bars	± 1 in

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Material	Allowable Variance
Length of bar laps	-1-1/2 in
Embedded length:	--
No. 3 through No. 11	-1 in
No. 14 through No. 18	-2 in
When reinforcing steel bars are to be placed at equal spacing within a plane:	--
Stirrups and ties	±1 in
All other reinforcement	±1 bar diameter

Before placing any concrete, the Contractor must:

a) Clean all mortar from reinforcement.

b) Obtain the Engineer's permission to place concrete after the Engineer has inspected the placement of the reinforcing steel. Any concrete placed without the Engineer's permission will be rejected and removed.

6-02.3(24)D SPLICING

The Contractor must supply steel reinforcing bars in the full lengths the Drawings require. Unless the Engineer approves in writing, the Contractor must not change the number, type, or location of splices.

The Engineer may allow the Contractor to use thermal or mechanical splices in place of the method shown on the Drawings if they are of an approved design. Use of a new design may be granted if:

1. The Contractor provides technical data and proof from the manufacturer that the design will perform satisfactorily.
2. Sample splices and materials from the manufacturer pass the Engineer's tests.

After a design has been approved, any changes in detail or material requires new approval.

When splicing, the Contractor must:

a. Not lap-splice reinforcing bars 14 or 18.

b. Not allow any welded or mechanical splice to deviate in alignment more than 1/4 inch per 3-1/2 feet of bar.

c. Distribute splices evenly, grouping them together only at points of low tensile stress.

d. Ensure at least 2 inches clearance between any splice and the nearest bar or the surface of the concrete, or 1-1/2 inch for the length of the sleeve on mechanical splices.

e. Rigidly clamp or wire all splices in a way the Engineer approves.

f. Place lap-spliced bars in contact for the length of the splice and tie them together near each end.

g. Securely fasten the ends and edges of welded-wire-fabric reinforcement, overlapping them enough to maintain even strength.

6-02.3(24)E WELDING REINFORCING STEEL

Welding of steel reinforcing bars must conform to the requirements of ANSI/AWS D1.4 Structural Welding Code - Reinforcing Steel, latest edition, except where superseded by the Contract, Drawings, and these Specifications.

Before any welding starts, the Contractor must obtain the Engineer's approval of a written welding procedure for each type of welded splice to be used, including the weld procedure Specifications and joint details. The weld procedure specifications must be written on a form taken from AWS D1.4 Annex A, or equivalent. Test results of tensile strength, macroetch, and visual examination must be included. The form must be signed and dated.

Welders must be qualified per AWS D1.4. The Contractor must be responsible for the testing and qualification of welders, and must submit welder qualification and retention records to the Engineer for approval. The weld joint and welding position a welder is qualified in are per AWS D1.4. The welder qualifications must remain in effect indefinitely unless, the welder is not engaged in a process of welding for which the welder is qualified for a period exceeding 6 months, or there is some specific reason to question a welder's ability.

Filler metals used for welding reinforcing bars are per AWS D1.4 Table 5.1. All filler metals must be low-hydrogen and handled in compliance with low-hydrogen practices specified in the AWS code.

All welding must be protected from air currents, drafts, and precipitation to prevent loss of heat or loss of arc shielding. Short circuiting transfer with gas metal arc welding is not allowed. Slugging of welds is not allowed.

The minimum preheat and interpass temperature for welding is per AWS D1.4 Table 5.2 and mill certification of carbon equivalence, per lot of reinforcing. Preheating must be applied to the reinforcing bars and other splice members within 6 inches of the weld, unless limited by the available lengths of the bars or splice member.

Generally, post heating of welded splices is only required for direct butt welded splices of AASHTO M 31 Grade 60 bars size No. 9 or larger and must be done immediately after welding before the splice has cooled to 700 °F. Post heating must not be less than 800 °F nor more than 1,000 °F and held at this temperature for not less than 10 minutes before allowing the splice to cool naturally to ambient temperature.

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For compatibility with AWS D1.4, welded lap splices for spiral or hoop reinforcing are considered Flare-V groove welds, indirect butt joints.

The Contractor is responsible for using a welding sequence that will limit the alignment distortion of the bars due to the effects of welding. The maximum out-of-line permitted will be 1/4 inch from a 3.5-foot straight-edge centered on the weld and in line with the bar.

The following procedure for welding steel reinforcing bars is recommended:

Sheared bar ends must be burned or sawed off a minimum of 1/2 inch to completely remove the ruptured portion of the steel shear area before welding butt splices. Surfaces to be welded must be smooth, uniform, and free from fins, tears, cracks, and other defects. Surfaces to be welded and surfaces adjacent to a weld must also be free from loose or thick scale, slag, rust, moisture, grease, paint, epoxy covering, or other foreign materials. All tack welds must be within the area of the final weld. No other tack weld will be permitted. Double bevel groove welds require chipping, grinding, or gouging to sound metal at the root of the weld before welding the other side. Progression of vertical welding must be upward. The ground wire from the welding machine must be clamped to the bar being welded.

Should the Contractor elect to use a procedure which differs in any way from the procedure recommended, the Contractor must submit the changes, in writing, to the Engineer for approval. Approved weld procedures must be strictly followed.

6-02.3(24)F MECHANICAL SPLICES

The Contractor must form mechanical splices with an Engineer-approved system using sleeve filler metal, threaded coupling, or another method that complies with this Section.

If necessary to maintain required clearances after the splices are in place, the Contractor must adjust, relocate, or add stirrups, ties, and bars.

Before splicing, the Contractor must provide the Engineer with the following information for each shipment of splice material:

a. The type or series identification, and heat treatment lot number for threaded-sleeve splices.
b. The grade and size of bars to be spliced.
c. A manufacturer’s catalog with complete data on material and procedures.
d. A written statement from the manufacturer that the material is identical to that used earlier by the Engineer in testing and approving the system design.
e. A written statement from the Contractor that the system and materials will be used according to the manufacturer’s instructions and all requirements of this Section.

All splices must comply with these criteria:

1. Mechanical splices must develop at least 125 percent of the specified yield strength of the un-spliced bar. The ultimate tensile strength of the mechanical splice must exceed that of the un-spliced bar.
2. The total slip of the bar within the spliced sleeve of the connector after loading in tension to 30.0 ksi and relaxing to 3.0 ksi must not exceed the following measured displacements between gage points clear of the splice sleeve:
   a. 0.01 inches for bar sizes up to No. 14
   b. 0.03 inches for No. 18 bars
3. The maximum allowable bar size for mechanical laps splices must be No. 6.

The Engineer will visually inspect the splices and accept all that appear to conform with the test samples. For sleeve-filler splices, the Engineer will allow voids within the limits on file in the design approval. If the Engineer considers any splice defective, it must be removed and replaced at the Contractor’s expense.

In preparing sleeve-filler metal splices, the Contractor must:

a) Clean the bar surfaces by oxyacetylene torch followed by power wire brushing, or abrasive blasting.
b) Remove all slag, mill scale, rust, and other foreign matter from all surfaces within and 2 inches beyond the sleeve.
c) Grind down any projection on the bar that would prevent placing the sleeve.
d) Prepare the ends of the bars as the splice manufacturer recommends and as the approved procedure requires.
e) Preheat, just before adding the filler, the entire sleeve and bar ends to 300 °F, ± 50 °F. If a gas torch is used, the flame must not be directed into the sleeve.

When a metallic, sleeve-filler splice is used, or any other system requiring special equipment, both the system and the operator must qualify in the following way under the supervision of the Owner's Materials and Fabrication inspector. The operator must prepare 6 test splices (3 vertical, 3 horizontal) using bars having the same AASHTO Designation and size (maximum) as those to be used in the Work. Each test sample must be 42 inches long, made up of 2 21-inch bars joined end-to-end by the splice. The bar alignment must not deviate more than 1/8 inch from a straight line over the whole length of the sample. All 6 samples must comply with the tensile strength and slip criteria specified in this Section.

The Contractor must provide labor, materials, and equipment for making these test samples at no expense to the Owner. The Owner will test the samples at no cost to the Contractor.

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6-02.3(24)G JOB CONTROL TESTS

As the Work progresses, the Engineer may require the Contractor to provide a sample of thermal or mechanical splice to be used in a project control test. The operator must create this sample on the Job Site with the Engineer present using bars of the same size as those being spliced in the Work. The sample must comply with all requirements of these Specifications, and is in addition to all other sample splices required for qualification. The Engineer will require no more than 2 samples on any project with fewer than 200 splices and no more than 1 sample per 100 splices on any project with more than 200 splices.

6-02.3(24)H EPOXY-COATED STEEL REINFORCING BAR

This Work is furnishing, fabricating, coating, and placing epoxy-coated steel reinforcing bars as the Drawings, these Specifications, and the Contract require. Coating material must be applied electrostatically, by spraying, or by the fluidized-bed method.

All epoxy-coated bars must comply with the requirements of Section 9-07. Fabrication may occur before or after coating.

The Contractor must protect epoxy-coated bars from damage using padded or nonmetallic slings and straps free from dirt or grit. To prevent abrasion from bending or sagging, the Contractor must lift bundled bars with a strong-back, multiple supports, or a platform bridge. Bundled bars must not be dropped or dragged. During shop or field storage, bars must rest on wooden or padded cribbing. The Contractor may substitute other methods for protecting the bars if the Engineer approves. If the Engineer believes the coated bars have been badly damaged, they will be rejected.

Metal chairs and supports must be coated with epoxy, or another inert coating, if the Engineer approves. The Contractor may use other support devices with the Engineer's approval. Use plastic coated tie wire, approved by the Engineer, to protect the coated bars from being damaged during placement.

The bars must be placed as the Drawings require and held firmly in place during placing and setting of the concrete. All bars must be placed and fastened as specified in Section 6-02.3(24)C.

In the interval between installing coated bars and concreting the deck, the Contractor must protect the coating from damage that might result from other construction Work.

The Engineer will inspect the coated bars after they are placed and before the deck concrete is placed. The Contractor must patch any areas that show significant damage as defined below.

Significant damage means any opening in the coating that exposes the steel in an area that exceeds:

1. 0.05 square inches (approximately 1/4-inch square or 1/4 inch in diameter or the equivalent).
2. 0.012 square inches (approximately 1/8-inch square or 1/8 inch in diameter) when the opening is within 1/4 inch of another opening of equal or larger size.
3. 6 inches long, any width.
4. 0.50 square inch aggregate area in any 1-foot length of bar.

The Contractor must patch significantly damaged areas with Engineer-approved patching material obtained from the epoxy resin manufacturer. This material must be compatible with the coating and inert in concrete. Areas to be patched must be clean and free of surface contaminants. Patching must be done before oxidation occurs and according to the resin manufacturer's instructions.

6-02.3(25) PRESTRESSED CONCRETE GIRDERS

The Contractor must perform quality control inspection. The manufacturing plant of prestressed concrete girders must be certified by the Precast/Prestressed Concrete Institute's Plant Certification Program for the type of prestressed member to be produced.

Before the start of production of girders, the Contractor must advise the Engineer of the production schedule. The Contractor must give the inspector safe and free access to the Work. If the inspector observes any Work not in conformance with the Specifications or unacceptable quality control practices, the inspector will advise the plant manager. If the corrective action is not acceptable to the Engineer, the girder will be subject to rejection by the Engineer.

The Owner intends to perform Quality Assurance Inspection. By its inspection, the Owner intends only to facilitate the Work and verify the quality of that Work. This inspection does not relieve the Contractor of any responsibility for identifying and replacing defective material and workmanship.

The various types of girders are:

1. Prestressed Concrete Girder: Refers to prestressed concrete girders of all types, including prestressed concrete I girders, prestressed concrete wide flange I girders, bulb tee girders, deck bulb tee girders, thin flange deck bulb tee girders, precast prestressed members, spliced prestressed concrete girders, and prestressed concrete tub girders.
2. Prestressed Concrete I Girder: Refers to a prestressed concrete girder with a flanged I shaped cross-section, requiring a cast-in-place concrete deck to support traffic loads. Standard girders in this category include Series W42G, W50G, W58G, and W74G.
3. Prestressed Concrete Wide Flange I Girder: Refers to a prestressed concrete girder with an I-shaped cross-section with wide top and bottom flanges, requiring a cast-in-place concrete deck to support traffic loads. Standard girders in this category include Series WF36G, WF42G, WF50G, WF58G, WF66G, WF74G, WF83G, WF95G and WF100G.

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4. Bulb Tee Girder: Refers to a prestressed concrete girder, with a wide top flange requiring a cast-in-place concrete deck to support traffic loads. Standard girders in this category include Series W32BTG, W38BTG, and W62BTG.
5. Deck Bulb Tee Girder: Refers to a bulb tee girder with a top flange designed to support traffic loads, and designed to be mechanically connected at the flange edges to adjacent girders at the Job Site. Unless otherwise specified, deck bulb tee girders must conform to all requirements specified for bulb tee girders. Standard girders in this category include Series W35DG, W41DG, W53DG, and W65DG.
6. Thin Flange Deck Bulb Tee Girder: Refers to a bulb tee girder with a top flange width equal to the girder spacing and requiring a cast-in-place concrete deck to support traffic loads. Unless otherwise specified, thin flange deck bulb tee girders must conform to all requirements specified for bulb tee girders. Standard girders in this category include Series W32TFG, W38TFG, W50TFG, and W62TFG.
7. Precast Prestressed Member (PCPS Member) – Refers to a precast prestressed slab, precast prestressed ribbed section, or a deck double tee girder. PCPS members are designed to be mechanically connected at the flange or member edges to adjacent PCPS members at the Job Site. Unless otherwise specified, PCPS members must conform to all requirements specified for deck bulb tee girders.
8. Spliced Prestressed Concrete Girder – Refers to prestressed concrete girders initially manufactured in segments to be longitudinally spliced together with cast-in-place concrete closures at the Job Site. Unless otherwise specified, spliced prestressed concrete girders must conform to all requirements specified for prestressed concrete girders. Anchorages must conform to Sections 6-02.3(26)B, 6-02.3(26)C, and 6-02.3(26)D. Ducts must conform to the Section 6-02.3(26)E requirements for internal embedded installation, except that ducts for I girders may be 24-gage, semi-rigid, galvanized, corrugated, ferrous metal. Ducts must be round, unless the Engineer approves use of elliptical shaped ducts. Duct-wedge plate transitions must conform to Section 6-02.3(26)E. Prestressing reinforcement must conform to Section 6-02.3(26)F. Standard girders in this category include Series WF74PTG, WF83PTG, WF95PTG and WF100PTG.
9. Prestressed Concrete Tub Girder – Refers to prestressed concrete trapezoidal box or bathtub girders including those manufactured in segments to be spliced together with cast-in-place concrete closures at the Job Site. Unless otherwise specified, prestressed concrete tub girders must conform to all requirements specified for prestressed concrete girders and spliced prestressed concrete girders. Standard girders in this category include Series U**G* or Series UF**G*, where U specifies webs without flanges, UF specifies webs with flanges, ** specifies the girder height in inches, and * specifies the bottom flange width in feet.

6-02.3(25)A SHOP DRAWINGS

The Drawings show design conditions and details for prestressed girders. Deviations are not permitted, except as allowed by these Specifications, the Shop Drawings as approved by the Engineer, or by manufacturing processes approved by the annual plant approval process.

Shop Drawings must show the size and location of all cast-in holes for installation of deck formwork hangers and/or temporary bracing. Holes for formwork hangers must match approved deck formwork plans designed as specified in Section 6-02.3(16). There must be no field-drilled holes in prestressed concrete girders. Post-tensioning ducts in spliced prestressed concrete girders must be located so their center of gravity is per the Drawings.

The Contractor may change prestressed concrete girder dimensions from that shown on the Drawings provided:

1. The girder has the same or higher load carrying capacity using the current AASHTO LRFD Design Specifications and WSDOT Bridge Design Manual LRFD, as demonstrated by design calculations submitted to the Engineer for approval as specified in Section 1-05.3, and accompanying the Shop Drawing submittal.
2. The Contractor receives the Engineer's approval of the Shop Drawing and design calculation submittal for the modified girder section before starting fabrication of the girder.
3. The Contractor adjusts substructures to yield the same top of roadway elevation shown on the Drawings.
4. The depth of the girder is not increased by more than 2 inches and is not decreased, except that in no case must an increase in the girder depth reduce the minimum vertical clearance of the bridge and girder over a traveled way to less than 16-1/2 feet, or to less than the minimum vertical clearance specified in the Drawings if the Drawings already specify a minimum vertical clearance of less than 16-1/2 feet.

The Contractor must provide Shop Drawings to the Engineer for approval as specified in Section 1-05.3. Shop Drawings for spliced prestressed concrete girders must conform to Section 6-02.3(26)A. The Shop Drawings for spliced prestressed concrete girders must include all details related to the post-tensioning operations in the field, including details of hardware required, tendon geometry, blockout details, and details of additional or modified steel reinforcing bars required in cast-in-place closures.

6-02.3(25)B CASTING

Before casting girders, the Contractor must have possession of an approved set of Shop Drawings. Side forms must be steel except that cast-in-place concrete closure forms for spliced prestressed concrete girders, interior forms of prestressed concrete tub girders, and end bulkhead forms of prestressed concrete girders may be wood. Interior voids for precast prestressed slabs with voids must be formed by either wax soaked cardboard or expanded polystyrene forms. The interior void

forms must be secured in the position as shown on the Shop Drawings as approved by the Engineer, and must remain in place.

All concrete mixes to be used must comply with the requirements of Section 9-19.1. The temperature of the concrete when placed must be between 50 °F and 90 °F.

Slump must not exceed 4 inches for normal concrete nor 7 inches with the use of a high range water reducing admixture, nor 9 inches when both a high range water reducing admixture is used and the water-cement ratio is less than or equal to 0.35. The high range water reducer must comply with the requirements of Sections 9-23.4.

Air-entrainment is not required in the concrete placed into prestressed precast concrete girders, including cast-in-place concrete closures for spliced prestressed concrete girders.

No welds will be permitted on steel within prestressed girders. Once the prestressing steel has been installed, no welds or grounds for welders must be made on the forms or the steel in the girder, except as specified**.**

The Contractor may form circular block-outs in the girder top flanges to receive falsework hanger rods. These block-outs must:

1. Not exceed 1 inch in diameter.
2. Be spaced no more than 72 inches apart longitudinally on the girder.
3. Be located 3 inches or more from the outside edge of the top flange on Series W42G, W50G, W58G, girders, and all prestressed concrete tub girders with webs with flanges, and 6 inches or more for all other prestressed concrete girders with flanges.

The Contractor may form circular block-outs in the girder webs to support brackets for bridge deck falsework. These block-outs must:

a. Not exceed 1 inch in diameter.
b. Be spaced no more than 72 inches apart longitudinally on the girder.
c. Be positioned to clear the girder reinforcing and prestressing steel.

6-02.3(25)C PRESTRESSING

Each stressing system must have a pressure gauge or load cell that will measure jacking force. Any gauge must display pressure accurately and readably with a dial at least 6 inches in diameter or with a digital display. Each jack and its gauge must be calibrated as a unit and must be accompanied by a certified calibration chart. The Contractor must provide 1 copy of this chart to the Engineer. The cylinder extension during calibration must be in approximately the position it will occupy at final jacking force.

Jacks and gauges must be recalibrated and recertified:

1. Annually.
2. After any repair or adjustment.
3. Anytime there are indications that the jack calibration is in error.

The Engineer may use load cells to check jacks, gauges, and calibration charts before and during tensioning.

All load cells must be calibrated and must have an indicator that shows prestressing force in the strand. The range of this cell must be broad enough that the lowest 10 percent of the manufacturer's rated capacity is not used to measure jacking force.

From manufacture to encasement in concrete, prestressing strand must be protected against dirt, oil, grease, damage, and all corrosives. Strand must be stored in a dry, covered area and must be kept in the manufacturer's original packaging until placement in the forms. If prestressing strand has been damaged or pitted, it will be rejected. Prestressing strand with rust must be spot-cleaned with a nonmetallic pad to inspect for any sign of pitting or section loss.

Post-tensioning of spliced prestressed concrete girders must conform to Section 6-02.3(26)G, and the following requirements:

a. Before tensioning, the Contractor must remove all side forms from the cast-in-place concrete closures. From this point until 48 hours after grouting the tendons, the Contractor must keep all construction and other live loads off the superstructure and must keep the falsework supporting the superstructure in place.
b. No welds or welding grounds must be attached to metal forms, structural steel, or steel reinforcing bars of the structural member.
c. The Contractor must not tension the post-tensioning reinforcement until the concrete in the cast-in-place closures reaches the minimum compressive strength specified in the Drawings (or 5,000 psi if the concrete strength is not specified in the Drawings). This strength must be measured with concrete cylinders made of the same concrete and cured under the same conditions as the cast-in-place closures.
d. All post-tensioning must be completed before placing the sidewalks and barriers on the superstructure.

6-02.3(25)D CURING

During curing, the Contractor must keep the girder in a saturated curing atmosphere until the girder concrete has reached the required release strength. If the Engineer approves, the Contractor may shorten curing time by heating the

outside of impervious forms. Heat may be radiant, convection, conducted steam, or hot air. With steam, the arrangement must envelop the entire surface with saturated steam. The Engineer will not allow hot air curing until after approving the Contractor's proposed method to envelop and maintain the girder in a saturated atmosphere. Saturated atmosphere means a relative humidity of at least 90 percent. The Contractor must never allow dry heat to touch the girder surface at any point.

Under heat curing methods, the Contractor must:

1. Keep all unformed girder surfaces in a saturated atmosphere throughout the curing time.
2. Embed a thermocouple (linked with a thermometer accurate to ± 5 °F) 6 to 8 inches from the top or bottom of the girder on its centerline and near its midpoint.
3. Monitor with a recording sensor (accurate to ± 5 °F) arranged and calibrated to continuously record, date, and identify concrete temperature throughout the heating cycle.
4. Make this temperature record available for the Engineer to inspect.
5. Heat concrete to no more than 100 °F during the first 2 hours after placing the concrete, and then increase 25 °F per hour to a maximum of 175 °F.
6. Cool concrete, after curing is complete, no more than 25 °F per hour, to 100 °F. and
7. Keep the temperature of the concrete above 60 °F until the girder reaches release strength.

The Contractor may strip side forms from prestressed concrete girders once the concrete has reached a minimum compressive strength of 3,000 psi. All damage from stripping is the Contractor's responsibility.

Curing of cast-in-place concrete closures for spliced prestressed concrete girders must conform to Section 6-02.3(11).

6-02.3(25)E CONTRACTORS CONTROL STRENGTH

Concrete strength must be measured on test cylinders cast from the same concrete as that in the girder. These cylinders must be cured under time-temperature relationships and conditions that simulate those of the girder. If the forms are heated by steam or hot air, test cylinders will remain in the coolest zone throughout curing. If forms are heated another way, the Contractor must provide a record of the curing time-temperature relationship for the cylinders for each girder to the Engineer. When 2 or more girders are cast in a continuous line and in a continuous pour, a single set of test cylinders may represent all girders provided the Contractor demonstrates uniformity of casting and curing to the satisfaction of the Engineer.

The Contractor must mold, cure, and test enough of these cylinders to satisfy Specification requirements for measuring concrete strength. The Contractor may use 4" x 8" or 6" x 12" cylinders. If heat is used to shorten curing time, the Contractor must let cylinders cool for at least 1/2 hour before testing.

Test cylinders may be cured in a moist room or water tank per AASHTO T-23 after the girder concrete has obtained the required release strength. If, however, the Contractor intends to ship the girder before the standard 28 day strength test, determine the design strength for shipping from cylinders placed with the girder and cured under the same conditions as the girder. These cylinders may be placed in a non-insulated, moisture-proof envelope.

To measure concrete strength in the girder, the Contractor must randomly select 2 test cylinders and average their compressive strengths. The compressive strength in either cylinder must not fall more than 5 percent below the specified strength. If these 2 cylinders do not pass the test, 2 other cylinders must be selected and tested.

If too few cylinders were molded to carry out all required tests on the girder, the Contractor must remove and test cores from the girder under the surveillance of the Engineer. If the Contractor casts cylinders to represent more than 1 girder, all girders in that line must be cored and tested.

For precast prestressed members, a test must consist of 4 cores measuring 3 inches in diameter by 6 inches in height, for slabs, and by the thickness of the web, for ribbed sections. 2 cores must be taken from each side of the member and on each side of the member's span midpoint, at locations approved by the Engineer. The core locations for precast prestressed slabs must be near mid-depth of the slab, within the middle third of the span length, and must avoid all prestressing strands and steel reinforcing bars. The core locations for precast prestressed ribbed sections must be immediately beneath the top flange, within the middle third of the span length, and must avoid all prestressing strands and steel reinforcing bars.

For prestressed concrete tub girders, a test must consist of 4 cores measuring 3 inches in diameter by the thickness of the web, taken from each web approximately 3 feet to the left and to the right of the center of the girder span. The cores must avoid all prestressing strands and steel reinforcing bars.

For all other prestressed concrete girders, a test must consists of 3 cores measuring 3 inches in diameter by the thickness of the web and must be removed from just below the top flange: 1 at the midpoint of the girder's length and the other 2 approximately 3 feet to the left and approximately 3 feet to the right.

The cores must be taken per AASHTO T 24 and must be tested per AASHTO T 22. The Engineer may accept the girder if the average compressive strength of the 4 cores from the precast prestressed member, or prestressed concrete tub girder, or of the 3 cores from any other prestressed concrete girder, is at least 85 percent of the specified compressive strength with no one core less than 75 percent of specified compressive strength.

If the girder is cored to determine the release strength, the required patching and curing of the patch must be done before shipment. If there are more than 3 holes or if they are not in a neutral location, the prestress steel must not be released until the holes are patched and the patch material has attained a minimum compressive strength equal to the required release compressive strength or 4,000 psi, whichever is larger.

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The Contractor must coat cored holes with an epoxy bonding agent and patch the holes using the same type concrete as that in the girder, or a mix approved during the annual plant review and approval. The epoxy bonding agent must comply with the requirements of Section 9-26.1 for Type II, Grade 2 epoxy. The girder must not be shipped until tests show the patch material has attained a minimum compressive strength of 4,000 psi.

6-02.3(25)F PRESTRESS RELEASE

Side and flange forms that restrain deflection must be removed before release of the prestressing reinforcement.

All harped and straight strands must be released in a way that will produce the least possible tension in the concrete. This release must not occur until tests show each girder has reached the minimum compressive strength required by the Drawings.

The Contractor may request permission to release the prestressing reinforcement at a minimum concrete compressive strength less than specified in the Drawings. This request must be submitted to the Engineer for approval as specified in Section 1-05.3 and must be accompanied with calculations showing the adequacy of the proposed release concrete compressive strength. The release strength must not be less than 3,500 psi, except that the release strength for spliced prestressed concrete girders must not be less than 4,000 psi. The calculated release strength must comply with the requirements outlined in the Washington State Department of Transportation (WSDOT) Bridge Design Manual for tension and compression at release. The proposed minimum concrete compressive strength at release will be evaluated by the Owner. Fabrication of girders using the revised release strength must not start until the Owner has provided written approval of the revised release compressive strength. If a reduction of the minimum concrete compressive strength at release is allowed, the Contractor must bear any added cost that results from the change.

6-02.3(25)G PROTECTION OF EXPOSED REINFORCEMENT

When a girder is removed from its casting bed, all bars and strands projecting from the girder must be cleaned and painted with a minimum dry film thickness of 1 mil of paint conforming to Section 9-08.2 Item 3, Formula A-9-73. All steel reinforcing bars, including welded wire fabric, projecting from the girder must be protected as specified in Section 6-02.3(24)B. During handling and shipping, projecting reinforcement must be protected from bending or breaking. Just before placing concrete around the painted projecting bars or strands, the Contractor must remove from them all spattered concrete remaining from girder casting, dirt, oil, and other foreign matter.

Grouting of post-tensioning ducts for spliced prestressed concrete girders must conform to Section 6-02.3(26)H.

6-02.3(25)H FINISHING

The Contractor must apply a Class 1 finish, as defined in Section 6-02.3(14), to:

1. The exterior surfaces of the outside girders.
2. The bottoms, sides, and tops of the lower flanges on all girders.

All other girder surfaces must receive a Class 2 finish.

The interface on I-girders and other girders that contact the cast-in-place deck must have a finish of dense, screeded concrete without a smooth sheen or laitance on the surface. After vibrating and screeding, and just before the concrete reaches initial set, the Contractor must texture the interface. This texture must be applied with a steel brooming tool that etches the surface transversely leaving grooves 1/8 inch to 1/4 inch wide, between 1/8 inch and 1/4 inch deep, and spaced 1/4 inch to 1/2 inch apart.

On the deck bulb tee girder section and all precast prestressed members, the Contractor must test the bridge deck surface portion for flatness. This test must occur after floating but while the concrete remains plastic. Testing must be done with a 10-foot straight edge parallel to the girder centerline and with a flange width straight edge at right angles to the girder centerline. The Contractor must fill depressions, cut down high spots, and refinish to correct any deviation of more than 1/4 inch within the straight edge length. This section of the bridge deck surface must be finished to comply with the requirements for finishing bridge decks, as defined in Section 6-02.3(10) except that, if approved by the Engineer, a coarse stiff broom may be used to provide the finish instead of a metal tined comb.

The Contractor may repair rock pockets and other defects in the girder provided the repair is covered in the annual plant approval package. All other repairs and repair procedures must be documented and approved by the Engineer before acceptance of the girder.

6-02.3(25)I FABRICATION TOLERANCES

The girders must be produced as shown on the Shop Drawings as approved by the Engineer, and must comply with the dimensional tolerances listed below. Construction tolerances of cast-in-place closures for spliced prestressed concrete girders must conform to the tolerances specified for spliced prestressed concrete girders. Actual acceptance or rejection will depend on how the Engineer believes a defect outside these tolerances will affect the Structure's strength or appearance:

1. Prestressed Concrete Girder Length (overall): ± 1/4 inch per 25 feet of beam length, up to a maximum of ± 1-1/2 inch.
2. Precast Prestressed Member Length (overall): ± 1 inch.
3. Width (flanges): + 3/8 inch, - 1/4 inch.
4. Width (narrow web section): + 3/8 inch, - 1/4 inch.

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5. Width (Precast Prestressed Member): ± 1/4 inch.
6. Girder Depth (overall): ± 1/4 inch.
7. Flange Depth:
    a. For I and Wide Flange I girders: ± 1/4 inch
    b. For bulb tee and deck bulb tee girders: + 1/4 inch, - 1/8 inch
    c. For PCPS members: + 1/4 inch, - 1/8 inch
8. Strand Position in Prestressed Concrete Girder:
    a. ± 1/4 inch from the center of gravity of an individual strand.
    b. ± 1/2 inch from the center of gravity of a bundled strand group.
    c. ± 1 inch from the center of gravity of the harped strands at the girder ends.
9. Strand Position in Precast Prestressed Member: ± 1/4 inch from the center of gravity of a bundled strand group and of an individual strand.
10. Longitudinal Position of the Harping Point:
    a. Single harping point: ± 18 inches
    b. Multiple bundled strand groups
        1) First bundled strand group: ± 6 inches
        2) Second bundled strand group: ± 18 inches
        3) Third bundled strand group: ± 30 inches
11. Position of an interior void, vertically and horizontally (Precast Prestressed Slab with voids): ± 1/2 inch.
12. Bearing Recess (center recess to beam end): ± 1/4 inch.
13. Beam Ends (deviation from square or designated skew):
    a. Horizontal: ± 1/2 inch from web centerline to girder flange
    b. Vertical: ± 1/8 inch per foot of beam depth
14. Precast Prestressed Member Ends (deviation from square or designated skew): ± 1/2 inch.
15. Bearing Area Deviation from Plane (in length or width of bearing): 1/16 inch.
16. Stirrup Reinforcing Spacing: ± 1 inch.
17. Stirrup Projection from Top of Beam: ± 3/4 inch.
18. Mild Steel Concrete Cover: - 1/8 inch, + 3/8 inch.
19. Offset at Form Joints (deviation from a straight line extending 5 feet on each side of joint): ± 1/4 inch.
20. Deviation from Design Camber (Precast Prestressed Member): ± 1/4 inch per 10 feet of member length measured at midspan, but not greater than ± 3/4 inch total.
21. Differential Camber Between Girders in a Span (measured in place at the Job Site):
    a. For I, Wide Flange I, bulb tee, and spliced prestressed concrete girders: 1/8 inch per 10 feet of beam length.
    b. For deck bulb tee girders: Cambers must be equalized by an approved method when the differences in cambers between adjacent girders or stages measured at mid-span exceeds 1/4 inch.
    c. For PCPS members: ± 1/4 inch per 10 feet of member length measured at midspan, but not greater than ± 1/2 inch total.
    d. For prestressed concrete tub girders: ± 1/4 inch per 10 feet of member length measured at midspan, but not greater than ± 1/2 inch total.
22. Position of Inserts for Structural Connections: ± 1 inch.
23. Position of Lifting Loops: ± 3 inches longitudinal, ± 1/4 inch transverse.
24. Weld plates for bulb tee girders must be placed: ± 1/2 inch longitudinal and ± 1/8 inch vertical.
25. Position of post-tensioning ducts at girder and CIP closure ends: ± 1/4 inch.
26. Position of post tensioning ducts along segments of segmental prestressed concrete girders: ± 1/4 inch.
27. Deviation from a smooth curve for post-tensioning ducts at closures based on the sum total of duct placement and alignment tolerances: ± 3/8 inch.

6-02.3(25)J HORIZONTAL ALIGNMENT

The Contractor must check and record the horizontal alignment of the top and bottom flanges of each girder at the following times:

1. Initial: Upon removal of the girder from the casting bed.
2. Final: Within 2 weeks, but not less than 3 days before shipment.
3. Storage: Between 115 to 125 days after casting, if the girder remains in storage for a period exceeding 120 days.

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Each check must be made by measuring the distance between each flange and a chord that extends the full length of the girder. The Contractor must perform and record each check at a time when the alignment of the girder is not influenced by temporary differences in surface temperature. Records for the initial check must be included in the Contractor's prestressed concrete certificate of compliance. Records for the final and storage checks must be provided to the Engineer for approval.

Immediately after the girder is removed from the casting bed, neither flange must be offset more than 1/8 inch for each 10 feet of girder length. During storage and before shipping, the offset, with girder ends plumb and upright and with no external force, must not exceed 1/4 inch per 10 feet of girder length. Any girder within this tolerance may be shipped, but must be corrected at the Job Site to the 1/8 inch maximum offset per 10 feet of girder length before concrete is placed into the diaphragms.

The Engineer may allow using external force to correct girder alignment at the plant or Job Site if the Contractor provides stress calculations and a proposed procedure. If external force is permitted, it must not be released until after the bridge deck has been placed and cured 10 days.

The maximum deviation of the side of the precast prestressed slab, or the edge of the bridge deck slab of the deck double tee girder or the precast prestressed ribbed section, measured from a chord that extends end to end of the member, must be ± 1/8 inch per 10 feet of member length, but not greater than 1/2 inch total.

All precast prestressed members which exceed the specified horizontal alignment tolerance may be subject to rejection.

6-02.3(25)K GIRDER DEFLECTION

The Contractor must check and record the vertical deflection (camber) of each girder at the following times:

1. Initial: Upon removal of the girder from the casting bed.
2. Storage: Within 2 weeks, but not less than 3 days before shipment, if the girder remains in storage for a period exceeding 120 days.

The Contractor must perform and record each check at a time when the alignment of the girder is not influenced by temporary differences in surface temperature. These records must be available for the Engineer's inspection, and in girders older than 120 days, must be transmitted to the Engineer as soon as possible for evaluation of the effect of long-term storage on the "D" dimension. Records for the Initial check must be in the Contractor's Prestressed Concrete certificate of compliance. Records for the Storage check must be provided to the Engineer for approval.

The "D" dimensions shown on the Drawings are computed girder deflections at midspan based on a time lapse of 40 and 120 days after release of the prestressing strands, and are intended to advise the Contractor as to the expected range of girder deflection when deck forming. A positive (+) "D" dimension indicates upward deflection.

The Contractor must control the deflection of prestressed concrete girders to receive a cast-in-place slab by scheduling fabrication between 40 and 120 days of slab placement on the erected girders.

If it is anticipated that the girders will be older than 120 Days at the time of erection, the Contractor must submit calculations to the Engineer showing the estimated girder deflection at midspan at the age anticipated for erection. This submittal must also include the Contractor's proposal for accommodating any excess camber in the construction. The Contractor must not proceed with girder fabrication until this submittal is accepted by the Engineer. The actual girder deflection at the midspan may vary from the maximum estimated "D" dimension when slab forming by a maximum of plus 1/2 inch for girder lengths up to 80 feet, and plus 1 inch for girder lengths over 80 feet, but less than or equal to 140 feet, and plus 1-1/2 inches for girder lengths over 140 feet.

All costs, including bridge deck form adjustments required to maintain specified steel reinforcing bar clearances and deck profiles, and any additional Owner engineering expenses, for accommodating excess girder deflection must be at the Contractor's expense.

6-02.3(25)L HANDLING AND STORAGE

During handling and storage, each girder must always be kept plumb and upright, and each precast prestressed member and prestressed concrete tub girder must always be kept in the horizontal orientation as shown on the Drawings.

It must be lifted only by the lifting embedments, strand lift loops or high-strength threaded steel bars, at either end. For strand lift loops, use only 1/2-inch diameter or 0.6-inch diameter strand conforming to Section 9-07.10, and a minimum 2-inch diameter straight pin of a shackle through the loops. Multiple loops must be held level in the girder during casting to allow each loop to carry its share of the load during lifting. The minimum distance from the end of the girder to the strand lift loops must be 3'-0". The loops must project a minimum of 1 foot 6 inches from the top of the girder, and must extend to within 3 inches clear of the bottom of the girder, terminating with a 9-inch long 90 degree hook. Loads on individual loops must be limited to 12 kips, and all girders must be picked up at a minimum angle of 60 degrees from the top of the girder. For high-strength threaded steel bars, use a minimum of 2, 1-1/3-inch diameter bars conforming to Section 9-07.11 must at each end of the girder. The lifting hardware that connects to the bars must be designed, detailed, and furnished by the Contractor. The minimum distance from the end of the girder to the centroid of the lifting bars must be 3'-0". Lifting bars must extend to within 3 inches clear of the bottom of the girder and must be anchored in the bottom flange with steel plates and nuts. The minimum size of embedded plates for lifting bars must be 1/2" thick x 3" square. Lifting forces on the lifting bars must not exceed 58 kips on an individual bar, and must be within 10 degrees of perpendicular to the top of the girder.

For some girders, straight temporary top flange strands may be specified in the Drawings. The lifting locations and concrete release strengths in the girder schedule in the Drawings assume that these temporary strands are pre-tensioned.

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Alternatively, these temporary strands may be post-tensioned, provided the same lifting locations described in the girder schedule are used and the strands are tensioned before lifting the girder from the form. These temporary strands must be of the same diameter, and must be tensioned to the same force, as the permanent strands. The inside diameter of the debonding sleeves must be large enough such that the temporary strands fully retract upon cutting. When temporary top strands are specified for spliced prestressed concrete girders, the temporary top strands must be post-tensioned before lifting the assembled girder. When the post-tensioned alternative is used, the Contractor is responsible for properly sizing the anchorage plates, and the reinforcement adjacent to the anchorage plates, to prevent bursting or splitting of the concrete in the top flange. Temporary strands must be cut or released as specified in Section 6-02.3(25)N.

The Contractor may request permission to use lifting embedments, lifting embedment locations, lifting angles, concrete release strengths, or temporary top strand configurations except as specified in the Drawings. The number of temporary top strands may be increased from the number shown on the Drawings but must not be decreased. When temporary top strands are not needed for lifting but are required for shipping, they must be post-tensioned on the same day that the permanent prestress is released into the girder. The request, including calculations showing the adequacy of the proposed lifting method, must be submitted to the Engineer for approval as specified in Section 1-05.3 and 6-01.8. The Contractor's analysis must conform to Article 5.4.1 of the PCI Design Handbook, Precast and Prestressed Concrete, Sixth Edition, or other approved methods. The Contractor's calculations must verify that the concrete stresses in the prestressed girder do not exceed those listed in Section 6-02.3(25)M. The Contractor must not start girder lifting operations under the lifting method submittal until receiving the Engineer's written approval of the submittal, and must perform the girder lifting operations at no additional expense to the Owner.

If girders are to be stored, the Contractor must place them on a stable foundation that will keep them in a vertical position. Stored girders must be supported at the bearing recesses or, if there are no recesses, approximately 18 inches from the girder ends. Precast prestressed members must be supported at points between 1'-0" and 2'-0" from the member ends. After post-tensioning, segmental prestressed concrete girders must be supported at points between 2'-0" and 5'-0" from the girder ends, unless otherwise shown on the Drawings. For long-term storage of girders with initial horizontal curvature, the Contractor may wedge one side of the bottom flange, tilting the girders to control curvature. If the Contractor elects to set girders out of plumb during storage, the Contractor must have the proposed method analyzed by the Contractor's engineer to ensure against damaging the girder.

6-02.3(25)M SHIPPING

After the girder has reached its 28 day design strength, and the fabricator believes it to comply with the Specification, the girder and a completed Certification of Compliance, signed by a Precast/Prestressed Concrete Institute Certified Technician or a Professional Engineer, acceptable to the Owner, must be submitted to the Engineer for inspection. If the Engineer finds the certification and the girder to be acceptable, the Engineer will stamp the girder "Approved for Shipment."

No double tee girder, deck double tee girder, precast prestressed slab or precast prestressed ribbed section must be shipped for at least 3 days after concrete placement. No deck bulb tee girder or prestressed concrete tub girder must be shipped for at least 7 days after concrete placement, except that deck bulb tee girders or prestressed concrete tub girders may be shipped 3 days after concrete placement when L/(bd) is less than or equal to 5.0, where L equals the shipping length of the girder, b equals the girder top flange width (for deck bulb tee girders) or the bottom flange width (for prestressed concrete tub girders), and d equals the girder depth, all in feet. No other girder must be shipped for at least 10 days after concrete placement.

Girder support during shipping must be located as shown on the Drawings and must be no closer than the girder depth to the ends of the girder at the girder center line. Support locations have been determined per the criteria specified in the WSDOT Bridge Design Manual LRFD Section 5.6.3.D. The Contractor must verify the applicability of these criteria to the trucking configuration intended for transport of the girders. If the trucking configuration differs from these criteria, the Contractor must submit a girder shipping plan, with supporting calculations, to the Engineer for approval as specified in Sections 1-05.3 and 6-01.8.

The Contractor may request permission to use support locations except those specified. The Contractor must submit the support location modification proposal, with supporting calculations, to the Engineer for approval as specified in Sections 1-05.3 and 6-01.8. If the support locations are moved closer to the longitudinal ends of the girders, the calculations must demonstrate adequate control of bending during shipping. The calculations must also show that concrete stresses in the girders will not exceed those listed below.

If the Contractor elects to assemble spliced prestressed concrete girders into components of 2 or more segments before shipment, the Contractor must submit shipment support location working drawings with supporting calculations to the Engineer as specified in Sections 1-05.3 and 6-01.8. The calculations must show that concrete stresses in the assembled girders will not exceed those listed below.

Lateral bracing for shipping is not required for prestressed concrete tub girders and precast prestressed members as defined in Section 6-02.3(25).

For all prestressed concrete girders, except prestressed concrete tub girders and precast prestressed members, the Contractor must provide bracing to control lateral bending during shipping, unless the Contractor furnishes calculations as specified in Section 1-05.3 demonstrating that bracing is unnecessary. External bracing must be attached securely to the top flange of the girder. The Contractor is cautioned that more conservation guidelines for lateral bracing may be required for some delivery routes. The Contractor must submit a bracing plan, with supporting calculations, to the Engineer for approval as

specified in Section 1-05.3. The Contractor must not start shipping the girders until receiving the Engineer's approval of the bracing plan, and must perform all bracing operations at no additional cost to the Owner.

Criteria for Checking Girder Stresses at the time of Lifting or Transporting and Erecting.

Stresses at both the support and harping points must be satisfied based on these criteria:

1. Allowable compression stress, fc = 0.60f 'cm
   a. f'cm = compressive strength at time of lifting or transporting verified by test, not to exceed design compressive strength (f 'c) at 28 days in psi + 1,000 psi
2. Allowable tension stress, ksi
   a. With no bonded reinforcement = 3 times square root (f'cm) ≤ 0.20 ksi
   b. With bonded reinforcement to resist total tension force in the concrete computed on the basis of an uncracked section = 6.0 times square root (f'cm). The allowable tensile stress in the reinforcement is 30 ksi
3. Prestress losses
   a. For lifting from casting beds = computed losses at 1 day
   b. For transportation = computed losses at 10 days
   c. Impact on dead load
   d. Lifting from casting beds = 0 percent
   e. Transporting and erecting = 20 percent

6-02.3(25)N PRESTRESSED CONCRETE GIRDER ERECTION

Before erecting any prestressed concrete girders, the Contractor must submit to the Engineer for review and must have received approval for the erection plan and procedure describing the methods the Contractor intends to use. The erection plan and procedure must provide complete details of the erection process including but not limited to:

1. Temporary falsework support, bracing, guys, deadmen, and attachments to other Structure components or objects.
2. Procedure and sequence of operation.
3. Girder stresses during progressive stages of erection.
4. Girder weights, lift points, lifting embedments and devices, spreaders, and angle of lifting cables as specified in Section 6-02.3(25)L.
5. Crane make and model, mass, geometry, lift capacity, outrigger size and reactions.
6. Girder launcher or trolley details and capacity (if intended for use).
7. Locations of cranes, barges, trucks delivering girders, and the location of cranes and outriggers relative to other Structures, including retaining walls and wing walls.

The erection plan must include drawings, notes, catalog cuts, and calculations clearly showing the above listed details, assumptions, and dimensions. Material properties and Specifications, structural analysis, and any other data used must also be included. The plan must be prepared by, or under the direct supervision of, a Professional Engineer, licensed under Title 18 RCW, State of Washington, in the branch of Civil or Structural, and must carry the engineer's seal and signature, as specified in Section 6-02.3(16).

The Contractor must submit the erection plans, calculations, and procedure to the Engineer as specified in Sections 1-05.3 and 6-02.3(16). After the plan is accepted and returned to the Contractor, all changes that the Contractor proposes must be submitted to the Engineer for review and approval.

When prestressed girders arrive on the project, the Engineer will confirm they are stamped "Approved for Shipment," that the final horizontal alignment and deflection (camber) check records have been approved, and that they have not been damaged in shipment before accepting them.

The concrete in piers and crossbeams must reach at least 80 percent of design strength before girders are placed on them. The Contractor must hoist girders only by the lifting embedments at the ends, always keeping the girders plumb and upright. Once erected, the girders must be braced as specified in Sections 6-02.3(17)F4 and 6-02.3(17)F5. When temporary strands in the top flange are used, they must be cut after the girders are braced and before the intermediate diaphragms are cast. The Contractor must place the cast-in-place deck on the girders within 30 Calendar Days of cutting the temporary strands, except as otherwise approved by the Engineer.

For situations where the Contractor proposes to delay placing the cast-in-place deck on the girders beyond 30 Calendar Days after cutting the temporary strands, the Contractor must submit supporting girder camber calculations to the Engineer for approval as specified in Section 1-05.3. The Contractor must cut the temporary strands until receiving the Engineer's approval of the girder camber calculations.

Instead of the oak block wedges shown on the Drawings, the Contractor may use Douglas fir blocks if the grain is vertical. The aspect ratio (height/width) of oak block wedges at the girder centerline must not exceed 1.0.

The Contractor must check the horizontal alignment of both the top and bottom flanges of each girder after girder erection but before placing concrete in the bridge diaphragms as described in Section 6-02.3(25)J.

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The Contractor must fill all block-out holes and patch any damaged area caused by the Contractor's operation, with an approved mix, to the satisfaction of the Engineer.

For precast prestressed concrete slabs, the Contractor must place the 1-1/4-inch diameter vertical dowel bars at the top of the pier walls as shown on the Drawings. The Contractor must either form the hole or core drill the hole following the alternatives shown on the Drawings. The portion of the dowel bar in the top of the pier walls must be set with either grout that complies with Section 9-26.3 or type II epoxy bonding agent conforming to Section 9-26.1 following placement of each precast prestressed slab.

6-02.3(25)O DECK BULB TEE GIRDER FLANGE CONNECTION

The Contractor must submit a method of equalizing deck bulb tee girder, and precast prestressed member, deflections to the Engineer for approval as specified in Section 1-05.3, and that submittal must be included with the deck bulb tee girder fabrication Shop Drawing submittal specified in Section 6-02.3(25)A. Deflection equalizing methods approved for previous Owner Contracts will be acceptable providing the bridge configuration is similar and the previous method was satisfactory. A listing of the previous Owner Contract numbers for which the method was used must be included with the submittal. The weld-ties may be used as a component of the equalizing system provided the Contractor's procedure outlines how the weld-ties are to be used, and that the Contractor's submittal includes a list and description of previous bridge projects where the Contractor has successfully used weld-ties as a component of the equalizing system.

The concrete diaphragms for deck bulb tee girders must attain a minimum compressive strength of 2,500 psi before any camber equalizing equipment is removed.

On deck bulb tee girders, girder deflection must be equalized using the approved method before girders are weld-tied and before keyways are filled. Keyways between tee girders must be filled flush with the surrounding surfaces with non-shrink grout conforming to Section 9-20.3(2), except that keyways for deck bulb tee girders receiving a cast-in-place concrete deck slab need not be filled with grout. This nonshrink grout must have a compressive strength of 5,000 psi before the equalizing equipment is removed. Determine compressive strength by fabricating and testing cubes per WSDOT Test Method 813 and testing per AASHTO T-106.

Welding ground must be attached directly to the steel plates being welded when welding the weld-ties on bulb tee girders.

No construction equipment must be placed on the Structure, except equalizing equipment, until the girders have been weld-tied and the keyway grout has attained a compressive strength of 5,000 psi.

6-02.3(26) CAST-IN-PLACE PRESTRESSED CONCRETE

Unless otherwise shown on the Drawings, concrete for cast-in-place prestressed bridge members must be Class 4000D in the bridge deck, and Class 4000 at all other locations. Air entrainment must conform to Sections 6-02.3(2)A and 6-02.3(3).

The Contractor must construct supporting falsework to leave the superstructure free to contract and lift off the falsework during post-tensioning. Forms that will remain inside box girders to support the bridge deck must, by design, resist girder contraction as little as possible.

Before tensioning, the Contractor must remove all side forms from girders. From this point until 48 hours after grouting the tendons, the Contractor must keep all construction and other live loads off the superstructure and must keep the falsework supporting the superstructure in place.

Once the prestressing steel is installed, no welds or welding grounds must be attached to metal forms, structural steel, or reinforcing bars of the structural member.

The Contractor must not stress the strands until all concrete has reached a compressive strength of at least 4,000 psi, or the strength shown on the Drawings. This strength must be measured on concrete test cylinders made of the same concrete cured under the same conditions as the cast-in-place unit.

All post-tensioning must be completed before sidewalks and barriers are placed.

6-02.3(26)A SHOP DRAWINGS

Before casting the structural elements, the Contractor must submit Shop Drawings as specified in Section 1-05.3.

These Shop Drawings must show complete details of the methods, materials, and equipment the Contractor proposes to use in prestressing Work. The Shop Drawings must comply with the design conditions shown on the Drawings unless the Engineer permits equally effective variations.

In addition, the Shop Drawings must show:

1. The method and sequence of stressing.
2. Technical data on tendons and steel reinforcement, anchorage devices, anchorage device efficiency and acceptance test results and records, anchoring stresses, types of tendon conduit, and all other data on prestressing operations.
3. Stress and elongation calculations. Separate stress and elongation calculations must be submitted for each tendon if the difference in tendon elongations exceeds 2 percent.
4. That tendons in the bridge will be arranged to locate their center of gravity as the Drawings require.
5. Details of additional or modified reinforcing steel required by the stressing system.

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6. Procedures and lift-off forces at both ends of the tendon for performing a force verification lift-off if discrepancies occurs between measured and calculated elongations.

Couplings or splices are not permitted in prestressing strands. Couplings or splices in bar tendons are subject to the Engineer's approval.

Friction losses used to calculate forces of the post-tensioning steel must be based on the assumed values used for the design. The assumed anchor set, friction coefficient "μ," and friction wobble coefficient "k" values for design are shown on the Drawings. The post-tensioning Supplier may change the assumed anchor set value provided all stress and force limits listed in Section 6-02.3(26)G are met.

The Contractor must determine all points of interference between the mild steel reinforcement and the paths of the post-tensioning tendons. Details to resolve interferences must be submitted with the Shop Drawings for approval. Where reinforcing bar placement conflicts with post-tensioning tendon placement, the tendon profile shown on the Drawings must be maintained. Mild steel reinforcement for post-tensioning anchorage zones must not be produced until after the post-tensioning Shop Drawings have been accepted by the Engineer.

Approval of these Shop Drawings will mean only that the Engineer considers them to show a reasonable approach in enough detail. Approval will not indicate a check on dimensions.

The Contractor may deviate from the approved Shop Drawings only after obtaining the Engineer's approval of a written request that describes the proposed changes. Approval of a change in method, material, or equipment does not relieve the Contractor of any responsibility for completing the Work.

Before Physical Completion of the project, the Contractor must provide the Engineer with reproducible originals of the Shop Drawings (and any approved changes). These must be clear, suitable for microfilming, and on permanent sheets that measure no smaller than 11" x 17". Alternatively, the Shop Drawings may be provided in an electronic format with the approval of the Bridge and Structures Engineer.

6-02.3(26)B GENERAL REQUIREMENTS FOR ANCHORAGES

Post-tensioning reinforcement must be secured at each end with an approved anchorage device, which must not kink, neck down, or otherwise damage the post-tensioning reinforcement. The anchorage assembly must be grouted to the Engineer's satisfaction.

The Structure must be reinforced with steel reinforcing bars in the anchorage zone in the vicinity of the anchorage device. This reinforcement must be categorized into 2 zones. The first or local zone must be the concrete surrounding and immediately ahead of the anchorage device. The second or general zone must be the overall anchorage zone, including the local zone.

The steel reinforcing bars required for concrete confinement in the local zone is determined by the post-tensioning system Supplier and must be shown on the Shop Drawings. The calculations must be submitted with the Shop Drawings. The local zone steel reinforcing bars must be furnished and installed by the Contractor, at no additional cost to the Owner, in addition to the structural reinforcement required by the Drawings. The steel reinforcing bars required in the general zone must be as shown on the Drawings and are included in the appropriate Bid Items.

The Contractor must submit details, certified test reports, and/or supporting calculations, as specified below, which verify the structural adequacy of the anchorage devices for approval by the Engineer. This requirement does not apply where the anchorage devices have been previously approved by the Owner for the same Structure configuration. The Contractor must also submit any necessary changes to the Drawings. The test report must specify all pertinent test data.

Dead ended anchorages are not permitted. Dead ended anchorages are defined as anchorages that cannot be accessed during the stressing operations.

Materials and workmanship must conform to the applicable requirements of Section 6-03 and Section 9-06.

Before installing the anchorage device, the Contractor must submit to the Engineer a manufacturer's certificate of compliance as specified in Section 1-06.3.

Anchorage devices must comply with the requirements listed in either Sections 6-02.3(26)C or 6-02.3(26)D.

All anchorages must develop at least 96 percent of the actual ultimate strength of the prestressing steel, when tested in an unbounded state, without exceeding anticipated set. This anchor efficiency test must be performed, or inspected and certified, by an independent testing agency approved by the Engineer.

6-02.3(26)C NORMAL ANCHORAGE DEVICES

Normal anchorage devices, defined as post-tensioning anchorage assemblies conforming to the factored bearing resistance requirements specified in this Section, must provide a factored bearing resistance greater than or equal to 1.2 times the maximum jacking force. The Contractor must submit calculations showing that the factored bearing resistances of the anchorage devices are not exceeded.

The factored bearing resistance of the anchorages must be taken as:

$$Pr = \varphi f_n A_b$$

For which f_n is the lesser of:

$$f_n = 0.7 f'_{ci}(A / A_g)^{1/2}$$

$$f_n = 2.25f'_{ci}$$

Where:

φ = Resistance factor of 0.70

A = Maximum area of the portion of the supporting surface that is similar to the load area and concentric with it and does not overlap similar areas for adjacent anchorage devices (square inches)

A_b = Effective net area of the bearing plate calculated as the area A_g, minus the area of openings in the bearing plate (square inches)

A_g = Gross bearing area of the bearing plate calculated as specified below (square inches)

f'_{ci} = Nominal compressive strength of concrete at the time of application of the tendon force (ksi)

The full bearing plate area may be used for A_g and the calculation of A_b if the plate material does not yield at the factored tendon force and the slenderness of the bearing plate, n/t, conforms to:

$$(n / t) \leq 0.08(E_b / f_b)^{0.33}$$

Where:

E_b = Modulus of elasticity of the bearing plate material (ksi)

f_b = Stress in the anchor plate at a section taken at the edge of the wedge hole or holes (ksi)

n = Projection of the base plate beyond the wedge hole or wedge plate, as appropriate (inches)

t = average thickness of the bearing plate (inches)

For anchorages with separate wedge plates, n may be taken as the largest distance from the outer edge of the bearing plate. For rectangular bearing plates, this distance must be measured parallel to the edge of the bearing plate. If the anchorage has no separate wedge plate, n may be taken as the projection beyond the outer perimeter of the group of holes in the direction under consideration.

For bearing plates that do not comply with the slenderness requirement specified above, the effective gross bearing area, A_g, must be taken as follows:

For anchorages with separate wedge plates, the area geometrically similar to the wedge plate, with dimensions increased by twice the bearing plate thickness.

For anchorages without separate wedge plates, the area geometrically similar to the outer perimeter of the wedge holes, with dimensions increased by twice the bearing plate thickness.

6-02.3(26)D SPECIAL ANCHORAGE DEVICES

Special anchorage devices, defined as post-tensioning anchorage assemblies that do not conform to the factored bearing pressure requirements specified in Section 6-02.3(26)C, must conform to the acceptance test requirements below. Acceptance testing must be performed, or inspected and certified, by an independent testing agency approved by the Engineer. Results of the special anchorage device acceptance testing must be recorded and submitted to the Engineer for approval as specified in Sections 1-05.3 and 6-01.8.

6-02.3(26)D1 TEST BLOCK REQUIREMENTS

The test block must be a rectangular prism of sufficient size to contain all special anchorage components that will also be embedded in the concrete of the Structure being post-tensioned. The arrangement of the special anchorage device components must conform to practical application to the project and the special anchorage device manufacturer's recommendations. The test block must contain an empty duct of the size appropriate for the maximum tendon size that can be accommodated by the special anchorage device.

6-02.3(26)D2 TEST BLOCK DIMENSIONS

The dimensions of the test block perpendicular to the tendon in each direction must be the smaller of the minimum edge distance or the minimum spacing specified by the special anchorage device manufacturer, with the stipulation that the concrete cover over any confining reinforcing steel or supplementary skin reinforcement must be appropriate for the project-specific application and circumstances. The length of the block along the axis of the tendon must be at least 2 times the larger of the cross-section dimensions.

6-02.3(26)D3 LOCAL ZONE REINFORCEMENT FOR CONFINEMENT

The confining reinforcement steel in the local zone of the test block must be the same as that recommended by the special anchorage device manufacturer.

6-02.3(26)D4 SUPPLEMENTARY SKIN REINFORCEMENT

In addition to the special anchorage device and the associated zone reinforcement for confinement, supplementary skin reinforcement may be provided throughout the test block. Such supplementary skin reinforcement must be as specified by the special anchorage device manufacturer, but must not exceed a volumetric ratio of 0.01.

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The Contractor must furnish and install supplementary skin reinforcement in the anchorage zone of the Structure similar in configuration and equivalent in volumetric ratio to the supplementary skin reinforcement used in the test block at no additional cost to the Owner. The steel reinforcing bars shown on the Drawings in corresponding portions of the general zone may be counted toward this reinforcement requirement.

6-02.3(26)D5 TEST BLOCK CONCRETE STRENGTH

The compressive strength of the test block when acceptance testing must not exceed the compressive strength of Structure being post-tensioned when post-tensioning.

6-02.3(26)D6 SPECIAL ANCHORAGE DEVICE ACCEPTANCE TESTING

Special anchorage device acceptance testing must be conducted using one of the following test methods:

1. Cyclic load test.
2. Sustained load test.
3. Monotonic load test.

The loads specified for the tests are specified in fractions of the ultimate load F_{pu} of the largest tendon that the special anchorage device is designed to accommodate. The specimen must be loaded per conventional usage of the device in post-tensioning applications, except that the load may be applied directly to the wedge plate or equivalent area.

6-02.3(26)D7 CYCLIC LOADING TEST

A load of $.8F_{pu}$ must be applied. The load must be cycled between $0.1F_{pu}$ and $0.8F_{pu}$ until crack widths stabilize, but for no less than 10 cycles. Crack widths are considered stabilized if they do not change more than 0.001 inches over the last 3 readings. Upon completion of the cyclic loading portion of the test, the specimen must be loaded to failure, or, if limited by the capacity of the loading equipment, to at least $1.1F_{pu}$.

Crack widths and patterns must be recorded at the initial load of $0.8F_{pu}$, at least at the last 3 consecutive peak loadings before termination of the cyclic loading portion of the test, and at $0.9F_{pu}$. The maximum load must also be reported.

6-02.3(26)D8 SUSTAINED LOADING TEST

A load of $0.8F_{pu}$ must be applied and held constant until crack widths stabilize, but not less than 48 hours. Crack widths are considered stabilized if they do not change by more than 0.001 inches over the last 3 readings. Upon completion of the sustained loading portion of the test, the specimen must be loaded to failure, or, if limited by the capacity of the loading equipment, to at least $1.1F_{pu}$. Crack widths and crack patterns must be recorded at the initial load of $0.8F_{pu}$, at least 3 times at intervals of no less than 4 hours during the last 12 hours of the sustained loading time period, and at $0.9F_{pu}$. The maximum load must also be reported.

6-02.3(26)D9 MONOTONIC LOADING TEST

A load of $0.9F_{pu}$ must be applied and held constant for 1 hour. Upon completion of the 1 hour load hold period, the specimen must be loaded to failure, or, if limited by the capacity of the loading equipment, to at least $1.2F_{pu}$.

Crack width and crack patterns must be recorded at $0.9F_{pu}$, at the conclusion of the 1 hour load hold period, and at $1.0F_{pu}$. The maximum load must be reported.

6-02.3(26)D10 SPECIAL ANCHORAGE DEVICE TEST PERFORMANCE REQUIREMENTS

The test block must conform to the following load requirements under test load:

1. The maximum test load for cyclic loading and sustained loading tests must be $1.1F_{pu}$ minimum.
2. The maximum test load for monotonic load testing must be $1.2F_{pu}$ minimum.

The test block must conform to the following crack width requirements under test load:

a. Cracks must not exceed 0.010 inches in width at $0.8F_{pu}$ at completion of the cyclic loading test or sustained loading test, or at $0.9F_{pu}$ after the 1 hour load hold period of the monotonic loading test.

b. Cracks must not exceed 0.016 inches at $0.9F_{pu}$ for the cyclic loading test or the sustained loading test, or at $1.0F_{pu}$ for the monotonic loading test.

6-02.3(26)D11 TEST SERIES REQUIREMENTS

A test series must consist of 3 test specimens. Each one of the test specimens must conform to the acceptance criteria specified above. If 1 of the 3 specimens fails to pass the test, a supplementary test series of 3 additional specimens must be conducted. The 3 additional test specimens must conform to the specified acceptance criteria.

6-02.3(26)D12 SPECIAL ANCHORAGE DEVICE ACCEPTANCE TESTING RESULTS REPORT

The special anchorage device acceptance testing results report includes:

1. Dimensions of the test specimen.
2. Working drawings with details and dimensions of the special anchorage device, including all confining reinforcing steel.

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3. Quantity and arrangement of supplementary skin reinforcement.
4. Type and yield strength of the reinforcing steel.
5. Type and compressive strength of the concrete when testing.
6. Type of testing procedure and all measurements specified for each specimen under the test.

The special anchorage device manufacturer must specify auxiliary and confining reinforcement, minimum edge distance, minimum anchor spacing, and minimum concrete strength when stressing required for proper performance of the local zone

6-02.3(26)E DUCTS

Ducts for transverse post-tensioning of bridge deck slabs may be rectangular. All other ducts must be round. Ducts must conform to the following requirements for internal embedded installation and external exposed installation. Elliptical shaped duct may be used if approved by the Engineer.

6-02.3(26)E1 DUCTS FOR INTERNAL EMBEDDED INSTALLATION

Ducts, including their splices, must be semi-rigid, air and mortar tight, corrugated plastic ducts of virgin polyethylene or polypropylene materials, free of water-soluble chlorides or other chemicals reactive with concrete or post-tensioning reinforcement. Ducts, including their splices, must either have a white coating on the outside or must be of a white material with ultraviolet stabilizers added. Ducts, including their splices, must be capable of withstanding concrete pressures without deforming or permitting the intrusion of cement paste during placement of concrete. All fasteners must be appropriate for use with plastic ducts, and all clamps must be of an approved plastic material.

Polyethylene ducts must conform to ASTM D 3350 with a cell classification of 345464A. Polypropylene ducts must conform to ASTM D 4101 with a cell classification range of PP0340B14541 to PP0340B67884. Resins used for duct fabrication must have a minimum oxidation induction time of 20 minutes, per ASTM D 3895, based on tests performed by the duct fabricator on samples taken from the lot of finished product. The duct thickness is specified in Section 10.8.3 of the AASHTO LRFD Bridge Construction Specifications, latest edition and current interims.

All duct splices, joints, couplings, and connections to anchorages must be made with devices or methods (mechanical couplers, plastic sleeves, shrink sleeves) that are approved by the duct manufacturer and produce a smooth interior alignment with no lips or kinks. All connections and fittings must be air and mortar tight. Taping is not acceptable for connections and fittings.

Each duct must maintain the required profile within a placement tolerance of ± 1/4 inch for longitudinal tendons and ± 1/8 inch for transverse slab tendons during all phases of the work. The minimum acceptable radius of curvature must be as recommended by the duct manufacturer and as supported by documented industry standard testing. The ducts must be completely sealed to keep out all mortar.

Each duct must be located to place the tendon at the center of gravity alignment shown on the Drawings. To keep friction losses to a minimum, the Contractor must install ducts to the exact lines and grades shown on the Drawings. Once in place, the ducts must be tied firmly in position before they are covered with concrete. During concrete placement, the Contractor must not displace or damage the ducts.

The ends of the ducts must:

1. Permit free movement of anchorage devices.
2. Remain covered after installation in the forms to keep out all water or debris.

Immediately after any concrete placement, the Contractor must force blasts of oil-free, compressed air through the ducts to break up and remove any mortar inside before it hardens. Before deck concrete is placed, the Contractor must satisfy the Engineer ducts are unobstructed and contain nothing that could interfere with tendon installation, tensioning, or grouting. If the tendons are in place, the Contractor must show they are free in the duct.

Ducts must be capped and sealed at all times until completing grouting to prevent the intrusion of water.

Strand tendon duct must have an inside cross-sectional area large enough to accomplish strand installation and grouting. The area of the duct must be at least 2.5 times the net area of prestressing steel in the duct. The maximum duct diameter must be 4 1/2 inches.

The inside diameter of bar tendon duct must at least be 1/4 inch larger than the bar diameter. At coupler locations the duct diameter must at least be 1/4 inch larger than the coupler diameter.

Ducts installed and cast into concrete before prestressing steel installation, must be capable of withstanding at least 10 feet of concrete fluid pressure.

Ducts must have adequate longitudinal bending stiffness for smooth, wobble free placement. A minimum of 3 successful duct qualification tests are required for each diameter and type of duct as follows:

a. Ducts with diameters 2 inches and smaller must not deflect more than 3 inches under its own weight, when a 10-foot duct segment is supported at its ends.
b. Ducts larger than 2 inches in diameter must not deflect more than 3 inches under its own weight, when a 20-foot duct segment is supported at its ends.
c. Duct must not dent more than 1/8 inch under a concentrated load of 100 pounds applied between corrugations by a #4 steel reinforcing bar.

When the duct must be curved in a tight radius, more flexible duct may be used, subject to the Engineer's approval.

6-02.3(26)E2 DUCTS FOR EXTERNAL EXPOSED INSTALLATION

Duct must be high-density polyethylene (HDPE) conforming to ASTM D 3350. The cell classification for each property listed in the table below:

Property	Cell Classification
1	3 or 4
2	2, 3, or 4
3	4 or 5
4	4 or 5
5	2 or 3
6	2, 3, or 4

The color code must be C.

Duct for external tendons, including their splices, must be water tight, seamless or welded, and be capable of resisting at least 150 psi grout pressure.

Transition couplers between ducts must conform to either the standard pressure ratings of ASTM D 3505 or the hydrostatic design stresses of ASTM F 714 at 73 °F. The inside diameter through the coupled length must not be less than that produced by the dimensional tolerances specified in ASTM D 3505.

Workers performing HDPE pipe welding must have satisfactorily completed a certified HDPE pipe welding course and must have a minimum of 5 years of experience in welding HDPE pipe.

The Contractor must submit the name and HDPE pipe welding work experience of each HDPE pipe welder proposed to perform this Work in the project. The experience submittal for each HDPE pipe welder must include:

The Engineer may require the HDPE pipe welder to demonstrate test HDPE pipe welding before receiving final approval.

1. The name of the pipe welder.
2. The name, date, and location of the certified HDPE pipe welding course, with the course completion certificate.
3. A list of at least 3 projects in the last 5 years where the pipe welder performed HDPE pipe welding, including:
   a. The project name and location, and date of construction.
   b. The Governmental Agency/Owner.
   c. The name, address, and phone number of the Governmental Agency/Owner's representative.

The Contractor must not start HDPE pipe welding operations until receiving the Engineer's approval of the work experience submittal for each HDPE pipe welder performing HDPE pipe welding in the project. The Engineer may require the HDPE pipe welder to demonstrate test HDPE pipe welding before receiving final approval.

6-02.3(26)E3 TRANSITIONS

Transitions between ducts and wedge plates must have adequate length to reduce the angle change effect on the performance of strand-wedge connection, friction loss at the anchorage, and fatigue strength of the post-tensioning reinforcement.

6-02.3(26)E4 VENTS, GROUT INJECTION PORTS, DRAINS, AND CAPS

The Contractor must install vents at high points and drains at low points of the tendon profile, and at other places if the Drawings require. Vents at high points must consist of a set of 3 vents: one to be installed at the high point of the duct, and flanking vents to be installed on either side of the high-point vent at locations where the duct profile is 8 to 12 inches below the elevation of the high-point vent. Vents must include grout injection ports.

Vents and drains must have a minimum inside diameter of 3/4 inches, and must be of either stainless steel, nylon, or polyolefin materials, free of water-soluble chlorides or other chemicals reactive with concrete or post-tensioning reinforcement. Stainless steel vents and drains must conform to ASTM A 240 Type 316. Nylon vents and drains must conform to cell classification S-PA0141 (weather-resistant). Polyolefin vents and drains must contain an antioxidant with a minimum oxidation induction time of 20 minutes per ASTM D 3895. Polyolefin vents and drains must also have a stress crack resistance of 3 hours minimum when tested at an applied stress of 350 psi per ASTM F 2136.

All fasteners must be appropriate for use with plastic ducts, and all clamps must be of an approved plastic material. Taping of connections is not allowed. Valves must be positive mechanical shut-off valves. Valves, and associated caps, must have a minimum pressure rating of 100 psi.

Vents must point upward and remain closed until grouting starts. Drains must point downward and remain open until grouting starts. Ends of stainless steel vents and drains must be removed 1 inch inside the concrete surface after grouting has been completed. Ends of nylon or polyolefin vents and drains may be left flush to the surface unless otherwise specified by the

Engineer. Vents, except for grout injection, are not required for transverse post-tensioning ducts in the bridge deck unless specified in the Drawings.

Caps must be made of either stainless steel or fiber reinforced polymer (FRP). Stainless steel caps must conform to ASTM A 240 Type 316L. The resin for FRP caps must be either nylon, polyester, or acrylonitrile butadiene styrene (ABS). Nylon must conform to cell classification S-PA0141 (weather-resistant). Caps must be sealed with "O" ring seals or precision-fitted flat gaskets placed against the bearing plate. Caps must be fastened to the anchorage with stainless steel bolts conforming to ASTM A 240 Type 316L.

6-02.3(26)E5 LEAK TIGHTNESS TESTING

The Contractor must test each completed duct assembly for leak tightness after placing concrete but before placing post tensioning reinforcement. The Contractor must submit the equipment used to conduct the leak tightness testing and to monitor and record the pressure maintained in and lost from the closed assembly, and the process to be followed in conducting the leak-tightness testing, to the Engineer for approval with the post-tensioning system Shop Drawings as specified in Section 6-02.3(26)A.

Before testing, all grout caps must be installed and all vents, grout injection ports, and drains must either be capped or have their shut-off valves closed. The Contractor must pressurize the completed duct assembly to an initial air pressure of 50 psi. This pressure must be held for 5 minutes to allow for internal adjustments within the assembly. After 5 minutes, the air supply valve must be closed. The Contractor must monitor and measure the pressure maintained within the closed assembly, and any subsequent loss of pressure, over a period of 1 minute following the closure of the air supply valve. The maximum pressure loss for duct assemblies equal to or less than 150 feet in length must be 25 psig. The maximum pressure loss for duct assemblies greater than 150 feet in length must be 15 psig. If the pressure loss exceeds the allowable, locations of leakage must be identified, repaired or reconstructed using methods approved by the Engineer. The repaired system must then be retested. The cycle of testing, repair and retesting of each completed duct assembly must continue until the completed duct assembly completes a test with pressure loss within the specified quantity.

All duct splices, joints, couplings and connections to anchorages must be made with devices or methods, such as mechanical couplers, plastic sleeves, or shrink sleeve, approved by the duct manufacturer and produce a smooth interior alignment with no lips or kinks. All connections and fittings must be air and mortar tight. Taping is not acceptable for connections and fittings

6-02.3(26)F PRESTRESSING REINFORCEMENT

All prestressing reinforcement strand must comply with Section 9-07.10. They must not be coupled or spliced. Tendon locations shown on the Drawings indicate final positions after stressing. No tendon made of 7-wire strands must contain more than 37 strands of 1/2-inch diameter, or more than 27 strands of 0.6-inch diameter.

All prestressing reinforcement bar must conform to Section 9-07.11. They must not be coupled or spliced except as otherwise specified in the Drawings or Contract.

Prestressing reinforcement not conforming to either Section 9-07.10 or 9-07.11 is not allowed except as otherwise noted. Such reinforcement may be used provided it is specifically allowed by the Drawings or Contract, it satisfies all material and performance criteria specified in the Drawings or Contract, and receives the Engineer's approval.

From manufacture to encasement in concrete or grout, prestressing strand must be protected against dirt, oil, grease, damage, and all corrosives. Strand must be stored in a dry, covered area and must be kept in the manufacturer's original packaging. If prestressing strand has been damaged or pitted, it will be rejected. Prestressing strand with rust must be spot-cleaned with a nonmetallic pad to inspect for any sign of pitting or section loss. If the prestressing reinforcement will not be stressed and grouted for more than 7 Calendar Days after it is placed in the ducts, the Contractor must place an approved corrosion inhibitor conforming to Federal Specification MIL-P-3420F-87 in the ducts.

The feeding ends of the strand tendons must be equipped with a bullet nosing or similar apparatus to facilitate strand tendon installation.

Strand tendons may be installed by pulling or pushing. Any equipment capable to performing the task may be used, provided it does not damage the strands and conforms to the following:

1. Pulling lines must have a capacity of at least 2.5 times the dead weight of the tendons when used for horizontal tendon installation.
2. Metal pushing wheels must not be used.
3. Bullets for checking duct clearance before concreting must be rigid and be 1/8 inch smaller than the inside diameter of the duct. Bullets for checking duct after concreting must be less than 1/4 inch smaller than the inside diameter of the duct.

6-02.3(26)G TENSIONING

Equipment for tensioning post-tensioning reinforcement must comply with the following requirements:

1. Stressing equipment must be capable of producing a jacking force of at least 81 percent of the specified tensile strength of the post-tensioning reinforcement.
2. Jacking force test capacity must be at least 95 percent of the specified tensile strength of the post-tensioning reinforcement.

3. Wedge seating methods must assure uniform seating of wedge segments and uniform wedge seating losses on all strand tendons.
4. Accumulation of differential seating losses during tensioning cycling must be prevented by proper devices.
5. Jacks used for stressing tendons less than 20 feet long must have wedge power seating capability.

The Contractor must not start to tension the tendons until:

a. All concrete has reached a compressive strength of at least 4,000 psi or the strength specified in the Drawings (demonstrated on test cylinders made of the same concrete cured under the same conditions as that in the bridge), and

b. The Engineer is satisfied that all strands are free in the ducts.

Tendons must be tensioned to the values shown on the Drawings (or approved Shop Drawings) with hydraulic jacks. When stressing from both ends of a tendon is specified, it need not be simultaneous unless otherwise specified in the Drawings. The jacking sequence must comply with the approved Shop Drawings.

Each jack must have a pressure gauge that will determine the load applied to the tendon. The gauge must display pressure accurately and readably with a dial at least 6 inches in diameter or with a digital display. Each jack and its gauge must be calibrated as a unit and must be accompanied by a certified calibration chart. The Contractor must provide 1 copy of this chart to the Engineer for monitoring. The cylinder extension during calibration must be in approximately the position it will occupy at final jacking force.

All jacks and gauges must be recalibrated and recertified: (1) at least every 180 days, and (2) after any repair or adjustment. The Engineer may use pressure cells to check jacks, gauges, and calibration charts before and during tensioning.

These stress limits apply to all tendons (unless the Drawings set other limits):

1) During jacking before seating: 90 percent of the yield strength of the steel.
2) At anchorages after seating: 70 percent of the specified tensile strength of the steel.
3) At service limit state after losses: 80 percent of the yield strength of the steel.

Tendons must be anchored at initial stresses that will ultimately maintain service loads at least as great as the Drawings require.

As stated in Section 6-02.3(26)A, use the assumed design friction coefficient “μ” and wobble coefficient “k” shown on the Drawings to calculate the stressing elongation. These coefficients may be revised by the post-tensioning Supplier by the following method provided it is approved by the Engineer:

a) Early in the project, the post-tensioning Supplier must test, in place, 2 representative tendons of each size and type shown on the Drawings, for accurately determining the friction loss in a strand and/or bar tendon.

b) The test procedure must consist of stressing the tendon at an anchor assembly with load cells at the dead end and jacking end. The test specimen must be tensioned to 80 percent of the specified tensile strength in 10 increments. For each increment, the gauge pressure, elongation, and load cell force must be recorded and the data furnished to the Engineer. The theoretical elongations and post-tensioning forces shown on the post-tensioning Shop Drawings must be re-evaluated by the post-tensioning Supplier using the results of the tests and corrected as necessary. Revisions to the theoretical elongations must be submitted to the Engineer for evaluation and approval. The apparatus and methods used to perform the tests must be proposed by the post-tensioning Supplier and be subject to the approval of the Engineer.

All costs associated with testing and evaluating test data must be in the unit Contract prices for the applicable items of Work involved.

As tensioning proceeds, the Engineer will be recording the applied load, tendon elongation, and anchorage seating values.

Elongation measurements must be made at each stressing location to verify that the tendon force has been properly achieved. If proper anchor set has been achieved and the measured elongation of each strand tendon is within ± 7 percent of the approved calculated elongation, the stressed tendon represented by the elongation measurements is acceptable to the Owner.

If discrepancies greater than 7 percent exist between the measured and calculated elongations, the jack calibration must be checked and stressing records reviewed for any evidence of wire or strand breakage. If the jack is properly calibrated and there is no evidence of wire or strand breakage, a force verification lift off must be performed to verify the force in the tendon. The post-tensioning Supplier force verification lift off procedure must provide access for visual verification of anchor plate lift off. The jacking equipment must be capable of bridging and lifting off the anchor plate. The tendon is acceptable if the verification lift off force is not less than 99 percent of the approved calculated force nor more than 70 percent of the specified tensile strength of the prestressing steel or as approved by the Engineer.

Elongation measurements must be recorded for bar tendons to verify proper tensioning only. Acceptance will be by force verification lift off. The bar tendon is acceptable if the verification lift off force is not less than 95 percent nor more than 105 percent of the approved calculated force or as approved by the Engineer.

When removing the jacks, the Contractor must relieve stresses gradually before cutting the prestressing reinforcement. The prestressing strands must be cut a minimum of 1 inch from the face of the anchorage device.

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6-02.3(26)H GROUTING

Grout for post-tensioning reinforcement must conform to Section 9-20.3(1). Use prepackaged components of the grout mix within 6 months or less from date of manufacture to date of usage. Grout for post-tensioning reinforcement will be accepted based on manufacturer's certificate of compliance as specified in Section 1-06.3, except that the water-cementitious material ratio of 0.45 maximum must be field verified.

All grout produced for any single Structure must be furnished by 1 Supplier.

All grouting operations must be conducted by ASBI-certified grout technicians.

The Contractor must submit a Grouting Operation Plan to the Engineer for approval as specified in Section 1-05.3. The grouting operation Plan must include, but is not limited to;

1. Names of the grout technicians, accompanied by documentation of their ASBI certification.
2. Type, quantity, and brand of materials used in the grouting operations, including all manufacturer's certificates of compliance.
3. Type of equipment to be used, including meters and measuring devices used to positively measure the quantity of materials used to mix the post-tensioning grout, the equipment capacity in relation to demand and working conditions, and all back-up equipment and spare parts.
4. General grouting procedure.
5. Duct leak tightness testing and repair procedures as specified in Section 6-02.3(26)E.
6. Methods used to control the rate of grout flow within the ducts.
7. Theoretical grout volume calculations, and target flow rates recommended by the grout manufacturer as a function of the mixer equipment and the expected range of ambient temperatures.
8. Grout mixing and pumping procedures.
9. Direction of grouting.
10. Sequence of use of the grout injection ports, vents, and drains.
11. Procedures for handling blockages.
12. Procedures for post grouting repairs.

The Contractor must not start grouting operations until receiving the Engineer's approval of the grouting operation Plan.

Post-tensioning grout must be mixed per the prepackaged grout manufacturer's recommendations using high-shear colloidal mixers. Mechanical paddle mixers are not allowed. The grout produced for filling post-tensioning ducts must be free of lumps and undispersed cement. All equipment used to mix each batch of post-tensioning grout must be equipped with appropriate meters and measuring devices to positively measure all quantities of all materials used to produce the mixed grout. The field test for water-cementitious materials ratio must be performed before starting the grout injection process. Grouting must not start until the material properties of each batch of grout have been confirmed as acceptable.

After tensioning the tendons, the Contractor must again blow oil-free, compressed air through each duct. All drains must then be closed and the vents opened. Grout caps must be installed at tendon ends before grouting. After completely filling the duct with grout, the Contractor must pump the grout from the low end at a pressure of not more than 250 psig, except for transverse tendons in deck slabs the grout pressure must not exceed 100 psig. Grout must be continuously wasted through each vent until no more air or water pockets show. At this point, all vents must be closed and grouting pressure at the injector held between 100 and 200 psig for at least 10 seconds, except for transverse tendons in deck slabs the grouting pressure must be held between 50 and 75 psig for at least 10 seconds. The Contractor must leave all plugs, caps, and valves in place and closed for at least 24 hours after grouting.

Grouting equipment must:

a. Include a pressure gauge with an upper end readout of between 275 and 325 psig;
b. Screen the grout before it enters the pump with an easily reached screen that has clear openings of no more than 0.125 inches;
c. Be gravity fed from an attached, overhead hopper kept partly full during pumping; and
d. Be able to complete the largest tendon on the project in no more than 20 minutes of continuous grouting.

In addition, the Contractor must have standby equipment (with a separate power source) available for flushing the grout when the regular equipment cannot maintain a 1 way flow of grout. This standby equipment must be able to pump at 250 psig.

The grout ejected from the end vent must have a minimum flow of 11 seconds.

The grout mix must be injected within 30 minutes after the water is added to the cement. Temperature of the surrounding concrete must be at least 35 °F from the time the grout injecting starts until 2-inch cubes of the grout have a compressive strength of 800 psi. Cubes must be made per WSDOT Test Method T 813 and stored per AASHTO T 23. If ambient conditions are such that the surrounding concrete temperature may fall below 35 °F, the Contractor must provide a heat source and protective covering for the Structure to keep the temperature of the surrounding concrete above 35 °F. Grout temperature must not exceed 90 °F during mixing and pumping. If conditions are such that the temperature of the grout mix may exceed 90 °F, the Contractor will make necessary provisions, such as cooling the mix water and/or dry ingredients, to ensure that the temperature of the grout mix does not exceed 90 °F.

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6-02.3(27) CONCRETE FOR PRECAST UNITS

Precast units must not be removed from forms until the concrete has attained a minimum compressive strength of 70 percent of the specified design strength as verified by rebound number determined per ASTM C 805. Type III Portland cement is permitted to be used in precast concrete units.

Precast units must not be shipped until the concrete has reached the specified design strength as determined by testing cylinders made from the same concrete as the precast units. The cylinders must be made, handled, and stored per AASHTO T 23 and compression tested per AASHTO Test Method T 22 and AASHTO Test Method T 231.

6-02.3(27)A OF SELF-CONSOLIDATING CONCRETE FOR PRECAST UNITS

Self-Consolidating Concrete (SCC) is concrete that is able to flow under its own weight and completely fill the formwork, without the need for any vibration, while maintaining homogeneity, even in the presence of dense reinforcement. SCC must be capable of flowing through the steel reinforcing bar cage without segregation or buildup of differential head inside or outside of the steel reinforcing bar cage.

SCC may be used for the following precast concrete structure elements:

1. Precast roof, wall, and floor panels and retaining wall panels as specified in Section 6-02.3(28).
2. Precast reinforced concrete 3-sided structures as specified in Section 6-02.3(28) as supplemented in the Special Provisions.
3. Precast concrete barrier as specified in Section 6-10.3(1).
4. Precast concrete wall stem panels as specified in Section 6-11.3(3).

6-02.3(27)B SUBMITTALS FOR SELF-CONSOLIDATING CONCRETE FOR PRECAST UNITS

With the exception of items 3, 7, and 8 in Section 6-02.3(27)A, the Contractor must submit the mix design for SCC to the Engineer for annual approval as specified in Section 6-02.3(28)B. The mix design submittal must include items specified in Section 6-02.3(2)A, and results of the following tests conducted on concrete that has slump flow within the slump flow range defined below:

1. Slump Flow.
   a. The mix design must specify the target slump flow in inches, per WSDOT FOP for ASTM C 1611. The slump flow range is defined as the target slump flow ± 2 inches.
   b. The visual stability index (VSI) must be less than or equal to 1 per ASTM C 1611, Appendix X1, using Filling Procedure B.
   c. The T_{50} flow rate results must be less than 6 seconds per ASTM C 1611, Appendix X1, using Filling Procedure B.
2. Column Segregation.
   a. The maximum static segregation must be 10 percent per ASTM C 1610.
   b. The Maximum Hardened Visual Stability Index (HVSI) must be per AASHTO PP 58.
3. J ring test results for passing ability must be less than or equal to 1-1/2 inches per the WSDOT FOP for ASTM C 1621.
4. Air content must be tested per WSDOT Test Method T 818 and must conform to Section 6-02.3(2)A.
5. Concrete unit weight results in pounds per cubic foot must be recorded per AASHTO T 121, except that the concrete must not be consolidated in the test mold.
6. The temperature of all concrete laboratory test samples must be tested per AASHTO T 309 and must conform to the placement limits specified in Section 6-02.3(4)D.
7. The modulus of elasticity in pounds per square inch at 28 days must be recorded per ASTM C 469.

Use of Type III cement is permitted.

Placement for construction may include consolidation using light vibration, but the requirements of Section 6-02.3(4)C for consistency will not apply.

Items 3, 7, and 8 in Section 6-02.3(27)A require the precast plant to cast 1 representative structure acceptable to the Engineer and have the structure sawn in half for examination by the Owner to determine that segregation has not occurred. The Owner's approval of the sawn structure will constitute approval of the precast plant to use SCC, and a concrete mix design submittal is not required.

6-02.3(27)C ACCEPTANCE TESTING OF SELF-CONSOLIDATING CONCRETE FOR PRECAST UNITS

Acceptance testing must be performed by the Contractor and test results must be submitted to the Engineer. Placement of SCC for concrete testing such as cylinder preparation is per WSDOT Test Method T 819.

SCC for items 1, 2, 4, 5, and 6 in Section 6-02.3(27)A will be accepted as specified in Section 6-02.3(5) procedures and based on conformance to the requirements specified above and in Section 6-02.3(2)A for the following:

1. Temperature.
2. Air content.

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3. Compressive strength at 28 days.
4. Slump flow within the target slump flow range.
5. J ring passing ability less than or equal to 1-1/2 inches.
6. VSI less than or equal to 1.

SCC for concrete barrier will be accepted based on temperature, air, and compressive strength testing listed above.

SCC for precast junction boxes, cable vaults, and pull boxes will be accepted based on the temperature and compressive strength testing listed above.

SCC for precast drainage structure elements will be accepted per the requirements of AASHTO M 199.

6-02.3(28) PRECAST CONCRETE PANELS

The Contractor must perform quality control inspection. The manufacturing plant for precast concrete units must be certified by the Precast/Prestressed Concrete Institute's Plant Certification Program for the type of precast member to be produced, or the National Precast Concrete Association's Plant Certification Program or be an International Congress Building Officials or International Code Council Evaluation Services recognized fabricator of structural precast concrete products, and must be approved by WSDOT as a Certified Precast Concrete Fabricator before the start of production. WSDOT Certification must be granted at, and renewed during, the annual precast plant review and approval process. Products that must conform to this requirement include noise barrier panels, wall panels, floor and roof panels, marine pier deck panels, retaining walls, pier caps, and bridge deck panels. Precast concrete panels that are prestressed must comply with all requirements of Section 6-02.3(25).

Before the start of production of the precast concrete units, the Contractor must advise the Engineer of the production schedule. The Contractor must give the inspector safe and free access to the Work. If the inspector observes any Work not in compliance with the Specifications or unacceptable quality control practices, the inspector will advise the plant manager. If the corrective action is not acceptable to the Engineer, the panel will be rejected.

6-02.3(28)A SHOP DRAWINGS

Before casting the structural elements, the Contractor must submit Shop Drawings as specified in Section 1-05.3.

These Shop Drawings must show complete details of the methods, materials, and equipment the Contractor proposes to use in prestressing/precasting Work. The Shop Drawings must comply with the design conditions shown on the Drawings unless the Engineer approves equally effective variations.

The Shop Drawings must contain as a minimum:

1. Panel shapes (elevations and sections) and dimensions.
2. Finishes and method of constructing the finish (i.e. forming and rolling).
3. Reinforcing, joint, and connection details.
4. Lifting, bracing, and erection inserts.
5. Locations and details of hardware attached to the Structure.
6. Relationship to adjacent material.

Approval of these Shop Drawings does not relieve the Contractor of responsibility for accuracy of the drawings or conformity with the Contract. Approval will not indicate a check on dimensions.

The Contractor may deviate from the approved Shop Drawings only after obtaining the Engineer's approval of a written request that describes the proposed changes. Approval of a change in method, material, or equipment does not relieve the Contractor of any responsibility for completing the Work.

Before completion of the Contract, the Contractor must provide the Engineer with reproducible originals of the Shop Drawings (and any approved changes). These must be clear, suitable for microfilming, and on permanent sheets that conform with the size requirements of Section 1-05.3.

6-02.3(28)B CASTING

Before casting precast concrete units, the Contractor and Fabrication inspector must have possession of an approved set of Shop Drawings.

Concrete must comply with requirements of Section 6-02.3(25)B for annual pre-approval of the concrete mix design, and slump. If SCC is used, the concrete must conform to Sections 6-02.3(27)B and 6-02.3(27)C.

Precast units must not be removed from forms until the concrete has attained a minimum compressive strength of 70 percent of the specified design strength. A minimum compressive strength at other than 70 percent may be used for specific precast units if the fabricator requests and receives approval as part of the WSDOT plant certification process.

Forms may be steel or plywood faced, providing they impart the required finish to the concrete.

6-02.3(28)C CURING

Concrete in the precast units must be cured by either moist or accelerated curing methods. The methods to be used must be preapproved in the WSDOT plant certification process.

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1. For moist curing, the surface of the concrete must be kept covered or moist until the compressive strength of the concrete reaches the strength specified for stripping. Exposed surfaces must be kept continually moist by fogging, spraying, or covering with moist burlap or cotton mats. Moist curing must start as soon as possible following completion of surface finishing.
2. For accelerated curing, heat must be applied at a controlled rate following the initial set of concrete in combination with an effective method of supplying or retaining moisture. Moisture may be applied by a cover of moist burlap, cotton matting, or other effective means. Moisture may be retained by covering the unit with an impermeable sheet.

Heat may be radiant, convection, conducted steam or hot air. Heat the concrete to no more than 100 °F during the first 2 hours after pouring the concrete, and then increase no more than 25 °F per hour to a maximum of 175 °F. After curing is complete, cool the concrete no more than 25 °F per hour to 100 °F. Maintain the concrete temperature above 60 °F until the unit reaches stripping strength.

Concrete temperature must be monitored with a thermocouple embedded in the concrete (linked with a thermometer accurate to ± 5 °F). The recording sensor (accurate to ± 5 °F) must be arranged and calibrated to continuously record, date, and identify concrete temperature throughout the heating cycle. This temperature record must be provided to the Engineer for inspection and become a part of the documentation required.

The Contractor must never allow dry heat to directly touch exposed panel surfaces at any point.

6-02.3(28)D CONTRACTORS CONTROL STRENGTH

Determine the concrete strength at stripping and the verification of design strength by testing cylinders made from the same concrete as the precast panels. The cylinders must be made, handled, and stored per AASHTO T 23 and compression tested per AASHTO Test Method T 22 and AASHTO Test Method T 231.

For accelerated cured units, concrete strength must be measured on test cylinders cast from the same concrete as that in the panel. These cylinders must be cured under time-temperature relationships and conditions that simulate those of the panel. If the forms are heated by steam or hot air, test cylinders will remain in the coolest zone throughout curing. If forms are heated another way, the Contractor must provide a record of the curing time-temperature relationship for the cylinders for each panel to the Engineer. When 2 or more panels are cast in a continuous line and in a continuous pour, a single set of test cylinders may represent all panels provided the Contractor demonstrates uniformity of casting and curing to the satisfaction of the Engineer.

The Contractor must mold, cure, and test enough of these cylinders to satisfy Specification requirements for measuring concrete strength. The Contractor may use 4” x 8” or 6” x 12” cylinders. The Contractor must let cylinders cool for at least 1/2-hour before testing for release strength.

Test cylinders may be cured in a moist room or water tank per AASHTO T-23 after the unit concrete has obtained the required release strength. If, however, the Contractor intends to ship the panel before standard 28 day strength test, determine the design strength for shipping from cylinders placed with the panel and cured under the same conditions as the panel. These cylinders may be placed in a non-insulated, moisture-proof envelope.

To measure concrete strength in the precast panel, the Contractor must randomly select 2 test cylinders and average their compressive strengths. The compressive strength in either cylinder must not fall more than 5 percent below the specified strength. If these 2 cylinders do not pass the test, 2 other cylinders must be selected and tested.

6-02.3(28)E FINISHING

The Contractor must provide a finish on all relevant concrete surfaces as defined in Section 6-02.3(14), unless the Contract requires otherwise.

6-02.3(28)F TOLERANCES

The panels must be manufactured as shown on the Drawings, and must comply with the dimensional tolerances listed in the latest edition of PCI-MNL-116, unless otherwise required by the Contract.

6-02.3(28)G HANDLING AND STORAGE

The Contractor must lift all panels only by adequate devices at locations designated on the Shop Drawings. When these devices and locations are not shown on the Drawings, Section 6-02.3(25)L must apply.

Precast panels must be stored off the ground on foundations suitable to prevent differential settlement or twisting of the panels. Stacked panels must be separated and supported by dunnage of uniform thickness capable of supporting the panels. Dunnage must be arranged in vertical planes. The upper units of a stacked tier must not be used as storage areas for shorter panels unless substantiated by engineering analysis and approved by the Engineer.

6-02.3(28)H SHIPPING

Precast panels must not be shipped until the concrete has reached the specified design strength, and the Engineer has reviewed the fabrication documentation for Contract compliance and stamped the precast concrete panels “Approved for Shipment.” The panels must be supported in such a manner that they are not damaged by anticipated impact on their dead load. Sufficient padding material must be provided between tie chains and cables to prevent chipping or spalling of the concrete.

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6-02.3(28)I ERECTION

When the precast panels arrive on the project, the Engineer will confirm that they are stamped “Approved for Shipment.” The Engineer will evaluate the present panels for damage before accepting them.

The Contractor must lift all panels by suitable devices at locations designated on the Shop Drawings. Temporary shoring or bracing must be provided, if necessary. Panels must be properly aligned and leveled as required by the Drawings. Variations between adjacent panels must be leveled out by a method approved by the Engineer.

6-02.3(29) PATTERNED, COLORED, AND EXPOSED AGGREGATE TREATMENTS

The following 3 treatments may be used with cement concrete referencing Section 6-02. Patterned and Colored or Exposed Aggregate and Colored may be combined for architectural landscaping or artistic surfaces. Payment for the extra effort required to create these 3 treatments will be per Section 6-02.5

Patterned Cement Concrete Surface Treatment: Patterned cement concrete is defined as additional work necessary to imprint cement concrete with a pattern, and is referenced by "Patterned" and “Running Bond Used Brick” or (other pattern) in the Bid Item description and call-outs for locations on the Drawings. Other patterns may be shown on the Drawings or on Drawing Details in the Appendix of the Contract. This extra work is described in Sections 5-05.3(20).

Colored Cement Concrete Treatment: Colored cement concrete is defined as additional work necessary to color cement concrete with a color, and is referenced by "Colored" and a Federal Standard 595B "F (color code)" in the Bid Item description and call-outs for locations on the Drawings. This extra work is described in Sections 5-05.3(20).

Exposed Aggregate Cement Concrete Surface Treatment: Exposed aggregate cement concrete is defined as additional work necessary to expose aggregate on the surface of cement concrete. This extra work is described in Sections 5-05.3(21).

6-02.4 MEASUREMENT

Except as noted below, all classes of concrete will be measured in place by the cubic yard to the neat lines of the Structure as shown on the Drawings.

Concrete in cofferdam seals. Payment for Class 4000W concrete used in these seals will be based on the volume calculated using the neat line dimensions for the seal as shown on the Drawings. For calculated purposes, the horizontal dimension will be increased by 1 foot outside the seal neat line perimeter. The vertical dimension is the distance between the top and bottom neat line elevations. No payment will be made for any concrete that lies outside of these limits to accommodate the Contractor’s cofferdam configuration. If the Engineer eliminates the seal in its entirety a Contract Change Order will be issued.

Concrete in a separate lump-sum, Superstructure Bid Item. Any concrete quantities noted under this item in the Contract will not be measured. Although the Contract lists approximate quantities for the Contractor’s convenience, the Owner does not guarantee the accuracy of these estimates. Before submitting a Bid, the Contractor must have verified the quantities. Even though actual quantities used may vary from those listed in the Contract, the Owner will not adjust the lump sum Contract price for Superstructure (except for approved changes).

The Owner will not pay for concrete placed below the established elevation of the bottom of any footing or seal.

Lean concrete will be measured by the cubic yard for the quantity of material placed per the producer’s invoice, except that lean concrete included in other Contract items will not be measured.

No deduction will be made for pile heads, reinforcing steel, structural steel, bolts, weep holes, rustications, chamfers, edgers, joint filler, junction boxes, miscellaneous hardware, ducts or less than 6-inch diameter drain pipes when computing concrete quantities for payment.

All reinforcing steel will be measured by the computed weight of all metal, including mechanical splices, actually in place and required by the Drawings or the Engineer. Epoxy-coated bars will be measured before coating. The Contractor must furnish without extra allowance:

1. Spreaders, form blocks, wire clips, and other fasteners.
2. Extra steel in splices not shown on the Drawings or specified in the Drawings as optional.
3. Extra shear steel at construction joints not shown on the Drawings when the Engineer permits such joints for the Contractor’s convenience.

The weight of mechanical splices will be based on the weight specified in the manufacturer’s catalog cut for the specific item.

Use the following table to compute weight of reinforcing steel:

Steel Reinforcing Bar		
Deformed Bar Designation Number	**Nominal Diameter Inches**	**Unit Weight Pounds per Foot**
3	0.375	0.376
4	0.500	0.668
5	0.625	1.043

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Steel Reinforcing Bar		
Deformed Bar Designation Number	**Nominal Diameter Inches**	**Unit Weight Pounds per Foot**
6	0.750	1.502
7	0.875	2.044
8	1.000	2.670
9	1.128	3.400
10	1.270	4.303
11	1.410	5.313
14	1.690	7.650
18	2.260	13.600

Gravel backfill will be measured as specified in Section 2-10.

Bridge approach slab will be measured by the square yard.

Measurement for "Patterned Cement Concrete, (pattern)" will be by the square yard of area where imprinting tools is applied.

Measurement for "Colored Cement Concrete, (color), F(color code)", will be by the square yard of area of color cement concrete.

Measurement for "Exposed Aggregate Cement Concrete", will be by the square yard of area of exposed aggregate cement concrete.

6-02.5 PAYMENT

A Hot Weather Concrete Placement and Curing Plan (Section 6-02.3(6)A1) or a Cold Weather Concrete Placement and Curing Plan (Section 6-02.3(6)A2) is required by the Engineer. All costs associated with the development, submittal, any resubmittal and implementation of this plan are incidental to the various concrete Bid Items and no separate payment will be made.

1. **"Conc. Class ____"**, per cubic yard.
2. **"Conc. Class ____ w/ ___% minimum pozzolans"**, per cubic yard.
3. **"Commercial Concrete"**, per cubic yard.

All concrete, except in superstructure when this is covered by a separate Bid Item, is paid for at the unit Contract price per cubic yard in place for the various classes of concrete. All costs with furnishing and applying pigmented sealer to concrete surfaces as specified must be in the unit Contract Price per cubic yard for "Conc. Class ____..." If the concrete is paid for except by class of concrete, then the costs must be in the applicable adjacent item of work

4. **"Superstructure (name bridge)"**, lump sum.
5. **"Superstructure (name bridge) w/ ___% minimum pozzolans"**, lump sum.

All costs in connection with providing holes for vents, for furnishing and installing cell drainage pipes for box girder Structures, and furnishing and placing grout and shims under steel shoes must be in the unit Contract prices for the Bid Items involved.

All costs associated with the construction of weep holes, including the gravel backfill for drains surrounding the weep holes except as provided in Section 2-10 must be included by the Contractor in the unit Contract price per cubic yard for "Conc. Class ____...."

6. **"Lean Concrete"**, per cubic yard.

Lean concrete, except when included in another Bid Item, is paid for at the unit Contract price per cubic yard.

7. **"Steel Reinforcing Bar"**, per pound.
8. **"Epoxy-Coated Steel Reinforcing Bar"**, per pound.

Payment for reinforcing steel includes the cost of furnishing, fabricating, placing, and splicing the reinforcement. In Structures of reinforced concrete where there are no structural steel Bid Items, such minor metal parts as expansion joints, bearing assemblies, and bolts will be paid for at the unit Contract price for "Reinforcing Bar" unless otherwise specified.

9. **"Gravel Backfill for Foundation Class A"**, per cubic yard.
10. **"Gravel Backfill for Foundation Class B"**, per cubic yard.
11. **"Gravel Backfill for Wall"**, per cubic yard.
12. **"Deficient Strength Conc. Price Adjustment"**, by calculation.

"Deficient Strength Conc. Price Adjustment" must be calculated and paid for as described in Section 6-02.3(5)J. To provide a common Proposal for all Bidders, the Owner has entered 0 as an amount for the item "Deficient Strength Conc.

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Price Adjustment" in the Bid Proposal to become a part of the total Bid by the Contractor. The item "Deficient Strength Conc. Price Adjustment" covers all applicable classes of concrete.

All costs for providing, operating, maintaining, moving and removing the cure boxes and providing, maintaining and operating all necessary power sources and connections needed to operate the curing boxes must be included in the applicable concrete Bid Items.

13. **"Bridge Approach Slab"**, per square yard.

14. **"Bridge Approach Slab w/ ___% minimum pozzolans"**, per square yard.

The unit Contract price per square yard for "Bridge Approach Slab…" will be full pay for providing, placing, and compacting the crushed surfacing base course, furnishing and placing Class 4000A concrete, and furnishing and installing compression seal, anchors, and reinforcing steel.

15. **"Patterned Cement Concrete Treatment**, **(pattern)"**, per square yard.

The Bid Item price for "Patterned Cement Concrete Treatment" includes all costs for additional work as described in Section 5-05.3(20) and necessary to imprint cement concrete with a pattern referenced in the Bid Item description.

16. **"Colored Cement Concrete Treatment**, **(color), F(color code)"**, per cubic yard.

The Bid Item price for "Colored Cement Concrete Treatment" includes all costs for additional work as described in Section 5-05.3(20) and necessary to color cement concrete with a color referenced in the Bid Item description.

17. **"Exposed Aggregate Cement Concrete Treatment "**, per square yard.

The Bid Item price for "Exposed Aggregate Cement Concrete Treatment" includes all costs for additional work as described in Section 5-05.3(21) and necessary to expose aggregate of cement concrete per the Contract.

SECTION 6-03 STEEL STRUCTURES

6-03.1 DESCRIPTION

Section 6-03 describes furnishing, fabricating, erecting, cleaning, and painting steel structures and the structural steel parts of non-steel Structures.

Any part of a steel Structure made of non-steel Materials must comply with the Sections of the Standard Specifications governing those Materials.

6-03.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Material	Section
Structural Steel and Related Materials	Section 9-06
Paints	Section 9-08
Grout	Section 9-20

Structural steel is classified as:

1. Structural carbon steel (to be used whenever the Contract does not specify another classification).
2. Structural low alloy steel.
3. Structural high strength steel.

Unless the Contract states otherwise, the following are classified as structural carbon steel: shims; ladders; stairways; anchor bolts and sleeves; pipe, fittings and fastenings used in handrails; and other metal parts, even if made of other materials, for which payment is not specified.

All AASHTO M 270 material used in what the Drawings show as main load carrying tension members or as tension components of flexural members must comply with the Charpy V notch requirements of AASHTO M 270, temperature zone 2. All AASHTO M 270 material used in what the Drawings show as fracture critical members must comply with the Charpy V notch requirements of AASHTO M 270, Fracture Critical Impact Test requirements, temperature zone 2. Charpy V notch requirements for other steel materials must be as specified in the Contract. Filler metals for welding must comply with the toughness requirements of the applicable welding code specified in Section 6-03.3(25).

The Contractor must submit for the Engineer's approval a written plan for visibly marking the material so it can be traced. These marks must remain visible at least through the fit up of the main load carrying tension members. The marking method must include the following information:

a. Material specification designation.
b. Heat number.
c. Material test reports to comply with any special requirements.

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As-built Drawings: For steel in main load carrying tension members and in tension components of flexural members, the Contractor must include the heat numbers on the reproducible copies of the as-built Shop Drawings, see Section 1-05.3(11).

6-03.3 CONSTRUCTION REQUIREMENTS

Structural steel fabricators of girders, floor beams, truss members, and stringers, for permanent steel bridges, must be certified under the AISC Quality Certification Program, Category III, Major Steel Bridges. When fracture critical members are specified in the Contract, structural steel fabricators must also have an endorsement F, Fracture Critical, under the AISC Quality Certification Program.

6-03.3(1) NOTICE OF ROLLING

Before rolling work starts, the Contractor must provide enough advance notice that the Engineer may observe it. The Contractor must notify the Engineer of who is to do the work and where it is to be done. No material must be rolled until the Engineer gives written notice to Proceed.

6-03.3(2) FACILITIES FOR INSPECTION

See Section 1-05.6 and Section 1-06 for the Engineer's right to inspect Material and workmanship.

6-03.3(3) INSPECTOR'S AUTHORITY

See Section 1-05.

6-03.3(4) REJECTIONS

See Section 1-05 and Section 1-06.

6-03.3(5) MILL ORDERS AND SHIPPING STATEMENTS

The Contractor must furnish as many copies of mill orders and shipping statements as the Engineer requires.

6-03.3(6) WEIGHING

Structural steel need not be weighed unless specified otherwise in the Contract. When weight is specified, it may either be calculated or obtained by scales. The Contractor must furnish 4 copies of the calculations or weight slips unless the Contract specifies another quantity. If scale weights are used, the Contractor must record separately the weights of all tools, erection material, and dunnage.

6-03.3(7) SHOP DRAWINGS AND AS-BUILT RECORDS

The Contractor must submit to the Engineer for review all Shop Drawings, and certified mill test reports, for fabricating the steel. Ten sets of the Shop Drawings must be submitted to the Engineer. Four additional sets are required for each affected railroad company on any grade separation structure that carries a railroad over a highway.

The Engineer will return the Shop Drawings to the Contractor. When Shop Drawing sheets returned by the Engineer require correction, the Contractor must correct and resubmit them in the quantities required above. No material must be produced until:

1. The Engineer has reviewed all Shop Drawings; and
2. The SPU Materials Laboratory has approved the Material source and the fabricator.

See Section 1-05.3 regarding Shop Drawings.

As-built records: Before the Physical Completion Date can be established, the Contractor must furnish the Engineer 1 set of reproducible copies of the as-built Shop Drawings, see Sections 1-05.3(13) and 1-05.3(14). An additional set of as-built Shop Drawings is required for each affected railroad company on any grade separation Structure that carries a railroad over a transportation Right of Way. The reproducible as-built Shop Drawings must be 22" x 34" and must comply with the requirements of Section 1-05.3(11).

6-03.3(7)A ERECTION METHODS

The Contractor must submit a steel erection plan and procedure describing the methods the Contractor intends to use to the Engineer for review. The Contractor must have received the Engineer's returned submittal for the erection plan and procedure before doing this work. The Contractor's erection plan and procedure must first be reviewed by the steel fabricator before being submitted to the Engineer. The Contractor's submittal must include evidence that the fabricator has reviewed the erection Shop Drawings and procedures; and must submit the fabricator's review comments with the erection plan submittal.

The erection plan and procedure must provide complete details of the erection process including but not limited to:

1. Temporary falsework support, bracing, guys, deadmen, and attachments to other structure components or objects.
2. Procedure and sequence of operation.
3. Girder stresses during progressive stages of erection.
4. Girder masses, lift points, and lifting devices, spreaders, and glommers.
5. Crane make and model, masses, geometry, lift capacity, outrigger size and reactions.

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6. Girder launcher or trolley details and capacity (if intended for use).
7. Locations of cranes, barges, trucks delivering girders, and the location of cranes and outriggers relative to other Structures, including retaining walls and wing walls.

The Contractor may submit for approval the use of an engineered and manufactured lifting bracket bolted to the girder top flanges providing the following requirements are satisfied:

a. The lifting bracket must be engineered and supporting calculations must be submitted with the erection plan.
b. The calculations must include critical stresses in the girder including local stresses in the flanges at lifting bracket locations.
c. The calculations must include computation of the lifting bracket and associated bolt hole locations and the expected orientation of the girder during picking operation.
d. The lifting bracket must be load tested and certified for a load at least 2 times the working load and at all angles it will be used (angle of load or rigging). Certification documentation from a previous project may be submitted for approval.
e. Bolt holes in girders added for the lifting bracket connections must be shown on the shop plans and must be drilled in the shop. Field drilling of bolt holes for lifting brackets is not permitted.
f. Bolt holes in girder top flanges must be filled with high strength bolts after erection as specified in Section 6-02.3(17)K.

The erection plan must include Shop Drawings, notes, catalog cuts, calculations clearly showing the above listed details, assumptions, and dimensions, material properties, Specifications, structural analysis, and any other necessary data. The plan, including lifting bracket working drawings and calculations, must be prepared by, or under the direct supervision of, a Professional Engineer, licensed under Title 18 RCW, State of Washington, in the branch of Civil or Structural, and must carry the engineer's seal and signature, as specified in Section 1-05.3(12).

The Contractor must submit the erection Shop Drawings, calculations, procedure, and fabricator's comments directly to the Engineer, as specified in Section 6-02.3(16). After the plan is reviewed and returned to the Contractor, any change that the Contractor proposes to the reviewed submittal is specified in Section 1-05.3(6).

6-03.3(8) SUBSTITUTIONS

The Contractor must not substitute sections that differ from Drawings or Engineer reviewed Shop Drawings dimensions unless the Contractor has submitted the substitution for review by the Engineer. If the Contractor's submittal requests substitution of heavier members which exceed Contract requirements, such substitution must be at no additional cost to the Owner. Also see the requirements of Sections 1-05.3(6).

6-03.3(9) HANDLING, STORING, AND SHIPPING OF MATERIALS

Markings applied at the mill must distinguish structural low alloy steel from structural carbon steel. The fabricator must keep the 2 classes of steel carefully separated.

Before fabrication, all material stored at the fabricating plant must be protected from rust, dirt, oil, and other foreign matter. The Owner will not accept rust pitted material.

After fabrication, all material awaiting shipment is subject to the same storage requirements as unfabricated material.

All structural steel must arrive at the Project Site in a condition meeting or exceeding the specified requirements. Steel damaged by salt water shipment must be thoroughly cleaned by high pressure water flushing, chemical cleaning, or sandblasting, and repainted with the specified shop coat in compliance with specified requirements.

All material must be stored to prevent rust and loss of small parts. Piled material must rest on skids or platforms, and must not make contact with the ground or with water.

The loading, transporting, unloading, and stockpiling of the structural steel material must be so conducted that the metal is kept clean and free from injury from rough handling.

In field assembly of structural parts, the Contractor must use methods and equipment that must not twist, bend, deform, or otherwise injure the metal. Any bent or twisted member must be corrected before it is placed. The Owner will not accept any member with damage.

Girder sections must be handled to prevent damage to the girders. The Contractor must provide temporary stiffeners to prevent buckling during erection as necessary.

6-03.3(10) STRAIGHTENING BENT MATERIAL

Plates, angles, other shapes, and built up members may be straightened if authorized in writing by the Engineer. Straightening methods must not fracture or injure the metal. Distorted members must be straightened mechanically. A limited quantity of localized heat may be applied only if carefully planned and supervised, and only if the Engineer has approved a heat straightening procedure in writing.

Parts to be heat straightened must be free from all stress and external forces except those that result from the mechanical pressure used with the heat.

After straightening, the Contractor must inspect the member for fractures using a method specified in the Contract.

The Engineer will reject metal showing sharp kinks and bends.

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The procedure for heat straightening of universal mill (UM) plates by the mill or the fabricator must be submitted to the Engineer for review before doing this work.

6-03.3(11) WORKMANSHIP AND FINISH

Workmanship and finish must be first class, equaling the best practice in modern bridge fabrication shops. Welding, shearing, burning, chipping, and grinding must be done neatly and accurately. All parts of the work exposed to view must be neatly finished.

Wherever the Drawings show a surface finish symbol, the surface must be machined.

6-03.3(12) FALSEWORK

All falsework must conform to the requirements specified in Section 6-02.

6-03.3(13) FABRICATING TENSION MEMBERS

Plates for main load carrying tension members or tension components of flexural members must be:

1. Blast cleaned entirely or blast cleaned on all areas within 2 inches of welds to SSPC SP6, Commercial Blast Cleaning; and
2. Manufactured from plate stock with the primary rolling direction of the stock parallel to the length of the member, or as shown on the Drawings.

6-03.3(14) EDGE FINISHING

All rolled, sheared, and thermal cut edges must be true to line and free of rough corners and projections. Corners along exposed sheared or cut edges must be broken by light grinding or another method acceptable to the Engineer to achieve an approximate 1⁄16- inch chamfer or rounding.

Sheared edges on plates more than 5/8 inch thick must be planed, milled, ground, or thermal cut to a depth of at least 1/8 inch.

Re-entrant corners or cuts must be filleted to a minimum radius of 1 inch.

Exposed edges of main load-carrying tension members or tension components of flexural members must have a surface roughness no greater than 250-micro inches as defined by the American National Standards Institute, ANSI B46.1, Surface Texture. Exposed edges of other members must have surface roughness no greater than 1,000-micro inches.

The Rockwell hardness of thermal-cut edges of structural low alloy or high-strength steel flanges, as specified in Sections 9-06.2 and 9-06.3, for main load-carrying tension members or tension components of flexural members must not exceed RHC 30 when tested in accordance with ASTM A1038. The fabricator must prevent excessive hardening of flange edges through preheating, post heating, or control of the burning process as recommended by the steel manufacturer.

Hardness testing must consist of testing thermal-cut edges with a portable hardness tester. The Contractor must submit the hardness tester, and its operating test procedures to the Engineer for approval. The hardness tester must be convertible to Rockwell C scale values.

At two locations, two tests must be performed on each thermal-cut edge, one each within 1/4 inch of the top and bottom surfaces. The tests must be located 1/4 the length of each thermal-cut edge from each end of the cut. If one or more readings are greater than RHC 30, the entire length of the edge must be ground or machined to a depth sufficient to provide acceptable readings upon further retests. If thermal-cutting operations conform to procedures established by the steel manufacturer, and hardness testing results are consistently within acceptable limits, the Engineer may authorize a reduction in the testing frequency.

Hardness testing is the responsibility of the fabricator. The hardness testing device operator must be trained in its operation and competent in its use. Documentation of operator training must be made available to the Engineer upon request. Results of all hardness testing must be submitted to the Engineer.

6-03.3(15) PLANING OF BEARING SURFACES

Ends of columns that bear on base and cap plates must be milled to true surfaces and accurate bevels.

When assembled, caps and base plates of columns and the sole plates of girders and trusses must have full contact. If warped or deformed, the plates must be heat straightened, planed, or corrected in some other way to produce accurate, even contact. If necessary for proper contact, bearing surfaces that are in contact with other metal surfaces must be planed or milled. Surfaces of warped or deformed base and sole plates that are to in contact with masonry must be rough finished.

On the surface of expansion bearings, the cut of the planer must be in the direction of expansion.

6-03.3(16) ABUTTING JOINTS

Abutting ends of compression members must be faced accurately so they bear evenly when in the Structure. On built up members, the ends must be faced or milled after fabrication.

Ends of tension members at splices must be rough finished to produce neat, close joints. A contact fit is not required.

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6-03.3(17) END CONNECTION ANGLES

On floorbeams and stringers, end connection angles must be flush with each other and set accurately in relationship to the position and length of the member. End connection angles must not be finished unless specified otherwise in the Contract. If, however, faulty assembly requires them to be milled, milling must not reduce thickness by more than 1/16 inch.

6-03.3(18) BUILT UP MEMBERS

The various pieces forming 1 built up member must be straight and close fitting, true to detailed dimensions, and free from twists, bends, open joints, or other defects.

When fabricating curved girders, localized heat or using mechanical force must not be used to bend the girder flanges about an axis parallel to the girder webs.

6-03.3(19) HAND HOLES

Hand holes, whether punched or cut with burning torches, must be true to sizes and shapes shown on the Drawings. Edges must be true to line and ground smooth.

6-03.3(20) LACING BARS

Unless the Contract states otherwise, ends of lacing bars must be neatly rounded.

6-03.3(21) PLATE GIRDERS

6-03.3(21)A WEB PLATES

If web plates are spliced, clearance between plate ends must not exceed 3/8 inch.

6-03.3(21)B WEB SPLICES AND FILLERS

Web splice plates and fillers under stiffeners must fit within 1/8 inch at each end. Instead of the steel Material specified in the Drawings or Special Provisions, the Contractor may substitute ASTM A 1008 or ASTM A 1011 steel for all filler plates less than 1/4 inch thickness, provided that the grade of filler plate steel meets or exceeds that of the splice plates.

6-03.3(22) EYEBARS

Eyebars must be straight, true to size, and free from twists or folds in the neck or head and from any other defect that would reduce their strength. Heads must be formed by upsetting, rolling, or forging. Dies in use by the manufacturer may determine the shape of bar heads if approved in writing by the Engineer. Head and neck thickness must not overrun by more than 1/16 inch. Welds must not be made in the body or head of any bar.

Each eyebar must be properly annealed and carefully straightened before it is bored. Pinholes must be located on the centerline of each bar and in the center of its head. Holes in bar ends must be so precisely located that in a pile of bars for the same truss panel, the pins may be inserted completely without driving. All eyebars made for the same locations in trusses must be interchangeable.

6-03.3(23) ANNEALING

All eyebars must be annealed by being heated uniformly to the proper temperature, then cooled slowly and evenly in the furnace. At all stages, the temperature of the bars must be under full control.

Slight bends on secondary steel members may be made without heat. Crimped web stiffeners need no annealing.

6-03.3(24) PINS AND ROLLERS

Pins and rollers must be made of the class of forged steel as specified on the Drawings. They must be turned accurately to detailed dimensions, smooth, straight, and flawless. The final surface must be produced by a finishing cut.

Pins and rollers 9 inches or less in diameter may either be forged and annealed, or made of cold finished carbon steel shafting.

Pins more than 9 inches in diameter must have holes at least 2 inches in diameter bored longitudinally through their centers. Pins with inner defects will be rejected.

The Contractor must provide pilot and driving nuts for each size of pin unless the Contract specifies otherwise.

6-03.3(24)A BORING PIN HOLES

Pin holes must be bored true to detailed dimensions, smooth and straight, and at right angles to the axis of the member. Holes must be parallel with each other unless the Contract specifies otherwise. A finishing cut must always be made.

The distance between holes must not vary from detailed dimensions by more than 1/32 inch. In tension members, this distance must be measured from outside to outside of holes. In compression members, this distance must be measured from inside to inside of holes.

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6-03.3(24)B PIN CLEARANCES

Each pin must be 1/50 inch smaller in diameter than its hole. All pins must be numbered after being fitted into their holes in the assembled member.

6-03.3(25) WELDING AND REPAIR WELDING

Welding and repair welding of all steel bridges must comply with the AASHTO / AWS D1.5M/D1.5:2010, Bridge Welding Code. Welding and repair welding for all other steel fabrication must comply with AWS D1.1/D1.1M, latest edition, Structural Welding Code. The requirements described in the remainder of this Section must prevail whenever they differ from either of the above welding codes.

Welding of structural steel will be permitted only to the extent shown on the Drawings. No welding, including tack and temporary welds, must be done in the shop or field unless the location of the welds is shown on the submitted Shop Drawings reviewed by the Engineer.

Welding procedures must be submitted with the Shop Drawings. The procedures must specify the type of equipment to be used, electrode selection, preheat requirements, base materials, and joint details. When the procedures are not prequalified by AWS or AASHTO, evidence of qualification tests indicating the approval of a recognized agency must be in the submittal.

Welding must not start until after the Contractor has received the Engineer's review of Shop Drawings as required in Section 6-03.3(7). These Shop Drawings must include procedures for welding, assembly, and any heat straightening or heat curving.

Any welded shear connector longer than 8 inches may be made of 2 shorter shear connectors joined with full penetration welds.

In shielded metal arc welding, the Contractor must use low hydrogen electrodes.

In submerged arc welding, flux must be oven dried at 550 °F for at least 2 hours, then stored in ovens held at 250 °F or more. If not used within 4 hours after removal from a drying or storage oven, flux must be re-dried before use.

Preheat and interpass temperatures must conform to the applicable welding code as specified in this Section. When welding main members of steel bridges, the minimum preheat must not be less than 100 °F.

If groove welds (web to web or flange to flange) have been rejected, they may be repaired no more than twice. If a third failure occurs, the Contractor must at the Engineer's discretion:

1. Trim the members, if the Engineer approves, at least 1/2 inch on each side of the weld; or
2. Replace the members at no additional cost to the Owner.

By using extension bars and runoff plates, the Contractor must end groove welds to ensure the soundness of each weld to its ends. The bars and plates must be removed after the weld is finished and cooled. The weld ends must then be ground smooth and flush with the edges of abutting parts.

The Contractor must not:

a. Weld with electrogas or electroslag methods;
b. Weld nor flame cut when ambient temperature is below 20 °F; or
c. Use coped holes in the web for welding butt splices in the flanges unless the Drawings show them.

6-03.3(25)A WELDING INSPECTION

The Contractor's inspection procedures, techniques, methods, acceptance criteria and inspector qualifications for welding of steel bridges are per the AASHTO / AWS D1.5M/D1.5: 2010, Bridge Welding Code. The Contractor's inspection procedures, techniques, methods, acceptance criteria and inspector qualifications for welding of steel structures except steel bridges are per AWS D1.1/D1.1M, latest edition, Structural Welding Code. The requirements described in the remainder of this Section must prevail whenever they differ from either of the above welding codes.

Nondestructive testing, in addition to visual inspection, must be performed by the Contractor. Unless otherwise specified in the Contract, the extent of inspection is specified in this Section. Testing and inspection requirements apply to welding performed in the shop and in the field.

After repairs of defects have been made, additional nondestructive testing must be performed to ensure that the repairs are acceptable. This testing must include the repaired area plus at least 2 inches on each side of the repaired area.

After the Contractor's welding inspection is complete, the Contractor must allow the Engineer sufficient time to perform quality assurance ultrasonic welding inspection.

6-03.3(25)A1 VISUAL INSPECTION

All welds must be 100 percent visually inspected. Visual inspection must be performed before, during, and after completing welding.

6-03.3(25)A2 RADIOGRAPHIC INSPECTION

Complete penetration tension groove welds in highway bridges must be 100 percent radiographically inspected. These welds include those in the tension area of webs where inspection must cover the greater of these 2 distances:

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1. 15 inches from the tension flange or
2. 1/3 of the web depth. In addition, use edge blocks conforming to the requirements of AASHTO/AWS D1.5M/D1.5: 2010 Bridge Welding Code Section 6.10.14 for radiographic inspection.

The Contractor must maintain the radiographs and the radiographic inspection report in the shop until the last joint to be radiographed in that member is accepted by the radiographer representing the Contractor. Within 2 Working Days following this acceptance, the Contractor must submit the film and 2 copies of the radiographic inspection report to the Engineer.

6-03.3(25)A3 ULTRASONIC INSPECTION

Complete penetration groove welds on plates thicker than 5/16 inch in the following welded assemblies or structures must be 100 percent ultrasonically inspected:

1. Welded connections and splices in highway bridges and earth retaining structures, except longitudinal butt welds in beam or girder webs.
2. Bridge bearings and modular expansion joints.
3. Sign bridges, cantilever sign structures, and bridge mounted sign brackets except longitudinal butt joint welds in beams.
4. Light, signal, and strain pole standards; and steel casing for concrete columns.

   A minimum of 30 percent of complete penetration vertical welds on steel column jackets thicker than 5/16 inch, within 1.5 times column jacket diameter of the top and bottom of each column, must be inspected. If any rejectable flaws are found, 100 percent of the weld within the specific limits must be inspected. The largest column cross section diameter for tapered column jackets must constitute one column jacket diameter.

The testing procedure and acceptance criteria for tubular members must conform with Section 10 of the latest edition of the AWS Structural Welding Code D1.1/D1.1M.

The Contractor must maintain the video records of ultrasonic inspections and the ultrasonic inspection reports in the shop until the last joint to be tested by ultrasonic means has been accepted by the inspector conducting these inspections for the Contractor. Within 2 Working Days following this acceptance, the Contractor must mail the film and video record together with 2 copies of the ultrasonic inspection reports to the Engineer.

6-03.3(25)A4 MAGNETIC PARTICLE INSPECTION

1. Fillet and partial penetration groove welds: At least 30 percent of each size and type of fillet welds (except intermittent fillet welds) and partial penetration groove welds in the following welded assemblies or Structures must be tested by the magnetic particle method:
   a. Flange to web connections in highway bridges.
   b. End and intermediate pier diaphragms in highway bridges.
   c. Stiffeners and connection plates in highway bridges.
   d. Welded connections and splices in earth retaining Structures.
   e. Boxed members of trusses.
   f. Bridge bearings and modular expansion joints.
   g. Sign bridges, cantilever sign Structures, and bridge mounted sign brackets.
   h. Light, signal, and strain pole standards.
2. Longitudinal butt welds in beam and girder webs: At least 30 percent of each longitudinal butt weld in the beam and girder webs must be tested by the magnetic particle method.
3. Complete penetration groove welds on plates 5/16 inch or thinner, excluding steel column jackets, must be 100 percent tested by the magnetic particle method. Testing must apply to both sides of the weld, if backing plate is not used.

   The ends of each complete penetration groove weld at plate edges must be tested by the magnetic particle method.

   A minimum of 30 percent of complete penetration vertical welds on steel column jackets 5/16 inch or thinner, within 1.5 times column jacket diameters of the top and bottom of each column, must be magnetic particle inspected. The largest column cross section diameter for tapered column jackets must constitute one column jacket diameter.

If rejectable flaws are found in fillet and partial penetration groove welds or longitudinal butt welds in beam and girder webs, the full length of the weld or 5 feet on each side of the test length, whichever is less, must be tested.

6-03.3(26) SCREW THREADS

Screw threads must be U.S. Standard and must fit closely in the nuts.

6-03.3(27) HIGH STRENGTH BOLT HOLES

At the Contractor's option under the conditions described in this Section, holes may be punched or subpunched and reamed, drilled or subdrilled and reamed, or formed by numerically controlled drilling operations.

The hole for each high strength bolt must be 1/16 inch larger than the nominal diameter of the bolt.

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In fabricating any connection, the Contractor may subdrill or subpunch the holes and then ream full size after assembly or drill holes full size from the solid with all thicknesses of material shop assembled in the proper position. If the Contractor chooses not to use either of these methods, the following must apply:

1. Drill bolt holes in steel splice plates full size using steel templates;
2. Drill bolt holes in the main members of trusses, arches, continuous beam spans, bents, towers, plate girders, box girders, and rigid frames at all connections as follows:
   a. A minimum of 30 percent of the holes in one side of the connection must be made full size using steel templates.
   b. A minimum of 30 percent of the holes in the second side must be made full size assembled in the shop.
   c. All remaining holes may be made full size in unassembled members using steel templates.
3. Drill bolt holes in crossframes, gussets, lateral braces, and other secondary members full size using steel templates.

The Contractor must submit for the Engineer's review, a detailed outline of the procedures proposed to accomplish the work from initial drilling through shop assembly.

6-03.3(27)A PUNCHED HOLES

For punched holes, die diameter must not exceed punch diameter by more than 1/16 inch. Any hole requiring enlargement to admit the bolt must be reamed. All holes must be cut clean with no torn or ragged edges. The Owner will reject components having poorly matched holes.

6-03.3(27)B REAMED AND DRILLED HOLES

Reaming and drilling must be done with twist drills, or with short taper reamers, producing cylindrical holes perpendicular to the member. Reamers and drills must be directed mechanically, not hand held. Connecting parts that require reamed or drilled holes must be assembled and held securely as the holes are formed, then match marked before disassembly. The Contractor must provide the Engineer with a diagram showing these match marks. The Owner will reject components having poorly matched holes.

Burrs on outside surfaces must be removed. The Contractor must disassemble parts to remove burrs as applicable.

If templates are used to ream or drill full size connection holes, the templates must be positioned and angled with accuracy and bolted securely in place. Templates for reaming or drilling matching members, or the opposite face of 1 member, must be duplicates. All splice components must be match marked.

6-03.3(27)C NUMERICALLY CONTROLLED (N/C) DRILLED CONNECTIONS

In forming any hole described in Section 6-03.3(27), the fabricator may use numerically controlled (N/C) drilling or punching equipment if it meets the requirements in this Section.

The Contractor must submit for review, a detailed outline of proposed N/C procedures. This outline must:

1. Cover all steps from initial drilling or punching through check assembly.
2. Include the specific members of the Structure to be drilled or punched, hole sizes, locations of the common index and other reference points, makeup of check assemblies, and all other information needed to describe the process fully.

N/C holes may be drilled or punched to size through individual pieces, or may be drilled through any combination of pieces restrained from moving while being drilled.

At the Engineer's request, the Contractor must demonstrate that the N/C procedures consistently produces holes and connections meeting the requirements of these Specifications.

6-03.3(27)D ACCURACY OF PUNCHED, SUBPUNCHED AND SUBDRILLED HOLES

After shop assembly and before reaming, all punched, subpunched, and subdrilled holes must comply with the following standard of accuracy. At least 75 percent of the holes in each connection must allow passing a cylindrical pin 1/8 inch smaller in diameter than nominal hole size. This pin must pass through at right angles to the face of the member without drifting. All holes must allow passage of a pin 3/16 inch smaller in diameter than nominal hole size. The Owner will reject any pieces that fail to comply with these standards.

6-03.3(27)E ACCURACY OF REAMED AND DRILLED HOLES

At least 85 percent of all holes in a connection of reamed or drilled holes must show no offset greater than 1/32 inch between adjacent thicknesses of metal. No hole must have an offset greater than 1/16 inch.

Centerlines from the connection must be inscribed on the template, and holes must be located from these centerlines. Centerlines must also be used for accurately locating the template relative to the milled or scribed ends of the members.

Templates must have a hardened steel bushing inserted into each hole. These bushings may be omitted, however, if the fabricator can acceptably demonstrate this to the Engineer:

1. That the template is to be used no more than 5 times, and
2. That use produces no template wear.

Each template must be at least 1/2 inch thick. Use thicker templates to prevent buckling and misalignment as the holes are formed.

6-03.3(27)F FITTING FOR BOLTING

Before drilling, reaming, and bolting starts, all parts of a member must be assembled, well pinned, and drawn firmly together. If necessary, assembled pieces must be taken apart to allow removal of any burrs or shavings produced as the holes are formed. The member must be free from twists, bends, and other deformation.

In shop bolted connections, contacting metal surfaces must be sandblasted clean before assembly. Sandblasting must comply with the requirements of the SSPC Specifications for Commercial Blast Cleaning (SSPC SP 6).

Any drifting done during assembly must be no more than enough to bring the parts into place. Drifting must not enlarge the holes or distort the metal.

6-03.3(28) SHOP ASSEMBLY

6-03.3(28)A METHOD OF SHOP ASSEMBLY

Unless the Contract specifies otherwise, the Contractor must choose from the following 5 described shop assembly methods, the method that best fits the proposed erection method. The Contractor must submit and obtain review from the Engineer, both the shop assembly and the erection methods before this work starts.

1. Full Truss or Girder Assembly: Each truss or girder is completely assembled over the full length of the superstructure.
2. Progressive Truss or Girder Assembly: Each truss or girder is assembled in stages longitudinally over the full length of the superstructure.
    a. For Trusses: The first stage must include at least 3 adjacent truss panels. Each truss panel must include all truss members in the space bounded by the top and bottom chords and the horizontal distance between adjacent bottom chord joints.
    b. For Girders: The first stage must include at least 3 adjacent girder shop sections. Shop sections are measured from the end of the girder to the first field splice or from field splice to field splice.
    c. For Trusses and Girders – After the first stage has been completed, each subsequent stage must be assembled to include: at least 1 truss panel or girder shop section of the previous stage and 2 or more truss panels or girder shop sections added at the advancing end. The previous stages must be repositioned if necessary, and pinned to ensure accurate alignment.
        1) For girders on tangents without skews or tapers, the Contractor may assemble subsequent stages which include 1 girder shop section of the previous stage and 2 or more girder shop sections at the advancing end.
        2) If the bridge is longer than 150 feet, each longitudinal stage must be at least 150 feet long, regardless of the length of individual continuous truss panels or girder shop sections.
        3) The Contractor may start the assembly sequence at any point on the bridge and proceed in either or both directions from that point.
        4) No assembly must have less than 3 truss panels or girder shop sections.
3. Full Chord Assembly: The full length of each chord for each truss is assembled with geometric angles at the joints. Chord connection bolt holes are drilled or reamed while members are assembled. The truss web member connections are drilled/reamed to steel templates set by relating geometric angles to the chord lines. At least 1 end of each web member must be milled or scribed at right angles to its long axis. The templates at both ends of the member must be positioned accurately from the milled end or scribed line.
4. Progressive Chord Assembly: Adjacent chord sections are assembled in the same way as specified for Full Chord Assembly, using the procedure specified for Progressive Truss or Girder Assembly.
5. Special Complete Structure Assembly: All structural steel members (superstructure and substructure, including all secondary members) are assembled at one time.

6-03.3(28)B CHECK OF SHOP ASSEMBLY

The Contractor must check each assembly for alignment, accuracy of holes, fit of milled joints, and other assembly techniques. Drilling or reaming must not start until the Engineer has given written approval. If the Contractor uses N/C drilling, this written approval from the Engineer must be obtained before the assembly or stage is dismantled.

6-03.3(29) WELDED SHEAR CONNECTORS

All welded shear connectors on steel girder top flanges must be installed in the field after the forms for the concrete bridge deck are in place. The steel surface to be welded must be prepared to SSPC-SP 11, power tool cleaning, just before welding. Installation, production control, and inspection of welded shear connectors must conform to Chapter 7 of the AASHTO/AWS D1.5M/D1.5: 2010 Bridge Welding Code. After the welded shear connectors are installed, the weld and the disturbed steel surface must be cleaned and painted as specified in Section 6-07.3(9)I.

6-03.3(30) PAINTING

All painting is specified in Section 6-07.

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6-03.3(30)A ERECTION MARKS

Erection marks to allow identification of members in the field must be painted on previously painted surfaces.

6-03.3(30)B MACHINE FINISHED SURFACES

As soon as possible and before they leave the shop, machine finished surfaces on abutting chord splices, column splices, and column bases must be covered with grease. After erection, the steel must be cleaned and painted as specified.

All surfaces of iron and steel castings milled to smooth the surface must be painted with the primer called for in the specified paint system.

While still in the shop, machine finished surfaces and inaccessible surfaces of rocker or pin type bearings must receive the full paint system. Surfaces of pins and holes machine finished to specific tolerances must not be painted. However, as soon as possible and before they leave the shop, they must be coated with grease.

6-03.3(31) ALIGNMENT AND CAMBER

Before starting field bolting, the Contractor must:

1. Adjust the structure to correct grade and alignment.
2. Regulate elevations of panel points (ends of floorbeams).
3. Delay bolting at compression joints until adjusting the blocking to provide full and even bearing over the whole joint.

On truss spans, a slight excess camber will be permitted as the bottom chords are bolted. But camber and relative elevations of panel points must be correct before the top chord joints, top lateral system, and sway braces are bolted.

6-03.3(31)A MEASURING CAMBER

The Contractor must provide the Engineer with a diagram for each truss that shows camber at each panel point. This diagram must display actual measurements taken as the truss is being assembled.

6-03.3(32) ASSEMBLING AND BOLTING

To bolt any field connection or splice, the Contractor must install and tighten to snug tight enough bolts to bring all parts into full contact with each other before tightening the bolts to the specified minimum tension.

“Snug tight” means either the tightness reached by:

1. A few blows from an impact wrench, or
2. The full effort of a person using a spud wrench.

As erection proceeds, all field connections and splices for each member must be securely drift pinned and bolted as described below, before the weight of the member can be released or the next member is added. Field erection Shop Drawings must specify pinning and bolting requirements that comply with or exceed the following minimums:

a. Joints in Normal Structures: Fifty percent of the holes in a single field connection and 50 percent of the holes on each side of a single joint in a splice plate must be filled with drift pins and bolts. 30 percent of the filled holes must be pinned. 70 percent of the filled holes must be bolted and tightened to snug tight. Once all these bolts are snug tight, each bolt must be systematically tightened to the specified minimum tension. “Systematically tightened” means starting with bolts in the most rigid part, which is usually the center of the joint, and working out to its free edges. The fully tensioned bolts must be located near the middle of a single field connection or a single splice plate.

b. Joints in Cantilevered Structures: 75 percent of the holes in a single field connection and 75 percent of the holes on each side of a single joint in a splice plate must be filled with drift pins and bolts. 50 percent of the filled holes must be pinned. 50 percent of the filled holes must be bolted and tightened to snug tight. Once all these bolts are snug tight, each bolt must be systematically tightened to the specified minimum tension. The fully tensioned bolts must be located near the middle of a single field connection or a single splice plate.

Cylindrical erection pins (drift pins) must be placed throughout each field connection and each field joint with the greatest concentration in the outer edges of a splice plate or member being bolted. Drift pins must be double-tapered barrel pins of hardened steel. The diameter of the drift pins must be at least 1/32 inch larger than the diameter of the bolts in the connection or the full hole diameter.

To complete a joint following one of the methods listed above, the Contractor must fill all remaining holes of the field connection or splice place with bolts and tighten to snug-tight. Once all of these bolts are snug tight, each bolt must be systematically tightened to the specified minimum tension. After these bolts are tightened to the specified minimum tension, the Contractor must replace the drift pins with bolts tightened to the specified minimum tension.

The Contractor must complete the joint or connection within 10 Calendar Days of installing the first bolt or within a duration approved by the Engineer. Any bolts inserted in an incomplete connection, either loose or tightened snug-tight, which exceed the specified duration for completing the connection, are subject to the following requirements:

1) 3 assemblies for each size and length must be removed from connections that are to be tensioned. Rotational capacity tests must be performed on the removed assemblies to demonstrate the assembly has sufficient lubricant to be tensioned satisfactorily.
2) 5 assemblies must be removed from the connection to establish the inspection torque.

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3) In the case of tension controlled bolts, 3 assemblies must be removed and tested as specified in Section 6-03.3(33)A to verify the minimum specified tension can be achieved before shearing of the spline.

Assemblies removed for the purpose of rotational capacity testing, determination of the inspection torques, or verification of tension controlled bolt performance must be replaced with new bolts at no additional expense to the Owner. To minimize the number of removed assemblies, the Contractor may combine rotational capacity testing and inspection torque determination as approved by the Engineer.

The Contractor may complete a field bolted connection or splice in a continuous operation before releasing the mass of the member or adding the next member. The Contractor must use drift pins to align the connection. The alignment drift pins must fill between 15 and 30 percent of the holes in a single field connection and between 15 and 30 percent of the holes on each side of a single joint in a splice plate. Once the alignment drift pins are in place, all remaining holes must be filled with bolts and tightened to snug tight starting from near the middle and proceeding toward the outer gage lines. Once all of these bolts are snug tight, the Contractor must systematically tighten all these bolts to the specified minimum tension. The Contractor must then replace the drift pints with bolts. Each of these bolts must be tightened to the specified minimum tension.

All bolts must be placed with heads toward the outside and underside of the bridge. All high strength bolts must be installed and tightened before the falsework is removed.

The Contractor may erect metal railings as erection proceeds. But railings must not be bolted or adjusted permanently until the falsework is released and the deck placed.

The Contractor must not start painting until the Engineer has inspected and accepted field bolting.

6-03.3(33) BOLTED CONNECTIONS

Fastener components include bolts, nuts, washers, tension control bolt assemblies, and direct tension indicators. Fastener components must comply with the requirements of Section 9-06.4(2).

The Contractor must submit documentation of the bolt tension calibrator for approval by the Engineer, which must include brand, capacity, model, date of last calibration, and manufacturer's instructions for use. The Contractor must supply the approved bolt tension calibrator and all accompanying hardware and calibrated torque wrenches to conduct all testing and inspections described here. Use of the bolt tension calibrator must comply with manufacturer's recommendations.

Fastener components must be protected from dirt and moisture in closed containers at the site of installation. Only as many fastener components as are anticipated to be installed during the workshift must be taken from protected storage. Fastener components that are not incorporated into the Work must be returned to protected storage at the end of the workshift. Fastener components must not be cleaned or modified from the as-delivered condition. Fastener components that accumulate rust or dirt must not be incorporated into the Work. Tension control bolt assemblies must not be relubricated, except by the manufacturer.

All bolted connections are slip critical. Painted structures require either Type 1 or Type 3 bolts. Unpainted structures require Type 3 bolts. Bolts must not be galvanized unless specified in the Contract documents. AASHTO M 253 bolts must not be galvanized or used in contact with galvanized metal.

Washers are required under turned elements for bolted connections and as required in the following:

1. Use washers under both the head and the nut when AASHTO M 253 bolts are to be installed in structural carbon steel, as specified in Section 9-06.1.
2. Where the outer face of the bolted parts has a slope greater than 1 to 20 with respect to a plane normal to the bolt axis, a beveled washer must be used.
3. Washers must not be stacked unless otherwise approved by the Engineer.
4. It is acceptable to place a washer under the unturned element.

All galvanized nuts must be lubricated by the manufacturer with a lubricant containing a visible dye so a visual check for the lubricant can be made during field installation. Black bolts must be lubricated by the manufacturer and must be "oily" to the touch when installed.

After assembly, bolted parts must fit solidly together. Bolted parts must not be separated by washers, gaskets, or any other material. Assembled joint surfaces, including those adjacent to bolt heads, nuts, and washers, must be free of loose mill scale, burrs, dirt, and other foreign material that would prevent solid seating.

When all bolts in a joint are tight, each bolt must carry at least the proof load described in the following table:

Table 1: Minimum Bolt Tension

Bolt Size (Inches)	**AASHTO M 164 ASTM F 1852** (Pounds)	**AASHTO M 253** (Pounds)
1/2	12,050	14,900
5/8	19,200	23,700
3/4	28,400	35,100
7/8	39,250	48,500
1	51,500	63,600

Bolt Size (Inches)	**AASHTO M 164 ASTM F 1852** (Pounds)	**AASHTO M 253** (Pounds)
1 1/8	56,450	80,100
1 1/4	71,700	101,800
1 3/8	85,450	121,300
1 1/2	104,000	147,500

Before final tightening of any bolts in a bolted connection, the connection must be compacted to a snug tight condition. Snug tight must include bringing all plies of the connection into firm contact and snug tightening all bolts as specified in Section 6-03.3(32).

Final tightening may be done by the Turn-of-Nut Method, the direct-tension indicator method, or the twist off-type tension control structural bolt/nut/washer assembly method. Preferably, the nut must be turned tight while the bolt is prevented from rotating. However, if required by either turn-of-nut or direct-tension-indicator methods because of bolt entering and/or wrench operational clearances, tightening may be done by turning the bolt while the nut is prevented from rotating.

1) Turn-of-Nut Method

After all specified bolting conditions are satisfied, and before final tightening, the Contractor must match-mark with crayon or paint the outer face of each nut and the protruding part of the bolt. Each bolt must be final tightened to the specified minimum tension by rotating the quantity specified in Table 2. To ensure this tightening method is followed, the Engineer will observe as the Contractor installs, snug tightens, and final tightens all bolts and inspect each match-mark.

Table 2: Turn of Nut Tightening Method
Nut Rotational from Snug Tight Condition

	Disposition of Outer Faces of Bolted Parts		
Bolt Length[1]	**Condition[2]**	**Condition[3]**	**Condition[4]**
L ≤ 4D	1/3 turn	1/2 turn	2/3 turn
4D < L ≤ 8D	1/2 turn	2/3 turn	5/6 turn
8D < L ≤ 12D	2/3 turn	5/6 turn	1 turn

NOTE:

1. L = Bolt length measured from underside of head to extreme end of point. D = Nominal bolt diameter of bolt being tightened.
2. Condition 1: both faces at right angles to bolt axis.
3. Condition 2: one face at right angle to bolt axis, one face sloped no more than 1 to 20, without bevel washer.
4. Condition 3: both faces sloped no more than 1 to 20 from right angle to bolt axis, without bevel washer.

Nut rotation is relative to the bolt regardless of which element (nut or bolt) is being turned.

The following tolerances are permitted: ± 30 degrees (1/12 turn) for final turns of 1/2 turn or less; ± 45 degrees (1/8 turn) for final turns of 2/3 turn or more.

When bolt length exceeds 12D, determine the rotation by actual tests in which a suitable tension device simulates actual conditions.

2) Direct Tension Indicator Method:

Direct Tension Indicators (DTIs) must not be used under the turned element. DTIs must be placed under the bolt head with the protrusions facing the bolt head when the nut is turned. DTIs must be placed under the nut with the protrusions facing the nut when the bolt is turned.

Gap refusal must be measured with a 0.005-inch tapered feeler gage. After all specified bolting conditions are satisfied, the snug tightened gaps must comply with Table 3 snug tight limits.

Each bolt must be final-tightened to comply with Table 3 final-tighten limits. If the bolt is tensioned so that no visible gap in any space remains, the bolt and DTI must be removed and replaced by a new properly tensioned bolt and DTI.

The Contractor must tension all bolts, inspecting all DTIs with a feeler gage, in the presence of the Engineer. DTIs must be installed by 2 person, or more, crews, with 1 individual preventing the element at the DTI from turning and measuring the gap of the DTI to determine the proper tension of the bolt.

If a bolt, that has had its DTI brought to full load, loosens while bolting the connection, it must be rejected. Reuse of the bolt and nut are subject to the provisions of this Section. The used DTI must not be reinstalled.

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Table 3: Direct Tension Indicator Requirements

Bolt Size (inches)	DTI Spaces		Maximum Snug Tight Refusals		Minimum Final Tighten Refusals	
	M 164	M 253	M 164	M 253	M 164	M 253
1/2	4	5	1	2	2	3
5/8	4	5	1	2	2	3
3/4	5	6	2	2	3	3
7/8	5	6	2	2	3	3
1	6	7	2	3	3	4
1 1/8	6	7	2	3	3	4
1 1/4	7	8	3	3	4	4
1 3/8	7	8	3	3	4	4
1 1/2	8	9	3	4	4	5

3) Twist Off-Type Tension Control Structural Bolt/Nut/Washer Assembly Method (Tension Control Bolt Assembly)

Tension control bolt assemblies must include the bolt, nut, and washer packaged and shipped as a single assembly. Unless otherwise approved by the Engineer, tension control bolt assembly components must not be interchanged for testing or installation and must comply with all provisions of ASTM F 1852. If approved by the Engineer, the tension control bolt assembly components may be interchanged within the same component lot for girder web splices or other locations where access to both sides of the connection is restricted.

The tension control bolts must incorporate a design feature intended to either indirectly indicate, or to automatically provide, the minimum tension specified in Table 1.

The Contractor must submit the tension control bolt assembly to the Engineer for approval with: bolt capacities; type of bolt, nut, and washer lubricant; method of packaging and protection of the lubricated bolt; installation equipment; calibration equipment; and installation procedures.

The tension control bolt manufacturer's installation procedure must be followed for installation of bolts in the verification testing device, in all calibration devices, and in all structure connections.

In some cases, proper tensioning of the bolts may require more than 1 cycle of systematic partial tightening before final yield or fracture of the tension control element of each bolt. If yield or fracture of the tension control element of a bolt occurs before the final tightening cycle, that bolt must be replaced with a new one.

Additional field verification testing must be performed upon request.

All bolts and connecting hardware must be stored and handled as to prevent corrosion and loss of lubricant. Bolts that are installed without the same lubricant coating as tested under the verification test will be rejected, and they must be removed from the joint and be replaced with new lubricated bolts at no additional cost to the Owner.

AASHTO M 253 bolts, galvanized AASHTO M 164 bolts, and ASTM F 1852 tension control bolt assemblies must not be reused. Black AASHTO M 164 bolts may be reused once if approved by the Engineer. All bolts to be reused must have their threads inspected for distortion by reinstalling the used nut on the bolt and turning the nut for the full length of the bolt threads by hand. Bolts to be reused must be relubricated per the manufacturer's recommendation and as approved by the Engineer. Used bolts are subject to a rotational capacity test as specified in Section 6-03.3(33)A. Touching up or retightening bolts previously tightened by the Turn-of-Nut Method, which may have been loosened by the tightening of adjacent bolts is not considered as reuse, provided the snugging up continues from the initial position and does not require greater rotation, including the tolerance, than that required by Table 2.

6-03.3(33)A PRE-ERECTION TESTING

High-strength bolt assemblies (bolt, nut, direct tension indicator, and washer), both black and galvanized, must be subjected to a field rotational capacity test, as outlined below, before any permanent fastener installation. For field installations, the rotational capacity test must be conducted at the Job Site. Each combination of bolt production lot, nut production lot, washer production lot, and direct tension indicator production lot must be tested as an assembly, except tension control bolt assemblies, which must be tested as supplied by the manufacturer. Each rotational capacity test must include 3 assemblies. Once an assembly passes the rotational capacity test, it is approved for use for the remainder of the project unless the Engineer deems further testing is necessary. All tests must be performed in a bolt tension calibrator by the Contractor in the presence of the Engineer. High-strength bolt assemblies used in this test must not be reused. The bolt assemblies must comply with the following requirements after being pretensioned to 15 percent of the minimum bolt tension in Table 1. The assembly is considered nonconforming if the assembly fails to pass any of the following requirements:

1. The measured torque to produce the minimum bolt tension must not exceed the maximum allowed torque value obtained by the following equation:

   Torque = 0.25 PD

Where: Torque = Calculated Torque (foot-pounds)

P = Measured Bolt Tension (pounds)

D = Normal Bolt Diameter (feet)

2. After placing the assembly through 2 cycles of the required number of turns, where turns are measured from the 15 percent pretension condition, as described in Table 2:
   a. The maximum recorded tension after the 2 turns must be equal to or greater than 1.15 times the minimum bolt tension listed in Table 1.
   b. Each assembly must be installed to the specified number of turns.
   c. The fastener components in the assembly must not exhibit shear failure or stripping of the threads as determined by visual examination of bolt and nut threads following removal.
   d. The bolts in the assembly must not exhibit torsional or torsional/tension failure.
3. If any specimen fails, the assembly will be rejected. Elongation of the bolt between the bolt head and the nut is not considered to be a failure.

Bolts that are too short to test in the bolt tension calibrator must be tested in a steel joint. The Contractor must install the high-strength bolt assemblies (bolt, nut, direct tension indicator, and washer) in a steel joint of the proper thickness; tighten to the snug tight condition; match-mark the outer face of each nut and the protruding part of the bolt with crayon or paint; rotate to the requirements of the Table 2: Turn of Nut Tightening Method table; and record the torque that is required to achieve the required amount of rotation. The assembly is considered nonconforming if the assembly fails to pass any of the following requirements:

a. The recorded torque to produce the minimum rotation must not exceed the maximum allowed torque value obtained by the following equation:

   Torque = 0.25 PD

   Where: Torque = Calculated Maximum Allowed Torque (foot-pounds)

   P = Specified Bolt Tension per Table 1, multiplied by a factor of 1.15 (pounds)

   D = Normal Bolt Diameter (feet)

b. After placing the assembly through 2 cycles of the required number of turns, where turns are measured from the snug tight condition specified in Section 6-03.3(32), the following conditions must be met: each assembly must be installed to the specified number of turns; the fastener components in the assembly must not exhibit shear failure or stripping of the threads as determined by visual examination of bolt and nut threads following removal; and the bolts in the assembly must not exhibit torsional or torsional/tension failure.

c. If any specimen fails, the assembly will be rejected. Elongation of the bolt between the bolt head and the nut is not considered to be a failure.

The Contractor must submit the manufacturer's detailed procedure for pre-erection, rotational capacity testing of tension control bolt assemblies to the Engineer for approval and must have an approved procedure before testing.

Three DTIs, per lot, must be tested in a bolt tension calibrator. The bolts must be tensioned to 105 percent of the tension described in Table 1. If all DTI protrusions are completely crushed (all 5 openings with 0 gap), this lot of DTIs is rejected.

Three twist off-type tension controlled bolt assemblies, per assembly lot, must be tested in a bolt tension calibrator. The bolts must first be tensioned to a snug tight condition. Tensioning must then be completed by tightening the assembly nut in a continuous operation using a spline drive installation tool until the spline shears from the bolt. The bolt assembly tension must comply with the requirements of Table 1. If any specimen fails, the assembly lot is rejected.

6-03.3(33)B BOLTING INSPECTION

The Contractor, in the presence of the Engineer, must inspect the tightened bolt using a calibrated inspection torque wrench, regardless of bolting method. The Contractor must supply the inspection torque wrench. Inspection must be performed within 7 Calendar Days from the completion of each bolted connection or as approved by the Engineer.

If the bolts to be installed are not long enough to fit in the Owner furnished tension calibrator, 5 bolts of the same grade, size and condition as those under inspection must be selected by the Contractor in the presence of the Engineer and must be tested using Direct Tension Indicators (DTI) to measure bolt tension. This tension measurement test must be done at least once each inspection day. The Contractor must supply the DTIs. The DTI must be placed under the bolt head. A washer must be placed under the nut, which must be the element turned during performing this tension measurement test. Each bolt must be tightened by any convenient means to the specified minimum tension as indicated by the DTI. The inspecting wrench must then be applied to the tightened bolt to determine the torque required to turn the nut 5 degrees (approximately 1 inch at a 12-inch radius) in the tightening direction. The job-inspection torque must be taken as the average of 3 values thus determined after rejecting the high and low values.

Five representative bolts/nuts/washers and DTIs if used (provided by the Contractor) of the same grade, size, and condition as those under inspection must be placed individually in a bolt tension calibrator to measure bolt tension. This calibration operation must be done at least each inspection day. There must be a washer under the part turned in tightening each bolt if washers are used on the Structure. In the bolt tension calibrator, each bolt must be tightened by any convenient means to the specified tension. Inspection torque wrench must then be applied to the tightened bolt to determine the torque

required to turn the nut or head 5 degrees, approximately 1 inch at a 12-inch radius, in the tightening direction. The job-inspection torque must be taken as the average of 3 values thus determined after rejecting the high and low values.

Ten percent, at least 2, or as specified by the Engineer, of the tightened bolts on the Structure represented by the test bolts must be selected at random in each connection. The job-inspection torque must then be applied to each with the inspection wrench turned in the tightening direction, with no restraint applied in the opposite end of the bolt. If this torque turns no bolt head or nut, the Owner will accept the connection as being properly tightened. If the torque turns 1 or more bolt heads or nuts, the job-inspection torque must be applied to all bolts in the connection. Except for tension control bolt assemblies and DTIs with 0 gap at all protrusion spaces, any bolt whose head or nut turns at this stage must be tightened and reinspected. Any tension control bolt assemblies or DTIs that have 0 gap at all protrusion spaces must be replaced if the head or nut turns at this stage.

The Contractor must submit the manufacturer's detailed procedure for routine observation to ensure proper use of the tension control bolt assemblies to the Engineer for approval and must have an approved procedure before any assembling of bolted connections.

6-03.3(34) ADJUSTING PIN NUTS

All pin nuts must be tightened thoroughly. The pins must be placed so members bear fully and evenly on the nuts. The pins must have enough thread to allow burring after the nuts are tightened.

6-03.3(35) SETTING ANCHOR BOLTS

Anchor bolts must be set in masonry as required in Section 6-02.3(18). Anchor bolts must be grouted in after the shoes, masonry plates, and keeper plates have been set and the span or series of continuous spans are completely erected and adjusted to line and camber.

6-03.3(36) SETTING AND GROUTING MASONRY PLATES

The following procedure applies to masonry plates for all steel spans, including shoes, keeper plates and turning racks on movable bridges.

To set masonry plates, the Contractor must:

1. Set masonry plates on the anchor bolts.
2. Place steel shims under the masonry plates to position pin centers or bearings to line and grade and in relationship to each other. Steel shims must be the size and be placed at the locations shown on the Drawings.
3. Level the bases of all masonry plates.
4. Draw anchor bolt nuts down tight.
5. Recheck pin centers or bearings for alignment.
6. Leave at least 3/4 inch of space under each masonry plate for grout.

After the masonry plates have been set and the span or series of continuous spans are completely erected and swung free, the space between the top of the masonry plate and the top of the concrete bearing seat must be filled with grout. Main masonry plates for cantilever spans must be set and grouted in before any steel work is erected.

Grout mixture and placement must be as required in Section 6-02.3(20).

6-03.3(37) SETTING STEEL BRIDGE BEARINGS

Masonry plates, shoes, and keeper plates of expansion bearings must be set and adjusted to center the expansion shoe at a normal temperature of 64 °F. Adjustment for any inaccuracy in manufactured length must be made after dead load camber is out.

6-03.3(38) PLACING SUPERSTRUCTURE

The concrete in piers and crossbeams must reach at least 80 percent of design strength before girders are placed on them.

6-03.3(39) SWINGING THE SPAN

Forms weighing less than 5 pounds per square foot of bridge deck area and uniformly distributed along the steel spans may be placed before the spans swing free on their supports. Steel reinforcing bars or concrete bridge deck must not be placed on steel spans until the spans swing free on their supports and elevations are recorded. No simple span or any series of continuous spans will be considered as swinging free until all temporary supports have been released. Reinforcing steel or concrete bridge decks must not be placed on any simple or continuous span steel girder bridge until all its spans are adjusted and its masonry plates, shoes, and keeper plates grouted. For this specification, the structure is considered continuous across hinged joints.

After the falsework is released, i.e. the spans swung free, the masonry plates, shoes, and keeper plates are grouted, and before any load is applied, the Contractor, or the Engineer if the Owner is responsible for surveying, must survey elevations at the tenth points along the centerline on top of all girders and floorbeams. The Contractor must calculate the theoretical top of girder or floorbeam flange elevations and compare the calculated elevations to the surveyed elevations. The theoretical pad or haunch depth shown on the Drawings must be increased or decreased by the difference between the

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theoretical and surveyed top of girder or floorbeam elevations. The soffit (deck formwork) must be set based on the Drawing bridge deck thickness and the adjusted pad or haunch depth.

The Contractor must submit all survey data and calculations to the Engineer for review 10 Working Days before placing any load, beyond the maximum 5 pounds per square foot of form weight allowed, on the Structure.

6-03.3(40) DRAINING POCKETS

The Contractor must provide enough holes to drain all water from pockets in trusses, girders, and other members. Unless shown on submitted and reviewed by Engineer Shop Drawings, drain holes must not be drilled without the written review of the Engineer.

6-03.3(41) FLOORBEAM PROTECTION

Each floorbeam that supports a concrete slab joint must be coated on its top and flange edges with a heavy mop of roofing grade asphalt applied hot. This asphalt must conform to ASTM D 312 (not mineral stabilized). A protective covering of asphalt coated glass fiber sheet (ASTM D 4601, Type 1, non-perforated) must be placed over the hot coat of asphalt. This combination coating must be applied over the shop paint. It must take the place of the 2 field coats of paint specified for other parts of the structural steel. The second and third coats are acceptable exceptions and must comply with Section 6-07.3(1)B.

6-03.3(42) SURFACE CONDITION

As the Structure is erected, the Contractor must keep all steel surfaces clean and free from dirt, concrete, mortar, oil, paint, grease, and other stain producing foreign matter. Any surfaces that become stained must be cleaned as follows:

1. Painted steel surfaces must be cleaned by methods required for the type of staining. The method must be submitted to the Engineer for approval; and
2. Unpainted steel surfaces must be cleaned by sandblasting. Sandblasting to remove stains on publicly visible surfaces must be done to the extent that, in the Engineer's opinion, the uniform weathering characteristics of the Structure are preserved.

6-03.3(43) CASTINGS, STEEL FORGINGS, AND MISCELLANEOUS METALS

Castings, steel forgings, and miscellaneous metals must be built to comply with Section 9-06.

6-03.3(43)A SHOP CONSTRUCTION, CASTINGS, STEEL FORGINGS, AND MISCELLANEOUS METALS

This Section's requirements for structural steel (including painting requirements) must also apply to castings, steel forgings, and miscellaneous metals.

Castings must be:

1. True to pattern in form and dimensions.
2. Free from pouring faults, sponginess, cracks, blow holes, and other defects in places that would affect strength, appearance, or value.
3. Clean and uniform in appearance.
4. Filleted boldly at angles.
5. Formed with sharp and perfect arises.

Iron and steel castings and forgings must be annealed before any machining, unless indicated otherwise in the Contract.

6-03.4 MEASUREMENT

Cast or forged metal (kind) or copper seals shown on the Drawings will be measured by the pound or will be paid for on a lump sum basis as shown on the Bid Form.

In computing pay weight on the basis of scale weights, the pay quantity of structural steel will be the shop scale weight of the fabricated members weighed on scales meeting the requirements of Section 1-09.2 in the presence of the Engineer. If the shop paint has been applied to the completed member when weighed, 0.4 percent of the weight of the member must be deducted from the scale weights to compensate for weight of shop paint.

6-03.5 PAYMENT

1. **"Structural Carbon Steel"**, per pound.
2. **"Structural Low Alloy Steel"**, per pound.
3. **"Structural High Strength Steel"**, per pound.

The Bid Item prices bid for the Bid Items "Structural Carbon Steel", "Structural Low Alloy Steel", and "Structural High Strength Steel" must include all costs for the work required for manufacture, fabrication, transportation, erection, welding inspection, and painting of all structural steel used in the completed structure, including protective coating or treatment as may be called for in the Contract.

For payment, minor items such as bearing plates, pedestals, forged steel pins, anchor bolts, field bolts, and shear connectors are considered structural carbon steel even though these items are made of other materials.

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All costs related to inspection of structural welds must be included in the Bid Item price bid for structural steel and must, in each case, refer to the appropriate inspection method for obtaining optimum quality assurance and at no additional cost to the Owner.

4. **"(Cast or Forged) Steel"**, lump sum or per pound.
5. **"(Cast, Malleable, or Ductile) Iron"**, lump sum or per pound.
6. **"Cast Bronze"**, lump sum or per pound.

The Bid Item prices for "(Cast or Forged) Steel", for "(Cast, Malleable or Ductile) Iron", and for "Cast Bronze" must include all costs for the work required to furnish and install the Material as specified.

7. **Other payment information**

When no Bid Item is in the Bid Form and payment is not otherwise provided, the castings, forgings, and miscellaneous metal are considered incidental to the construction, and all costs must be included in the Bid Item prices for the Bid Items involved and at no additional or separate expense to the Owner.

Prospective Bidders must verify the estimated weight of structural steel before submitting the Bid.

All costs related to filling pockets must be included in the Bid Item prices for structural or cast steel and are at no additional or separate expense to the Owner.

The weight of field bolts is based on the Engineer reviewed shipping list. No payment will be made for any weight over 1.5 percent above the computed net weight of the whole item.

Reinforcing bars which are threaded will be paid as "Steel Reinforcing Bar, (Grade)" or "Steel Reinforcing Bar, (Grade), Epoxy Coated" as specified in Section 6-02.5.

All costs related to providing drain holes will be included in the Bid Item prices for structural or cast steel and are at no additional or separate expense to the Owner.

All costs related to providing drain holes per Section 6-03.3(40) must be included in the Bid Item prices for structural or cast steel and are be at no additional or separate expense to the Owner.

SECTION 6-04 TIMBER STRUCTURES

6-04.1 DESCRIPTION

Section 6-04 describes building any Structure or parts of Structures, except piles, made of treated timber, untreated timber, or both. The Contractor must erect timber structures on prepared foundations. The Structures must conform to the dimensions, lines, and grades required by the Drawings, the Engineer, and these Specifications.

Any part of a timber structure made of non-timber Materials must comply with the Sections of the Standard Specifications that govern those Materials.

6-04.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Material	Section
Structural Steel and Related Material	Section 9-06
Paints	Section 9-08
Timber and Lumber	Section 9-09

6-04.3 CONSTRUCTION REQUIREMENTS

6-04.3(1) STORING AND HANDLING MATERIAL

At the Project Site, the Contractor must store all timber and lumber in stacked piles. Weeds and rubbish under and around these piles must be removed before the lumber is stacked.

Untreated lumber must be open stacked at least 12 inches above the ground and must be piled to shed water and prevent warping.

Treated timber must be:

1. Cut, framed, and bored (whenever possible) before treatment.
2. Close stacked and piled to prevent warping.
3. Covered against the weather to prevent warping or deterioration.
4. Handled carefully to avoid sudden drops, broken outer fibers, and surface penetration or bruising with tools.
5. Lifted and moved with rope and chain slings (without using cant dogs, peaveys, hooks, or pike poles).

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6-04.3(2) WORKMANSHIP

See Section 1-05.13. Poor workmanship includes deep hammer marks in wood surfaces. Workmanship on metal parts must comply with requirements of Section 6-03.

6-04.3(3) SHOP DRAWINGS

The Contractor must provide the Engineer with 6 sets of Shop Drawings for all Structures built with treated timber. These Shop Drawings must show dimensions for all cut, framed, or bored timbers.

The Engineer will return to the Contractor 1 set of reviewed Shop Drawings. No material can be framed or bored until the Engineer has completed review of the Shop Drawings. Shop Drawings must be drawn on sheets that conform to the sizes specified in Section 1-05.3(11).

6-04.3(4) FIELD TREATMENT OF CUT SURFACES, BOLT HOLES, AND CONTACT SURFACES

All cut surfaces, bolt holes, and contact surfaces must be treated as specified in Section 9-09.3 for all timber and lumber requiring preservative treatment.

All cuts and abrasions in treated timber piles or treated timbers must be trimmed carefully and treated again at the cut or abrasion as specified in Section 9-09.3.

6-04.3(5) HOLES FOR BOLTS, DOWELS, RODS, AND LAG SCREWS

Holes must be bored:

1. For drift pins and dowels: with a bit 1/16 inch smaller in diameter than the pins and dowels.
2. For truss rods or bolts: with a bit the same diameter as the rods or bolts.
3. For lag screws in 2 parts:
   a. With the shank lead hole the same diameter as the shank and as deep as the unthreaded shank is long; and
   b. With the lead hole for the threaded part approximately 2/3 of the shank diameter.

6-04.3(6) BOLTS, WASHERS, AND OTHER HARDWARE

Bolts, flat head bolts, dowels, washers, and other hardware, including nails, must be black or galvanized as specified on the Drawings. Hardware not otherwise specified must be galvanized when used in treated timber Structures. Flat head bolts are detailed in the Standard Plans.

Use washers of the size and type specified under all bolt heads and nuts that contact wood. Flat head bolts require washers under the nuts only.

All bolts must be checked by burring the threads after the nuts have been finally tightened. Vertical bolts must have nuts on the lower ends.

Wherever bolts fasten timber to timber, timber to concrete, or timber to steel, the members must be bolted tightly together at installation and retightened just before the Owner accepts the Work. These bolts must have surplus threading of at least 3/8 inch per foot of timber thickness to allow future tightening.

6-04.3(7) COUNTERSINKING

Countersinking must be done wherever smooth faces are specified in the Contract. Each recess must be treated as specified in Section 9-09.3.

6-04.3(8) FRAMING

The Contractor must cut and frame lumber and timber to produce close fitting, full contact joints. Each mortise must be true to size for its full depth, and its tenon must fit it snugly. Neither shimmed nor open joints are permitted.

6-04.3(9) FRAMED BENTS

Mudsills must be of pressure treated timber, firmly and evenly bedded to solid bearing, and tamped in place.

Concrete pedestals that support framed bents must be finished so sills bear evenly on them. To anchor the sills, set dowels in the pedestals when cast. The dowels must be at least 3/4 inch in diameter and protrude at least 6 inches above the pedestal tops. Pedestal concrete must comply with Section 6-02.

Each sill must rest squarely on mudsills, piles, or pedestals. It must be drift bolted to mudsills or piles with 3/4-inch diameter or larger bolts that extend at least 6 inches into the mudsill or pile. Ensure no earth touches the sills and that free air circulation surrounds them.

Each post must be fastened to sills with 3/4-inch diameter or larger dowels that extend at least 6 inches into the post.

6-04.3(10) CAPS

Timber caps must rest uniformly across the tops of posts or piles and cap ends must be aligned evenly. Each cap must be fastened with a drift bolt 3/4 inch in diameter or larger that penetrates the post or pile at least 9 inches. The bolt must be approximately in the center of the pile or post.

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If the roadway grade exceeds 2 percent, each cap must be beveled to match the grade.

6-04.3(11) BRACING

When pile bents are taller than 10 feet, each bent must be braced transversely. Every other pair of bents must be braced longitudinally. No single cross bracing must brace more than 20 feet of vertical distance on the piles. Use more than 1 cross bracing if the vertical distance exceeds 20 feet. Each brace end must be bolted through the pile, post, or cap with a bolt at least 3/4 inch in diameter. Other brace/pile intersections must be bolted or boat spiked as indicated on the Drawings. Cross bracing must lap both upper or both lower caps and must be bolted to the caps or sills at each end.

6-04.3(12) STRINGERS

All stringers that carry laminated decking or vary more than 1/8 inch in depth must be sized to an even depth at bearing points. Outside stringers must be butt jointed and spliced.

Interior stringers must be lapped so that each rests over the full width of the cap or floorbeam at each end. Stringers may cover 2 spans except on sharp horizontal and vertical curves. In this case, joints must be staggered and the stringers either toenailed or drift bolted as specified in the Contract. To allow air circulation on untreated timber structures, the ends of lapped stringers must be separated. Separate by fastening across the lapping face a 1” x 3” wood strip cut 2 inches shorter than the depth of the stringer.

Any cross bridging or solid bridging must be neatly and accurately framed, then securely toenailed at each end with 2 nails for cross bridging and 4 nails for solid bridging. The Drawings show bridging size and spacing.

6-04.3(13) WHEEL GUARDS AND RAILINGS

Wheel guards and railings must comply with the construction requirements of Section 6-06.3(1). Construction requirements not addressed in Section 6-06.3(1) must comply with the construction requirements of Section 6-04.

6-04.3(14) SINGLE PLANK FLOORS

Single plank floors must be made of a single thickness of plank on stringers or joists.

The planks must be:

1. Laid heart side down with tight joints.
2. Spiked to each joist or nailing strip with at least 2 spikes that are at least 4 inches longer than the plank thickness.
3. Spiked at least 2-1/2 inches from the edges.
4. Cut off on a straight line parallel to the centerline of the roadway.
5. Arranged so that adjacent planks vary in thickness by no more than 1/16 inch.
6. Surfaced on 1 side and 1 edge (S1S1E) unless otherwise specified in the Contract.

6-04.3(15) LAMINATED FLOORS

The strips must be placed on edge and must be drawn down tightly against the stringer or nailing strip and the adjacent strip and, while held in place, must be spiked. Each strip must extend the full width of the deck, unless otherwise specified in the Contract.

Each strip must be spiked to the adjacent strip at intervals of not more than 2 feet, the spikes being staggered 8 inches in adjacent strips. The spikes must be of sufficient length to pass through 2 strips and at least halfway through the third. Unless bolting is specified in the Contract, each strip must be toenailed to alternate stringers with 40d common nails and adjacent strips must be nailed to every alternate stringer. The ends of all pieces must be toenailed to the outside stringer. The ends of the strips must be cut off on a true line parallel to the centerline of the roadway. When bolts are used to fasten laminated floors to stringers, the bolts must be placed at the spacing specified in the Contract, and the pieces must be drawn down tightly to the bolting strips. The bolt heads must be driven flush with the surface of the deck. Use double nuts or single nuts and lock nuts on all bolts. The strips must be spiked together in the same manner as specified above.

6-04.3(16) PLANK SUBFLOORS FOR CONCRETE DECKS

Any plank subfloor must be laid surfaced side down with close joints at right angles to the centerline of the roadway. Planks must be spiked in place as specified in Section 6-04.3(14).

Floor planks must be treated as specified in Section 9-09.3.

6-04.3(17) TRUSSES

Completed trusses must show no irregularities of line. From end to end, chords must be straight and true in horizontal projection. In vertical projection they must show a smooth curve through panel points that conforms to the correct camber. The Engineer will reject any pieces cut unevenly or roughly at bearing points. Before the Contractor places the hand railing, the Contractor must complete all trusses, swing them free of their falsework, and adjust them for line and camber.

6-04.3(18) PAINTING

See Section 6-07.3 for painting of timber Structures.

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6-04.4 MEASUREMENT

The criteria in Section 6-03.4 will be used to determine the weight of structural metal except hardware.

"Timber and lumber (treated or untreated)" will be measured by the 1,000 board feet (MBM), using nominal thicknesses and widths. Lengths are actual lengths of individual pieces in the finished structure with no deduction for daps, cuts, or splices. To measure laminated timber decking, the Engineer will use the number and after dressing sizes of pieces required on the Drawings. The length of each lamination must be the length remaining in the finished Structure.

No specific unit of measurement will apply to the lump sum item of "Structural Metal".

6-04.5 PAYMENT

1. **"Timber and Lumber (untreated or name treatment)"**, per MBM.
2. **"Structural Metal"**, lump sum.

Where no Bid Item for structural metal is included in the Bid Form, full pay for furnishing and placing metal parts must be included in the Bid Item price per MBM for Timber and Lumber (untreated or name treatment).

SECTION 6-05 PILES

6-05.1 DESCRIPTION

Section 6-05 describes furnishing and driving piles (timber, precast concrete, cast in place concrete, and steel) of the sizes and types specified in the Contract. This work also includes cutting off or building up piles when required.

6-05.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Material	Section
Reinforcing Steel	Section 9-07
Prestressing Steel	Section 9-07.10
Timber Piling	Section 9-10.1
Concrete Piling	Section 9-10.2
Cast-In-Place Piling	Section 9-10.3
Steel Pile Tips and Shoes	Section 9-10.4
Steel Piling	Section 9-10.5
Mortar	Section 9-20.4

6-05.3 CONSTRUCTION REQUIREMENTS

6-05.3(1) PILE TERMS

1. Allowable Bearing Capacity: Allowable bearing capacity is the ultimate bearing capacity divided by a factor of safety. The Contract may state the factor of safety to be used in calculating the allowable bearing capacity from the ultimate bearing capacity. Absent a specified factor of safety, use a value of 3.
2. Auger Cast-In-Place Piles: Auger cast-in-place piles are auger drilled soil penetrations to the limits specified in the Contract and then filled with concrete as the auger is removed. A steel cage is typically inserted in the concrete after the concrete is placed.
3. Concrete Piles: Concrete piles may be precast or precast prestressed concrete, or steel casings driven to the ultimate bearing capacity called for in the Contract which are filled with concrete (cast-in-place) after driving.
4. Developed Hammer Energy: The developed hammer energy is the actual gross energy produced by the hammer for a given blow. This value must never exceed the rated hammer energy. The developed energy may be calculated as the ram weight times the drop (or stroke) for drop, single acting hydraulic, single acting air/steam, and open ended diesel hammers. For double acting hydraulic and air/steam hammers, the developed hammer energy must be calculated from ram impact velocity measurements or other means approved by the Engineer. For closed ended diesel hammers, the developed energy must be calculated from the measured bounce chamber pressure for a given blow. Hammer manufacturer calibration data may be used to correlate bounce chamber pressure to developed hammer energy. For a single acting diesel hammer the developed energy is determined using the blows per minute.
5. Follower: A follower is a structural member placed between the hammer assembly, which includes the helmet, and the pile top when the pile top is below the reach of the hammer.
6. Hammer cushion: The hammer cushion is a disk of material placed on top of the helmet but below the anvil or striker plate to relieve impact shock, protecting the hammer and the pile.

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7. Helmet: The helmet, also termed the cap, drive cap, or driving head, is used to transmit impact forces from the hammer ram to the pile top uniformly across the pile top such that the impact force of the ram is transmitted axially to the pile. The term helmet can apply to the complete impact force transfer system, which includes the anvil or striker plate, hammer cushion and cushion block, and a pile cushion if used, or just the single piece unit into which these other components (such as anvil and hammer cushion) fit. The helmet does not include the follower, if one is used. For hydraulic hammers, the helmet is sometimes referred to as the anvil.
8. Maximum Driving Resistance: The maximum driving resistance is the pile ultimate bearing capacity, or ultimate bearing capacity plus overdriving, to reach minimum tip elevation as specified in the Contract, whichever is greater.
9. Minimum Tip Elevation: The minimum tip elevation is the elevation to which the pile tip must be driven. Driving deeper to obtain the required bearing capacity may be required.
10. Overdriving: Over driving of piles occurs when the ultimate bearing capacity calculated from the equation in Section 6-05.3(12), or the wave equation if applicable, exceeds the ultimate bearing capacity required in the Contract to reach the minimum tip elevation specified in the Contract, or as required by the Engineer.
11. Pile Cushion: The pile cushion is a disk of material placed between the helmet and the pile top to relieve impact shock, primarily to protect the pile.
12. Pile Driving Analyzer: A pile driving analyzer (PDA) is a device which can measure the transferred energy of a pile driving system, the compressive and tensile stresses induced in the pile due to driving, the bending stresses induced by hammer misalignment with the pile, and estimate the ultimate capacity of a pile at a given blow.
13. Pile Driving Refusal: Pile driving refusal is defined as 15 blows per inch for the last 4 inches of driving. This is the maximum blow count allowed during overdriving.
14. Pile Driving System: The pile driving system includes, but is not limited to, the hammer, leads, helmet or cap, cushion and pile.
15. Pile Head: The end of the pile struck by the hammer for driving. Also known as head, head end, butt, butt end, and pile top.
16. Pile Shoe: A hard metal tip secured to the driving end of a pile for protecting the pile tip during penetration into the soil.
17. Pile Tip: The penetrating end of the pile opposite the pile head where end bearing may occur. Also known as tip.
18. Rated Hammer Energy: The rated energy represents the theoretical maximum quantity of gross energy that a pile driving hammer can generate. The rated energy of a pile driving hammer must be stated in the hammer manufacturer's catalog or Specifications for that pile drive hammer.
19. Steel Piles: Open ended or closed ended pipe piles, or H piles.
20. Transferred Hammer Energy: The transferred hammer energy is the energy transferred to the pile for a given blow. This value must never exceed the developed hammer energy. Factors that cause transferred hammer energy to be lower than the developed hammer energy include friction during the ram downstroke, energy retained in the ram and helmet during rebound, and other impact losses. The transferred energy can only be measured directly by sensors attached to the pile. A pile driving analyzer (PDA) may be used to measure transferred energy.
21. Ultimate Bearing Capacity: Ultimate bearing capacity refers to the vertical load carrying capacity (in units of force) of a pile as determined by the equation in Section 6-05.3(12), the wave equation analysis, pile driving analyzer and CAPWAP, static load test, or any other means as required by the Contract.
22. Wave Equation Analysis: Wave equation analysis is an analysis performed using the wave equation analysis program (WEAP) with a version dated 1987 or later. The wave equation may be used as specified here to verify the Contractor's proposed pile driving system. The pile driving system includes, but is not limited to, the pile, the hammer, the helmet, and any cushion. The Engineer may also use the wave equation to determine pile driving criteria as may be required in the Contract.

6-05.3(2) ORDERING PILES

The length of piles given in the Bid Form is for estimating purposes only and is not to be used as an order list.

No order list for piles will be furnished by the Engineer.

All piles must be ordered by the Contractor. Determine the length required from the results obtained by the driving of the test piles called for in the Contract and from subsurface exploration data. Increase the lengths, at no additional cost to the Owner, by the amount necessary to provide for fresh heading and to reach from the cutoff elevation up to the position of the driving equipment.

See Section 6-05.3(10) regarding test piles.

6-05.3(3) MANUFACTURE OF PRECAST CONCRETE PILES

Precast concrete piles must consist of concrete sections reinforced to withstand handling and driving stresses. These may be reinforced with deformed steel bars or prestressed with steel strands. The Drawings show dimensions and details. If the Drawings require piles with square cross-sections, the corners must be chamfered 1 inch.

All precast or prestressed concrete piles must comply with the requirements of WSDOT Standard Plan E -4.

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Temporary stress in the prestressing reinforcement of prestressed piles, before loss from creep and shrinkage, must be 75 percent of the minimum ultimate tensile strength. For short periods during manufacture, the reinforcement may be overstressed to 80 percent of ultimate tensile strength if stress after transfer to concrete does not exceed 75 percent of that strength.

Prestressed concrete piles must have a final (effective) prestress of at least 1,000 psi.

Unless the Engineer approves splices, all piles must be full length.

The Engineer intends to perform inspection as specified in Section 1-06.1.

6-05.3(3)A CASTING AND STRESSING

Reinforcing bars, hoops, shoes, and similar elements must be placed as specified in the Contract. All parts must be securely tied together and placed to the specified spacings. No concrete can be placed until all reinforcement is in place and the forms are secured.

The Contractor must perform quality control inspection. The manufacturing plant for precast concrete piles must be certified by the Precast/Prestressed Concrete Institute's Plan Certification Program for the type of precast piles to be produced and must be approved by WSDOT as a Certified Precast Concrete Fabricator before start of production.

Before the start of production of the piles, the Contractor must provide the Engineer advance notification of the production schedule. The Engineer may inspect the fabrication of concrete piles as specified in Section 1-05 and Section 1-06.

In casting concrete piles, the Contractor must:

1. Cast them either vertically or horizontally.
2. Use metal forms with smooth joints and inside surfaces that can be thoroughly cleaned after each use.
3. Brace and stiffen the forms to prevent distortion.
4. Place concrete continuously in each pile, guarding against horizontal or diagonal cleavage planes.
5. Ensure the reinforcement is properly embedded.
6. Use internal vibration around the reinforcement during concrete placement to prevent rock pockets from forming.
7. Cast test cylinders with each set of piles as concrete is placed.

Forms must be metal and must be braced and stiffened to keep their shape under pressure of wet concrete. Forms must have smooth joints and inside surfaces easy to reach and clean after each use. That part of a form which shapes the end surface of the pile must be a true plane at right angles to the pile axis.

Each pile must contain a cage of non-prestressed reinforcing steel sized and located as indicated on the Drawings. Spiral steel reinforcing must be secured in position and must have a minimum 1-1/2-inch concrete cover from the outside pile surface.

Prestressing steel must be tensioned as required in Section 6-02.3(25)C.

The Drawings specify tensioning stress for strands or wires. Tension must be measured by jack pressure as described in Section 6-02.3(25)C. Mechanical locks or anchors must temporarily maintain cable tension. All jacks must have hydraulic pressure gauges, accurately calibrated and accompanied by a certified calibration curve no more than 180 days old, which allow stress calculations at all times.

All tensioned piles must be pretensioned. Post tensioning is not allowed.

The Contractor must not stress any pile until test cylinders made with it reach a compressive strength of at least 3,300 psi.

6-05.3(3)B FINISHING

As soon as the forms for each precast concrete pile are removed, fill all holes and irregularities in the pile with 1:2 mortar. That part of any trestle pile to be underground or below the low water line and all parts of any pile to be used in salt water or alkaline soil must receive only this mortar treatment. That part of any trestle pile that shows above the ground or water line must be given a Class 2 finish as specified in Section 6-02.3(14)B.

6-05.3(3)C CURING

Precast Concrete Piles: The Contractor must:

1. Keep the concrete continuously wet with water after placement for at least 10 days with Type I or II Portland cement or at least 3 days with Type III; and
2. Remove side forms no sooner than 24 hours after concrete placement, and then only if the surrounding air temperature remains at or above 50 °F for the next 5 days with Type I or II Portland cement or 3 days with Type III.

The Contractor may cure precast piles with saturated steam or hot air, as described in Section 6-02.3(25)D, provided the piles are kept continuously wet until the concrete has reached a compressive strength of 3,300 psi.

Precast Prestressed Concrete Piles must be cured as required in Section 6-02.3(25)D.

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6-05.3(4) MANUFACTURE OF STEEL CASINGS FOR CAST IN PLACE CONCRETE PILES

The diameter of steel casings must be as specified in the Contract. Spiral welded steel pile casings are not allowed for steel pile casings greater that 24 inches in diameter. A full penetration groove weld with a maximum 1/16-inch offset between welded edges is required.

6-05.3(5) MANUFACTURE OF STEEL PILES

Steel piles must be made of rolled steel H pile sections, steel pipe piles, or of other structural steel sections described in the Contract. Spiral welded steel pile casings are not allowed for steel pipe piles greater than 24 inches in diameter. A full penetration groove weld with a maximum 1/16-inch offset between welded edges is required.

6-05.3(6) SPLICING STEEL CASINGS AND STEEL PILES

The Engineer will normally allow steel piles and steel casings for cast in place concrete piles to be spliced. However, the Contractor must obtain the Engineer's advance approval on the need and the method for splicing. Welded splices must be spaced at a minimum distance of 10 feet. Only welded splices are permitted.

Splice welds must comply with Section 6-03.3(25) and AWS D1.1 Structural Welding Code. Splicing of steel piles must be performed using an approved weld procedure. Submit a weld procedure to the Engineer for approval before welding. For ASTM A 252 Material, mill certification for each lot of pipe to be welded must accompany the submittal.

The Contractor is responsible for weld splicing of steel casings for cast in place concrete piles. Casings that collapse or are not water tight, must be replaced at no additional cost to the Owner.

Steel casing joints must not be offset more than 1/16 inch.

6-05.3(7) STORAGE AND HANDLING

The Contractor must store and handle piles in ways that protect them from damage.

6-05.3(7)A TIMBER PILES

Timber piles must be stacked closely and in a manner to prevent warping. The ground beneath and around stored piles must be cleared of weeds, brush, and rubbish. Piles must be covered against the weather if the Engineer requires it.

The Contractor must take special care to avoid breaking the surface of treated piles. They must be lifted and moved with equipment, tools, and lifting devices which do not penetrate or damage the piles. If timber piles are rafted, any attachments must be within 3 feet of the butts or tips. Any surface cut or break must be repaired as per Section 9-09.3. The Engineer may reject any pile because of a cut or break.

6-05.3(7)B PRECAST CONCRETE PILES

The Contractor must not handle any pile until test cylinders made with the same batch of concrete as the pile reach a compressive strength of at least 3,300 psi.

Storing and handling methods must protect piles from fractures by impact and undue bending stresses. Handling methods must never stress the reinforcement more than 12,000 psi. Allow for twice the calculated load for impact and shock effects. The method of lifting the piles must be submitted to the Engineer for approval. Take extra care to not damage the surface of any pile to be used in sea water or alkaline soil.

6-05.3(7)C STEEL CASINGS AND STEEL PILES

The Engineer will reject bent, deformed, or kinked piles.

6-05.3(8) PILE TIPS AND SHOES

Timber piles must be driven with squared ends unless subsurface conditions require attaching metal shoes. Pile tips and shoes must be securely attached to the piles per the manufacturer’s recommendations.

When required in the Contract, use conical steel pile tips when driving steel casings. The tips must be inside fit, flush mounted such that neither the tip nor weld bead protrudes more than 1/16 inch beyond the nominal outside diameter of the steel casing.

If conical tips are not required in the Contract, the lower end of each casing must have a steel driving plate thick enough to keep the casing water tight and free from distortion as it is driven. The diameter of the steel driving plate must be less than the outside diameter of the steel casing.

Where called for in the Contract, use inside fit cutting shoes when driving open ended steel piles. The cutting shoes must be flush mounted such that neither the shoe nor the weld bead protrudes more than 1/16 inch beyond the nominal outside diameter of the steel pile. The cutting shoe must be of an inside diameter at least 0.75 inches less than the nominal inside diameter of the steel pile.

The Contractor must submit to the Engineer for approval, Shop Drawings of the proposed pile tip or shoe with design calculations, Specifications, material chemistry and installation requirements, and must also be prepared to provide a pile driving test demonstrating suitability of the proposed pile tip. The test must be performed in the presence of the Engineer or an acceptable to the Engineer independent AASHTO certified testing agency, and must consist of driving a pile fitted with the proposed tip. The pile must be located outside the proposed foundation limits if the pile cannot be visually inspected, see

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Section 6-05.3(11)F. The pile must be driven to a depth sufficient to develop the required bearing capacity specified in the Contract and in ground conditions determined by the Engineer to be equivalent to the ground conditions at the Project Site. For closed ended casings or piles, the pile need not be removed if, in the opinion of the Engineer, the pile can be evaluated for evidence of damage to the pile or the tip. For open ended steel casings or piles, timber piles or H piles, the pile must be removed for evaluation.

6-05.3(9) PILE DRIVING EQUIPMENT

6-05.3(9)A PILE DRIVING EQUIPMENT APPROVAL

Before driving any piles, the Contractor must submit to the Engineer for approval, the details of each proposed pile driving system. The pile driving system must comply with the minimum requirements for the combinations of hammer type and pile type specified in this Section. These requirements are minimums and may need to be increased to ensure that the required bearing capacity can be achieved, that minimum tip elevations can be reached, and to prevent pile damage.

The Contractor must submit a wave equation analysis for pile driving systems required by Contract or for all pile driving systems used to drive piles with required ultimate bearing capacities of 300 tons or greater. The wave equation analysis must be performed by, and bear the stamp of, a civil engineer licensed under Title 18 RCW in the State of Washington, see Section 1-05.3(12). The wave equation analysis must be performed per the requirements of this Section and the user's manual for the program. The wave equation analysis must verify that the proposed pile driving system does not produce stresses greater than 90 percent of the yield stress for steel piles, or steel casings for cast in place concrete piles. For prestressed concrete piles, the allowable driving stress must be 3 times the square root of f'_{cm}, plus prestress in tension, and $0.85f'_c$ minus prestress in compression. For precast concrete piles that are not prestressed, the allowable driving stress must be 70 percent of the yield stress of the steel reinforcement in tension, and $0.85f'_c$ in compression. The wave equation must also verify that the pile driving system does not exceed the refusal criteria at the depth of penetration anticipated for achieving the required ultimate bearing capacity and minimum tip elevation. The wave equation analysis must verify that at bearing, the maximum driving resistance is 100 blows per foot or less. Unless otherwise specified in the Contract, input the following default values into the wave equation analysis program:

Wave Equation Analysis Default Values	
Output option (IOUT)	0
Factor of safety applied to (R_{ult})	1.0
Type of damping	Smith
Residual stress option	No
(R_{ult}) is equal to the maximum driving resistance for the pile	

NOTE: R_{ult} is the resistance of the pile used in the wave equation analyses. If the ultimate bearing capacity equals the maximum driving resistance, a setup factor of 1.3 may be used in the wave equation analysis to account for pile setup. To use a setup factor in the wave equation analysis, R_{ult} in the analysis is the ultimate bearing capacity divided by 1.3. If the maximum driving resistance exceeds the ultimate bearing capacity, do not use a setup factor, and R_{ult} is equal to the maximum driving resistance of the pile.

Hammer Efficiencies

Hammer	For Analysis of Driving Resistance	For Analysis of Driving Stresses
Single acting diesel hammers	0.72	0.84
Closed ended diesel hammers	0.72	0.84
Single acting air/steam hammers	0.60	0.70
Double acting air/steam hammers	0.45	0.53
Hydraulic hammers or other external combustion hammers having ram velocity monitors that may be used to assign an equivalent stroke.	0.85	1.00

Within 15 Working Days after the Engineer receipt of the submittal, the Contractor will be notified of the Engineer's review. If the Contractor wishes to change the pile driving system after the Contractor's proposed system has been accepted, the Contractor must comply with the requirements of Section 1-05.3(5).

6-05.3(9)B PILE DRIVING EQUIPMENT MINIMUM REQUIREMENTS

For each drop hammer used, the Contractor must weigh it in the Engineer's presence or provide the Engineer with a certificate of its weight. The exact weight must be stamped on the hammer. Drop hammers must have a weight of not less than:

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1. 3,000 pounds for piles under 50 feet long that have an ultimate bearing capacity of not more than 60 tons,
2. 4,000 pounds for piles 50 feet and longer or that have an ultimate bearing capacity of 60 to 90 tons.

If a drop hammer is used for timber piles, it is preferable to use a heavy hammer and operate with a short drop.

For each diesel, hydraulic, steam, or air driven hammer used, the Contractor must provide the Engineer with the manufacturer's specifications and catalog. These must show all data needed to calculate the developed energy of the hammer used.

Underwater hammers may be used only with approval of the Engineer.

Drop hammers on timber piles must have a maximum drop of 10 feet. Do not use drop hammers to drive timber piles that have ultimate bearing capacities of more than 60 tons.

When used on timber piles, diesel, hydraulic, steam, or air driven hammers must provide at least 13,000 foot pounds of developed energy per blow. The ram of any diesel hammer must have a weight of at least 2,700 pounds.

Precast concrete, and precast prestressed concrete piles must be driven with a single acting steam, air, hydraulic, or diesel hammer with a ram weight of at least half as much as the weight of the pile, but never less than the minimums stated in the tables following. The ratio of developed hammer energy to ram weight must not exceed 6. Steel casings for cast in place concrete, steel pipe, and steel H piles must also be driven with diesel, hydraulic, steam, or air hammers.

These hammers must provide at least the following developed energy per blow:

Minimum Developed Energy per Blow (ft-lbs)

Maximum Driving Resistance (tons)	Air or Steam Hammers	Open Ended Diesel Hammers	Closed Ended Diesel Hammers	Hydraulic Hammers
Up to 165	21,500	23,000	30,000	18,500
166-210	27,500	29,500	38,000	23,500
211-300	39,000	41,500	54,000	33,500
301-450	59,000	63,000	81,000	50,500

The ram of any diesel or hydraulic hammer must have the following minimum weights:

Maximum Driving Resistance (tons)	Minimum Ram Weight (lbs)
Up-165	2,700
166-210	4,000
211-300	5,000
301-450	6,500

The minimum hammer size requirement may be waived by the Engineer if a wave equation analysis demonstrates the ability of the hammer to obtain the required bearing capacity and minimum tip elevation without damage to the pile.

Vibratory hammers may be used to drive piles provided the location and plumbness requirements of this Section are met. The required bearing capacity for all piles driven with vibratory hammers will be determined according to Section 6-05.3(12) by driving the pile at least an additional 2 feet using an impact hammer. This method of determining bearing capacity will be accepted provided the blows per inch are constant or increasing. If the pile cannot be driven 2 feet, the pile will be considered acceptable for bearing if the pile is driven to refusal.

If water jets are used, the number of jets and water volume and pressure must be enough to erode the material adjacent to the pile at the tip. The equipment must include a minimum of 2 water jet pipes and two 3/4-inch jet nozzles. The pump must produce a constant pressure of at least 100 psi at each nozzle.

6-05.3(9)C PILE DRIVING LEADS

All piles must be driven with fixed lead drivers. The leads must be fixed on the top and bottom during the pile driving operation. Leads must be long enough to eliminate the need for any follower (except for timber piles as specified in Section 6-05.3(11)E. To avoid bruising or breaking the surface of treated timber piles, use spuds and chocks as little as possible. In building a trestle or foundation with inclined piles, leads must be adapted for driving batter piles.

A helmet of the right size for the hammer must distribute the blow and protect the top of steel pile or steel casing from driving damage. The driving head must be positioned symmetrically below the hammer's striking parts, so the impact forces are applied concentric to the pile top.

For piles with specified ultimate bearing capacities of 300 tons or greater, pile driving leads except those fixed at the top and bottom may be used to complete driving when all following criteria are met:

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1. Each plumb and battered pile is located and initially driven at least 20 feet in true alignment using fixed leads or other approved means.
2. The pile driving system (hammer, cushion and pile) must be analyzed by Pile Driving Analyzer (PDA) to verify that driving stresses in the pile are not increased due to eccentric loading during driving, and transferred hammer energy is not reduced due to eccentric loading during driving, for all test piles and at least 1 production pile per pier.

The Contractor must submit the revised fixing of leads set-up and PDA analysis to the Engineer before pile driving.

6-05.3(10) TEST PILES

If specified in the Contract, the Contractor must drive test piles to determine pile lengths satisfying the specified load carrying capacity, penetration, or both. Test piles must:

1. Be made of the same material and have the same tip diameter as the permanent piles (although test piles for treated timber piles may be treated or untreated).
2. Be driven with pile tips if the permanent piles are to have tips.
3. Be pre-bored when pre-boring is specified for the permanent piles.
4. Have the same cross-section and other characteristics of the permanent piles for steel casings for cast in place concrete, precast concrete, precast prestressed concrete, or steel pipe or H piles.
5. Be long enough to accommodate Project Site soil conditions and Contract requirements.
6. Be driven with the same equipment and methods to be used for the permanent piles.
7. Be located where the Engineer directs. and
8. Be driven before the permanent piles in a pier.

Test piles may also be driven by the Contractor, at no additional cost to the Owner, as evidence that the pile driving system selected does not damage the pile or result in refusal before reaching any specified minimum tip elevation.

Timber test piles must be driven outside the footing and cut off 1 foot below the finished groundline. Timber test piles must not be used in place of permanent piles.

Steel test piles and all types of concrete test piles must become permanent piles. The Engineer will reduce the number of these permanent piles by the number of test piles.

The Contractor must base test pile length on test hole data provided in the Contract. Any test pile not long enough to comply with Contract requirements must be replaced, or spliced if the Contract allows splicing, at no additional cost to the Owner.

In foundations and trestles, test piles must be driven to at least 15 percent more than the bearing capacity required for the permanent piles, except where pile driving criteria is determined by the wave equation. When pile driving criteria is specified to be determined by the wave equation, the test piles must be driven to the same ultimate bearing capacity as the production piles. Test piles must penetrate to at least the minimum tip elevations specified in the Contract. If no minimum tip elevation is specified, test piles must extend at least 10 feet below the bottom of the concrete footing or groundline, and 15 feet below the bottom of the concrete seal.

When any test pile to be left as a permanent pile has been damaged by handling or driving, remove and replace the pile at no additional cost to the Owner. The Engineer may direct the Contractor to overdrive the test pile to more than 15 percent above the minimum bearing capacity for permanent piles or above ultimate bearing capacity if the wave equation is used to determine driving criteria. In this case, the overdriving must be at no additional cost to the Owner. But if pile damage results from this overdriving, any removal and replacement will be at the Owner's expense.

6-05.3(11) DRIVING PILES

6-05.3(11)A TOLERANCES

For elevated pier caps, the tops of piles at cut off elevation must be within 2 inches of the locations specified in the Contract. For piles capped below final grade, the tops of piles at cut off elevation must be within 6 inches of the horizontal locations specified in the Contract. No pile edge may be nearer than 4 inches from the edge of any footing or cap. Piles must be installed such that the axial alignment of the top 10 feet of the pile is within 4 percent of the specified alignment. Do not pull misaligned steel or concrete piles laterally. A properly aligned section must not be spliced onto a misaligned section for any type of pile. All piles must be driven vertically unless indicated otherwise on the Drawings.

6-05.3(11)B FOUNDATION PIT PREPARATION

The Contractor must replace any damaged pile, whether before or during driving, at no additional cost to the Owner.

The Contractor must complete all foundation pits (and build any required cofferdams or cribs) before driving foundation piles. The Contractor must adjust pit depths to allow for upheaval caused by pile driving. Before constructing the footing or pile cap, the Contractor must restore the pit bottom to the specified elevation by removing heaved material or by backfilling with granular material specified in the Contract.

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6-05.3(11)C PREPARATION FOR DRIVING

Treated and untreated timber piles must be cut square on the butt ends on-site just before driving. If piles are to be driven into or through hard soils, then caps, collars, or bands must be placed on the butt ends to prevent crushing or brooming. If the head area of the pile is larger than that of the hammer face, the head must be snipped or chamfered to fit the hammer. On treated piles, the heads must be snipped or chamfered to at least the depth of the sapwood to avoid splitting the sapwood from the pile body.

The Contractor must match timber pile sizes in any single bent to prevent sway braces from undue bending or distorting.

When driven, pile faces must be turned as shown on the Drawings.

No precast prestressed pile can be driven until sample concrete test cylinders taken of the pile concrete pour reach the minimum compressive strength specified in the Contract. On all other precast piles, the concrete test cylinders must reach a compressive strength of at least 4,000 psi before the piles are driven.

Helmets of approved design must protect the heads of all precast concrete piles as they are driven. Each helmet must have fitted into it a cushion adjacent to the pile head. The bottom side of the helmet must be recessed sufficiently to accommodate the required pile cushion and hold the pile in place during positioning and driving. Determine the inside helmet diameter before casting the pile. The pile head must be formed to fit loosely inside the helmet.

Steel Casing, steel pipe, or H piles must have square cut ends. During driving, each pile head must be protected by a fitted metal pile helmet.

6-05.3(11)D ACHIEVING MINIMUM TIP ELEVATION AND BEARING

Once pile driving has started, each pile must be driven continuously until the required load bearing capacity specified in the Contract has been achieved. Pauses during pile driving, except for splicing, mechanical breakdown, or other unforeseen events, are not allowed.

If the Contract specifies a minimum tip elevation, the pile must be driven to at least the minimum tip elevation, even if the load bearing capacity has been achieved. If a pile does not develop the required load bearing capacity at the minimum tip elevation, continue driving the pile until the required bearing capacity is achieved. If no minimum tip elevation is specified, then the piles must be driven to the load bearing capacity specified in the Contract and the following minimum penetrations:

Pile Application	Pile Tip Minimum Penetration
Pile supporting cross beams bents	10 feet below final top of ground elevated pile caps elevation
Piles supporting foundations	10 feet below bottom of foundation
Piles with a concrete seal	15 feet below bottom of seal

If overdriving is required to reach a specified minimum tip elevation, the Contractor must provide a pile driving system that does not result in damage to the pile, or produces refusal before the minimum tip elevation is reached.

So long as the pile is not damaged and the embankment or foundation material being driven through is not permanently damaged, the Contractor must use normal means necessary to:

1. Secure the minimum depth specified.
2. Penetrate hard material that lies under a soft upper layer.
3. Penetrate through hard material to obtain the specified minimum tip elevation.
4. Penetrate through a previously placed embankment.

Normal means refer to methods such as pre-boring, spudding, or jetting. Blasting or drilling through obstructions are not considered normal means and must not be used.

Pre-bored holes and pile spuds must have a diameter no larger than the least outside dimension of the pile. After the pile is driven, the Contractor must fill all open spaces between the pile and the soil caused by the pre-boring or spudding with dry sand, or pea gravel, or controlled density fill as approved by the Engineer.

If water jets are used, the jets must be withdrawn before the pile reaches its final penetration, and the pile must then be driven to its final penetration and bearing capacity. The pile must be driven a minimum of 2 feet to obtain bearing after the jets are withdrawn, or to refusal, whichever occurs first. If the water jets loosen a pile previously driven, it must be re-driven in place or pulled and replaced by a new pile. To check on pile loosening, the Contractor must attempt to re-drive at least 1 in every 5 piles as selected by the Engineer.

If the Engineer requires, the Contractor must overdrive the pile beyond the minimum load bearing capacity and minimum tip elevation specified in the Contract. In this case, the Contractor is not required to:

a. Use other than normal means to achieve the additional penetration.
b. Bear the expense of removing or replacing any pile damaged by overdriving.
c. Bear the expense of overdriving the pile more than 3 feet as specified in Section 6-05.5.

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In driving piles for footings with seals, the Contractor must not use any method (such as jetting or pre-boring) that might reduce friction capacity.

6-05.3(11)E USE OF FOLLOWERS OR DRIVING

Do not use followers to drive concrete or steel piles. On timber piles, the Contractor may use steel followers if the driving head and cap fit snugly over the pile head. Wood followers are not allowed. The Engineer prefers, however, that the hammer strike the pile head directly without any cushion, block, or follower. If a follower is used, the Contractor must, in every group of 10 piles, drive 1 long pile without a follower to the required bearing capacity and minimum tip elevation. Use this long pile to test the bearing capacity of the piles driven with a follower in the group. The tip elevation of the long pile must be similar to the tip elevations of the piles driven with the follower. If the tip elevations vary considerably, the Contractor must re-drive the remaining piles in the group to the tip elevation of the longer pile.

6-05.3(11)F PILE DAMAGE

The Contractor must remove and replace any pile which is damaged at no additional cost to the Owner.

After driving a steel casing for a cast in place concrete pile, the Contractor must leave it empty until the Engineer has inspected and accepted it. The Contractor must provide to the Engineer a light suitable for inspecting the entire length of its interior. The Engineer will reject any casing improperly driven, that shows partial collapse that would reduce its bearing capacity, that has been reduced in diameter, or that does not keep out water. The Contractor must remove and replace any rejected casing at no additional cost to the Owner.

Pile heads which have been broomed, rolled, or otherwise damaged must be cut back to undamaged material before proceeding with driving or acceptance of the pile.

6-05.3(11)G PILE CUTOFF

Trim the tops of all piles to the true plane and to the elevation specified in the Contract. If a pile is driven below cutoff elevation without the Engineer's approval, the contractor must remove and replace the pile at no additional cost to the Owner, even if this requires a longer pile. Any pile that rises as nearby piles are driven must be driven down again.

Any piles under timber caps or grillages must be sawed to the exact plane of the structure above them and fit it exactly. No shimming on top of timber piles to adjust for inaccurate pile top elevations will be permitted. If a timber pile is driven out of line, it must be straightened without damage before it is cut off or braced.

Steel casings must be cut off at least 6 inches below the finished groundline or at the low water line if a casing may be visible.

6-05.3(11)H PILE DRIVING FROM OR NEAR ADJACENT STRUCTURES

Do not drive piles from an existing structure unless:

1. The existing structure is to be demolished within the Contract.
2. The existing structure is permanently closed to traffic.
3. Working Shop Drawings are submitted as specified in Section 6-01.8 and 6-02.3(16), showing the structural adequacy of the existing structure to safely support all construction loads.

To minimize the detrimental effects of pile driving vibrations on new concrete less than 28 days old, do not drive piles closer to the new concrete than the distance determined by the following formula:

$$D = C \times \sqrt{E}$$

Where:

D = distance in feet

E = rated hammer energy in foot-pounds

C = coefficient described in the following table based on the number of days of curing time:

Curing Time (days)	Coefficient (C)	Curing Time (days)	Coefficient (C)
1	0.34	6	0.12
2	0.23	7-9	0.11
3	0.18	10-13	0.10
4	0.15	14-20	0.09

This distance may be reduced if approved in writing by the Engineer.

6-05.3(12) DETERMINATION OF BEARING VALUES

Use the following formula to determine ultimate bearing capacities:

$$P = F \times E \times L_n(10N)$$

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Where:

P = ultimate bearing capacity, in tons

F = 1.65 for air/steam hammers

= 1.55 for open ended diesel hammers

= 1.2 for close ended diesel hammers

= 1.9 for hydraulic hammers

= 0.6 for drop hammers

E = developed energy, equal to W times H, in ft-kips

W = weight of ram, in kips

H = vertical drop of hammer or stroke of ram, in feet

N = average penetration resistance in blows per inch for the last 4 inches of driving

L_n =the natural logarithm, in base "e"

For closed end diesel hammers (double acting), the developed hammer energy (E) is determined from the bounce chamber reading. Hammer manufacturer calibration data may be used to correlate bounce chamber pressure to developed hammer energy. For double acting hammer hydraulic and air/steam hammers, the developed hammer energy must be calculated from ram impact velocity measurements or other means approved by the Engineer. For open ended diesel hammers (single acting), use the blows per minute to determine the developed energy (E).

The above formula applies only when:

1. The hammer is in good working condition and operating as within the manufacturer's recommendations.
2. A follower is not used.
3. The pile top is not damaged.
4. The pile top is free from broomed or crushed wood fiber.
5. The penetration occurs at a reasonably quick, uniform rate and the pile has been driven at least 2 feet after any interruption in driving greater than 1 hour in length.
6. There is no perceptible bounce after the blow. If a significant bounce cannot be avoided, twice the height of the bounce must be deducted from “H” to determine its true value in the formula. and
7. If "N" is greater than or equal to 1.0 blow/inch.

If "N" required to achieve the required ultimate bearing capacity using the above formula is less than 1.0 blow/inch, the pile must be driven until the penetration resistance is a minimum of 1.0 blow/inch for the last 2 feet of driving. For timber piles, bearing capacities calculated by the formula above are considered effective only when it is less than the crushing strength of the piles.

The Engineer may require the Contractor to install a pressure gauge on the inboard end of the hose to monitor pressure at the hammer.

If water jets are used in driving, determine bearing capacities by either:

a. Calculating it with the driving data and the formula in this Section after the jets have been withdrawn and the pile is driven at least 2 feet, or

b. Applying a test load.

6-05.3(13) TREATMENT OF TIMBER PILE HEADS

After cutting timber piles to correct elevation, the Contractor must thoroughly coat the heads of all untreated piles with 2 coats of an approved preservative that meets the requirements of Section 9-09 (except concrete encased piles).

After cutting treated timber piles to correct elevation, the Contractor must brush 3 coats of an approved preservative that meets the requirements of Section 9-09 on all pile heads (except those to be covered with concrete footings or concrete caps). The pile heads must then be capped with alternate layers of an approved roofing asphalt and a waterproofing fabric that meets the requirements of Section 9-11.2. The cap must be made of 4 layers of an approved roofing asphalt and 3 layers of fabric. The fabric must be a single piece cut large enough to cover the pile top and fold down at least 6 inches along all sides of the pile. After the fabric cover is bent down over the pile, fasten its edges with large head galvanized nails or with 3 turns of galvanized wire. The edges of the cover must be neatly trimmed.

On any treated timber pile encased in concrete, the cut end must receive 2 coats of an approved preservative that meets the requirements of Section 9-09 and then a heavy coat of an approved roofing asphalt.

6-05.3(14) EXTENSIONS AND BUILD UPS OF PRECAST CONCRETE PILES

The Contractor must add extensions, or build ups (if necessary) on precast concrete piles after they are driven to the required bearing capacity and minimum tip elevation.

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Before adding extensions or build ups to precast prestressed piles, the Contractor must remove any spalled concrete, leaving the pile fresh headed and with a top surface perpendicular to the axis of the pile. The concrete in the buildup must reach a minimum compressive strength of 5,000 psi at 28 days.

Before adding to a non-prestressed precast concrete pile, the Contractor must cut the pile head to a depth 40 times the diameter of the vertical reinforcing bar. The final cut must be perpendicular to the axis of the pile. Use reinforcement of the same density and configuration as used in the pile in the buildup and fasten firmly to the projecting steel. Forms must be placed to prevent concrete from leaking along the pile. The concrete in the buildup must reach a minimum compressive strength of 4,000 psi at 28 days.

Just before placing the concrete for extensions or build ups to precast or precast prestressed concrete piles, the Contractor must thoroughly wet the top of the pile. Forms must remain in place at least 3 days.

6-05.3(15) COMPLETION OF CAST IN PLACE CONCRETE PILES

After acceptance of the casing by the Engineer, see Section 6-05.3(11)F, the driven casing must be cut off horizontally at the required elevation. The casings must be clean and free of water when concrete and reinforcing steel are placed.

These piles must consist of steel casings driven into the ground, reinforced as specified, and filled with designation P concrete.

6-05.3(15)A REINFORCEMENT

All reinforcing bars must be fastened rigidly into a single unit, then lowered into the casing before the concrete is placed. Do not use loose bars.

Spiral hooping reinforcement must be deformed steel bar, plain steel bar, cold drawn wire, or deformed wire.

6-05.3(15)B PLACING CONCRETE

Remove all debris and water from the casing before placing concrete. If the casing cannot be dewatered, it must be removed (or cut off 2 feet below the ground surface and filled with sand) and a new casing must be driven at a location determined by the Engineer.

Place concrete continuously through a rigid conduit at least 5 feet long. Direct the concrete down the center of the pile casing completely filling the casing including around the reinforcement. The top 5 feet of concrete must be placed with the tip of the conduit below the top of fresh concrete. Vibrate, as a minimum, the top 10 feet of concrete. In all cases, the concrete must be vibrated to a point at least 5 feet below the original groundline.

6-05.4 MEASUREMENT

Measurement for driving (type) pile will be the number of piles driven in place.

In these categories, measurement will be the number of linear feet driven below pile cutoff, or as described in the Engineer's order list:

1. Furnishing timber piles (untreated or name of treatment).
2. Precast concrete and precast prestressed concrete piles.

In these categories, measurements will be the number of linear feet driven below cut-off:

a. Cast in place concrete piles.

b. Furnishing steel piles.

Measurement for furnishing and driving test piles will be the number furnished and driven as the Contract requires.

Measurement for steel pile tips or shoes will be by the number of tips or shoes actually installed and driven in place on steel casings or steel piles.

No specific unit of measurement will apply to the item "Precast Concrete Pile Buildup".

6-05.5 PAYMENT

1. **"Furnishing and Driving (Type) Test Pile"**, per each.

The Bid Item price for "Furnishing and Driving (Type) Test Pile" must include all costs for the work required for furnishing and driving test piles to the bearing capacity or penetration required by the Engineer, furnishing and installing a pile tip when pile tips are specified for the permanent piles, pre-boring when pre-boring is specified for the permanent piles, for pulling the piles or cutting them off as required, and for removing them from the Job Site or for delivery to the Owner for salvage when directed by the Engineer. For cast-in-place concrete test piles, this price must include furnishing, fabricating, and installing the steel reinforcing bar cage and furnishing, casting, and curing the concrete. This Bid Item price must also include all costs with moving all pile driving equipment or other necessary equipment to the Project Site and for removing all such equipment from the Project Site after the piles have been driven. If, after the test piles have been driven, it is found necessary to eliminate the pile from all or any part of the Structure, moving the pile driving equipment to and from the Project Site must be at no additional cost to the Owner.

2. **"Driving Timber Pile (untreated or name treatment)"**, per each.

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The Bid Item price for "Driving Timber Pile (untreated or name treatment)" must include all costs for the work required to drive the specified timber pile including any metal shoes which the Contractor has determined to be beneficial to the pile driving.

3. **"Driving Concrete Pile (Size)"**, per each.

4. **"Driving Steel Pile"**, per each.

The Bid Item price for "Driving (type) Pile (____)" must include all costs for the work required to drive the pile to the ultimate bearing and/or penetration specified.

5. **"Furnishing Timber Piles**, **(Untreated or Name Treatment)"**, per linear foot.

6. **"Furnishing Concrete Piles**, **(Size)"**, per linear foot.

7. **"Furnishing Steel Piles"**, per linear foot.

The unit Contract price per linear foot for "Furnishing (type) Piling (____)" must be full pay for furnishing the piling specified, including furnishing, fabricating, and installing the steel reinforcing bar cage, and furnishing casting, and curing the concrete, as required for concrete piling. Such price must also be full pay, for furnishing timber, precast concrete, or precast-prestressed concrete piling length ordered from an Engineer's order sheet but not driven.

8. **"Precast Concrete Pile Buildup"**, per each.

Payment for build ups of precast or precast prestressed concrete piles will be made as specified in Section 1-09.4. No payment will be made for build ups or additional lengths of buildup made necessary because of damage to the pile during driving. The length of splice for precast concrete piles includes the length cut off to expose reinforcing steel for the splice. The length of splice for precast prestressed piles includes the length in which holes are drilled and reinforcing bars are grouted.

9. **"Furnishing Steel Pile Tip or Shoe (Size)"**, per each.

The Bid Item price for "Furnishing Steel Pile Tip or Shoe (Size)" must include all costs for the work required to furnish and install the pile tip or shoe. Payment for pile tip or shoe for test piles or test piles incorporated as permanent piles must be included in the Bid Item "Furnishing and Driving (Type) Test Pile" and no separate or additional payment will be made.

10. **Other payment information**

Any pile damaged or destroyed before or when it is being driven must be replaced by the Contractor at no additional cost to the Owner.

The Bid Item prices for driving piles must cover all costs related to water jets, pre-boring, or spudding. All costs the Contractor incurs in re-driving piles loosened because of water jets, pre-boring, or spudding must be at no additional cost to the Owner.

The Bid Item price for furnishing concrete pile (size specified) must cover all costs related to the pile build up above the steel casing.

All costs to remove and replace test piles intended to remain as permanent piles but which were damaged in handling or driving must be at no additional cost to the Owner.

All costs to remove and replace any pile damaged in driving or straightening or driven below grade must be at no additional cost to the Owner.

Should it be determined by survey that the elevations of the pile tops have heaved after installation, the Contractor must re-drive the heaved piles to a pile tip penetration equal to or greater than that achieved during initial driving of the heaved pile at no additional cost to the Owner.

All pile cutoffs and damaged pile must become the property of the Contractor and must be disposed of by the Contractor.

The Engineer will inspect all piles before driving and may have any pile damaged or destroyed before or when it is being driven replaced by the Contractor, at no additional cost to the Owner.

The Contractor must furnish the lengths of pile to reach from cutoff elevation up to the position of the driving equipment at no additional cost to the Owner.

All cost and expense to perform the work of removing the heaved soil within the limits of the footing excavation and filling the voids remaining from extracted piles with sand and pea gravel are incidental to the construction and must be included in the Bid Item prices for the Bid Items of Work involved in the project at no additional cost to the Owner.

All cost and expense for design of pile including uplift and pile build ups, and pile markings for blow count are incidental to the pile Bid Items and must be at no additional cost to the Owner.

All cost for submittals is specified in Section 1-05.3.

Payment for "Steel Reinforcing Bar" is specified in Section 6-02.5.

All cost and expense for jetting, sand and pea gravel, and vibration monitoring are incidental to the Bid Item price for the pile Bid Item and must be at no additional cost to the Owner.

Unless otherwise specified in the Contract, the cost of PDA testing per Section 6-05.3(9)C must be included in the various Bid Item prices for driving piles and must be at no additional cost to the Owner.

The cost of overdriving per Section 6-05.3(11)D is incidental to the Bid Item prices for furnishing and driving piles and must be at no additional cost to the Owner.

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SECTION 6-06 BRIDGE AND PEDESTRIAN RAILINGS

6-06.1 DESCRIPTION

Section 6-06 describes providing and building bridge railings and pedestrian railings.

6-06.2 MATERIALS

Material must comply with the requirements of the following Sections:

Material	Section
Timber Railing	Section 9-09
Metal Railing	Section 9-06.14

6-06.3 CONSTRUCTION REQUIREMENTS

6-06.3(1) TIMBER WHEEL GUARDS AND RAILINGS

Timber wheel guards and timber railings must be true to line and grade and framed accurately. Construction methods not specified in this Section must comply with the construction requirements of Section 6-04.

Unless the Contract indicates otherwise, wheel guards must be:

1. Beveled and surfaced on the roadway side and surfaced on the top edge. They may be surfaced on 4 sides (S4S).
2. Laid in sections at least 12 feet long.
3. Bolted through the floor plank and outside stringer (or nailing piece) with 3/4-inch diameter bolts spaced no more than 4 feet apart.

All rails and rail post material must be S4S and painted as required in Section 6-04 and Section 6-07. Railing members must be fastened securely together, with the bolts tightened once at installation, and again just before the Physical Completion Date. Provide the Engineer at least 3 Working Days advance notice of the last tightening.

6-06.3(2) METAL RAILINGS

Metal railing includes posts, web members, and horizontal members of the sidewalk and roadway railing. Unless the Contract indicates otherwise, railings must be made of aluminum alloy or steel.

Before fabricating the railing, submit Shop Drawings for the Engineer's review as specified in Section 1-05.3. The Contractor may substitute other rail connection details for those shown on the Drawings if details of these changes are shown and noted in the Shop Drawings and if the Engineer approves (Section 1-05.3(6)). Anchor bolts must be positioned with a template to ensure that bolts match the hole spacings of the bottom channels or anchorage plates.

Where specified, cover plates must fit the bottom channel tightly after being snapped into position.

Metal railings must be installed true to line and grade (or camber). After first setting the railing, readjust all or part, as necessary to create an overall line and grade as indicated on the Drawings.

6-06.4 MEASUREMENT

Timber railing will be measured by the linear foot along the line and slope at the base of the completed railing.

Metal railing will be measured by the linear foot along the line and slope at the base of the completed railing.

6-06.5 PAYMENT

1. **"Bridge Railing, (Type)"**, per linear foot.
2. **"Metal Railing, (Type)"**, per linear foot.

The Bid Item prices for "Bridge Railing, (Type)" and for "Metal Railing, (Type)" must include all costs for the work required to construct the railings as shown on the Drawings and as specified in this Section, including longitudinal, vertical and inclined structural members, plates, fastenings, anchor bolts, galvanizing, grouting, and painting as specified. If no Bid Item is in the Bid Form for "Bridge Railing, (Type)" and "Metal Railing, (Type)" and payment is not otherwise provided, all metal railings must be included in the Bid Item price for the Bid Item "Structural Carbon Steel" as specified in Section 6-03.

3. **"Timber Railing, (Type)"**, per linear foot.

The Bid Item price for "Timber Railing, (Type)" must include all costs for the work required to construct, provide hardware, and paint the complete railings and posts as shown on the Drawings.

SECTION 6-07 PAINTING

6-07.1 DESCRIPTION

Section 6-07 describes containment, surface preparation, shielding adjacent areas from unwanted surface preparation, testing and disposing of surface preparation debris, furnishing and applying paint, shielding adjacent areas from unwanted

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paint, and cleaning up after painting is completed. The work must comply with all requirements of the Drawings, these Specifications, and the Engineer. Terminology here uses definitions from the SSPC steel structures painting manual, Volume 2, Systems and Specifications.

6-07.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Material	Section
Paint	Section 9-08.1
Powder Coating Materials for Coating Galvanized Surfaces	Section 9-08.2
Abrasive Blast Media	Section 9-08.4(1)
Lead Abatement Additive	Section 9-08.4(1)
Bird Guano Treatment	Section 9-08.5(1)
Fungicide Treatment	Section 9-08.5(2)
Water	Section 9-08.5(3)
Filter Fabric	Section 9-08.6
Single Component Urethane Sealant	Section 9-08.7
Foam Backer Rod	Section 9-08.8

6-07.3 CONSTRUCTION REQUIREMENTS

6-07.3(1) WORK FORCE QUALIFICATIONS

6-07.3(1)A WORK FORCE QUALIFICATIONS FOR SHOP APPLICATION OF PAINT

Shop application of paint must comply with Section 1-06.

6-07.3(1)B WORK FORCE QUALIFICATIONS FOR FIELD APPLICATION OF PAINT

The Contractor preparing the surface and applying the paint must be certified under SSPC QP 1.

The Contractor removing and otherwise disturbing existing paint containing lead and other hazardous materials must be certified under SSPC-QP 2, Category A.

Instead of the above SSPC certifications, the Contractor performing the specified work may complete one of the following actions:

1. Substitute documentation of successful completion of 2 bridge painting projects in the past 10 years involving complete paint removal, including paint containing lead and other hazardous materials, with reapplication of a 3-component moisture-cured polyurethane paint system. The documentation must include the name and size of the project, the Dates of the work, the owner's name, and name and contact information for an owner's contact person.
2. Employ a quality control inspector for the project. Inspectors must be NACE-certified CIP Level 3.

6-07.3(2) PAINTING PLAN SUBMITTALS

The Contractor must submit a painting plan to the Engineer for approval as specified in Section 1-05.3.

For shop application of paint, the painting plan must include the documents listed in Sections 6-07.3(2)B and 6-07.3(2)E, item 2, the product data sheet for the primer coat with coefficient of friction certification, and paint samples as specified in Section 6-07.3(7).

For field application of paint, the painting plan must include the documents listed in Section 6-07.3(2)A through 6-07.3(2)F.

6-07.3(2)A WORK FORCE QUALIFICATIONS SUBMITTAL COMPONENT

The work force qualifications submittal component of the painting plan must include:

1. Documentation of the Contractor's workforce qualifications as specified in Section 6-07.3(1).
2. Resume of qualifications and contact information for the Contractor's on-site supervisors. An on-site supervisor must be present for each workshift at the bridge site, and each on-site supervisor must have 3 years' minimum of industrial painting field experience with 1 year minimum of field supervisory or management experience in paint removal projects.

6-07.3(2)B CONTRACTOR'S QUALITY CONTROL PROGRAM SUBMITTAL COMPONENT

The Contractor's quality control program submittal component of the painting plan must include:

1. Description of the inspection procedures and techniques and the acceptance criteria for all phases of work.
2. Procedure for implementation of corrective action.
3. The paint system manufacturer's recommended methods of preventing defects.
4. The Contractor's frequency of quality control inspection.
5. Description of the equipment used for inspection of prepared surfaces and inspection of paint.
6. Example completed forms of the daily quality control report used to record the inspection work and tests performed by the Contractor's quality control personnel.

6-07.3(2)C PAINT SYSTEM MANUFACTURER AND PAINT SYSTEM INFORMATION SUBMITTAL COMPONENT

The paint system manufacturer and paint system information submittal component of the painting plan must include:

1. Product data sheets and information on the paint materials, paint preparation, and paint application, as specified by the paint manufacturer, including:
   a. Samples and documents specified in Section 6-07.3(7) for each paint and thinner.
   b. All application instructions, including the mixing and thinning directions.
   c. Recommended spray nozzles and pressures.
   d. Minimum and maximum drying time between coats.
   e. Restrictions on temperature and humidity.
   f. Repair procedures as specified in Section 6-07.3(10)P.
   g. Maximum dry film thickness for each coat.
   h. Minimum wet film thickness for each coat to achieve the specified minimum dry film thickness.
2. Identification of, and contact information for, the paint system manufacturer's technical representative.
3. For painting of new steel, the friction coefficient of the faying surface, including test results and the paint manufacturer's certificate of compliance in support of the friction coefficient.

6-07.3(2)D HAZARDOUS WASTE CONTAINMENT, COLLECTION, TESTING, AND DISPOSAL SUBMITTAL COMPONENT

The hazardous waste containment, collection, testing, and disposal submittal component of the painting plan must include:

1. Filter fabric attachment and support as specified in Section 6-07.3(10)A.
2. Abrasive blasting containment system attachment and support as specified in Section 6-07.3(10)A.
3. Details of Job Site material storage facilities and containment waste storage facilities, including location, security, and environmental control.
4. Methods and materials used to contain, collect, and dispose of all containment waste and all construction-related waste, including transportation of waste.
5. Details of the containment waste sampling plan conforming to WAC 173-303 for waste designated as Dangerous Waste or extremely hazardous waste.
6. The name of, and contact information for, the accredited analytical laboratory performing the testing of the containment waste samples as specified in Section 6-07.3(10)F.
7. Process for tracking the disposal of hazardous waste, including a sample form of the tracking documentation.

6-07.3(2)E CLEANING AND SURFACE PREPARATION EQUIPMENT SUBMITTAL COMPONENT

The cleaning and surface preparation equipment submittal component of the painting plan must include:

1. Details of the water jetting operation, including:
   a. Water source.
   b. A list and description of the water jetting equipment, including maximum water discharge rates and pressure.
   c. Methods and materials used to protect vehicular and pedestrian traffic from wash water when conducting overhead water jetting operations.
2. Details of the abrasive blast cleaning operation, including:
   a. Description of the abrasive blast cleaning procedure.
   b. Type, manufacturer, and brand of abrasive blast material and all associated additives, including Materials Safety Data Sheets (MSDS).
   c. Description of the abrasive blast cleaning equipment to be used.

6-07.3(2)F PAINT APPLICATION EQUIPMENT AND OPERATIONS SUBMITTAL COMPONENT

The paint application equipment and operations submittal component of the painting plan must include:

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1. Description of the equipment used for paint application operations.
2. Details of Job Site material storage facilities, including location, security, and environmental control.
3. Description of the supports and platforms used to support equipment, materials, and workers, including scaffolds, platforms, accordion lifts, and barges, and the methods used to attach, moor, and anchor these supports and platforms.
4. Drip tarps as specified in Section 6-07.3(10)O.
5. Methods and materials used to protect surrounding structures, equipment, and property from exposure to, and damage from, painting operations.
6. Details of paint application operations for areas of limited and restricted access.
7. Description of the method for the removal of any accidental spills or drips on traffic that occur during the normal painting operations, and provisions for providing a vehicle-cleaning station.

6-07.3(2)G PAINTING PLAN MEETING

At the option of the Owner, a painting plan meeting may be scheduled following review of the Contractor's initial submittal of the plan. The Contractor must be represented by the superintendent, on-site supervisors, and quality control inspectors.

6-07.3(3) QUALITY CONTROL AND QUALITY ASSURANCE

6-07.3(3)A QUALITY CONTROL AND QUALITY ASSURANCE FOR SHOP APPLICATION OF PAINT

For shop application of paint, quality control procedures must be as approved by the Engineer.

6-07.3(3)B QUALITY CONTROL AND QUALITY ASSURANCE FOR FIELD APPLICATION OF PAINT

For field application of paint, the Contractor must conduct quality control inspections as required by SSPC-PA 1, using the personnel and the processes outlined in the painting plan as accepted by the Engineer. Maintain current copies of the SSPC Painting Manual, Volumes 1 and 2, at the Project Site at all times. The Contractor's quality control operations must include monitoring and documenting:

1. Equipment, personnel, and materials used.
2. Environmental conditions (ambient air temperature and humidity, steel surface temperature, dew point, wind direction, and velocity).
3. Steel surface condition, profile, and preparation.
4. Paint application and film thickness.

A copy of the Contractor's daily quality control report, signed and dated by the Contractor's quality control inspector, accompanied by copies of the test results of quality control tests performed on the work covered by the daily quality control report, must be submitted to the Engineer before the end of the next day's workshift.

The Contractor must provide the Engineer time and access to perform quality assurance testing. Each painting operation phase is considered a hold point, from which the Contractor cannot proceed with continuing work until receiving the Engineer's approval.

The Engineer may perform quality assurance testing at each of the following phases of painting operations:

a. After SSPC-SP 1 cleaning.
b. After water jetting.
c. After abrasive blast cleaning, hand and power tool surface cleaning, and compressed air surface cleaning.
d. After applying each coat when dry.
e. During final inspection of all work at the end of the project.

Quality assurance testing may include the following tests:

1) Environmental conditions for painting per ASTM D 337.
2) Cleanliness of abrasive blasting media and ionic contamination of abrasive blasting media per ASTM D 4940.
3) Cleanliness of compressed air per ASTM D 4285.
4) Pictorial of surface preparation standards per SSPC-VIS 1, 3, 4, and 5.
5) Surface profile by Keanne-Tator comparator per ASTM D 4417.
6) Surface profile by replica tape per ASTM D 4417.
7) Wet film thickness per ASTM D 4414.
8) Dry film thickness by magnetic gage per SSPC-PA 2 modified.
9) Dry film thickness by Tooke gage per ASTM D 4138.

The Contractor must repair all damage to paint resulting from Owner's quality assurance inspections at no additional cost or time to the Owner.

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6-07.3(4) PAINT SYSTEM MANUFACTURER'S TECHNICAL REPRESENTATIVE

The paint system manufacturer's technical representative must be present at the Job Site for the pre-painting conference and for the first day of paint application, and must be available for consultation for the full project duration.

6-07.3(5) PRE-PAINTING CONFERENCE

A pre-painting conference must be held 5 to 10 Working Days before starting painting operations to discuss the painting plan, construction operations, personnel, and equipment to be used. These persons are required to attend:

1. (Representing the Contractor) The superintendent, on-site supervisors, and all crew members in charge of cleaning and preparing the surfaces, containing, collecting and disposing of all removed materials, applying the paint, and performing all quality control inspections, measurements and tests; and the paint system manufacturer's technical representative.
2. The Engineer.

If the Contractor's key personnel change between any work operations, an additional conference may be held.

For projects that include painting of multiple structures, a separate conference may be held for each structure, at the discretion of the Engineer.

6-07.3(6) PAINT CONTAINERS, STORAGE, AND HANDLING

6-07.3(6)A PAINT CONTAINERS

Paint container labels must include the following information:

1. Manufacturer's name and product name, with batch number and date of manufacture.
2. Color name and Federal Standard 595 color number, where applicable.
3. Shelf life of the product, from date of batch manufacture.
4. Storage requirements and temperature limits.

Paint containers must conform to U.S. DOT hazardous material shipping regulations. Paint must be delivered to the Job Site in the manufacturer's original unopened containers with the original manufacturer's label legible and intact. Paint will be rejected if the container has a puncture or if the lid shows signs of paint leakage. Each container must be filled with paint and sealed airtight. Each container must be filled with the quantity of paint required to yield the specified quantity when measured at 70 °F. All paint must be shipped in new suitable containers having a capacity not greater than 5 gallons.

6-07.3(6)B PAINT STORAGE

Do not use or store paint materials on-site after the shelf life expiration date.

Paint material shipping, handling, and storage must conform to Sections 1-06.4 and Section 9-08 and the following requirements:

1. Paint materials must be stored in the manufacturer's original containers in a weather-tight space where the temperature is maintained within the storage temperature range recommended by the paint manufacturer, but in no case where the temperature is lower than 40 °F or greater than 100 °F.
2. The Contractor must monitor the paint material storage facility with a high-low recording thermometer device.
3. The paint material storage facility must be separate from the storage facilities used for storing painting equipment and used for storing containment waste and construction-generated waste.

6-07.3(7) PAINT SAMPLING AND TESTING

The Contractor must provide the Engineer 1 quart of each paint and each thinner representing each lot. Samples must be accompanied with a Material Safety Data Sheet and a paint drawdown sample.

If the quantity of paint required for each component of the paint system for the entire project is 20 gallons or less, then the paint system components will be accepted as specified in Section 9-08 with a paint drawdown sample.

Sampling and testing performed by the Owner is not construed as determining or predicting the performance or compatibility of the individual paint or the completed paint system.

6-07.3(8) EQUIPMENT

6-07.3(8)A PAINT FILM THICKNESS MEASUREMENT GAGES

Paint dry film thickness measurements must be performed with either a Type 1 pull-off gage or a Type 2 electronic gage as specified in SSPC Paint Application Specification 2, Measurement of Dry Paint Thickness with Magnetic Gages.

Paint wet film thickness measurement gages must be stainless steel with notches graduated in 1 mil increments.

6-07.3(9) PAINTING NEW STEEL STRUCTURES

All materials classified as non-galvanized structural steel must be painted with a 4-coat paint system as specified in Section 6-07.3(9)A. The primer coat must be shop-applied. The intermediate, intermediate stripe, and top coats must be field-applied after erection and following any primer coating repair operations.

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Steel surfaces embedded in concrete, and faying (contact) surfaces of bolted connections, including all surfaces internal to the connection and all filler plates, must receive the primer coat only. Stainless steel surfaces are not required to be painted. Welded shear connectors are not required to be painted except for the weld area.

Temporary attachments or supports for scaffolding or forms must not damage the paint system.

6-07.3(9)A PAINT SYSTEM

The paint system applied to new steel surfaces includes:

Coating	Section
Primer Coat	Section 9-08.1(2)C
Intermediate Coat	Section 9-08.1(2)G
Intermediate Stripe Coat	Section 9-08.1(2)G
Top Coat	Section 9-08.1(2)H

All paint coating components of the selected paint system must be produced by the same manufacturer.

Paint formulations to be used on faying surfaces must be Class B coatings with a mean slip coefficient not less than 0.50. Determine the slip coefficient by testing per Test Method to Determine the Slip Coefficient for Coatings Used in Bolted Joints as adopted by the Research Council on Structural Connections.

6-07.3(9)B PAINT COLOR

Each successive coat must be a contrasting color to the previously applied coat. The color of the top coat must be specified in the Drawings or Special Provisions and must conform to Section 9-08.1(8).

6-07.3(9)C MIXING AND THINNING PAINT

Paint must be mixed per the manufacturer's written recommendations to a smooth, lump-free consistency. Mixing must be done, to the extent possible, in the original containers and must be continued until all metallic powder or pigment is in suspension. The mixed paint must be kept under continuous agitation up to and during the time of application.

6-07.3(9)D COATING THICKNESS

Dry film thickness must be measured per SSPC Paint Application Specification 2. Measurement of Dry Paint Thickness with Magnetic Gages.

The minimum dry film thickness of the primer coat must not be less than 2.5 mils.

The minimum dry film thickness of the intermediate stripe and top coats must not be less than 3.0 mils.

The dry film thickness of each coat must not be thicker than the paint manufacturer's recommended maximum thickness.

If the specified number of coats does not produce a combined dry film thickness of at least the sum of the thicknesses required per coat, apply another full coat of the top coat of paint. The dry film thickness must not be thicker than the paint manufacturer's recommended maximum thickness.

6-07.3(9)E SURFACE TEMPERATURE REQUIREMENTS BEFORE APPLICATION OF PAINT

For application of the paint system, the temperature of the steel surface must be greater than 40 °F and less than 115 °F.

6-07.3(9)F SHOP SURFACE CLEANING AND PREPARATION

Provide a roughened surface profile by an abrasive blasting procedure as accepted by the Engineer. The profile must be as specified in the Contract requirements or per the paint manufacturer's recommendations, whichever is greater. The entire steel surface to be painted, including surfaces specified in Section 6-07.3(9)G to receive a mist coat of primer, must be cleaned to a near white condition per SSPC-SP 10 and must be in this condition immediately before paint application.

6-07.3(9)G APPLICATION OF SHOP PRIMER COAT

After receiving the Engineer's approval of the prepared surface, the primer must be applied so as to produce a uniform, even coating that has fully bonded with the metal. Primer must be applied with the spray nozzles and pressures recommended by the manufacturer of the paint system, so as to attain the film thicknesses specified.

Steel girder top flanges and soldier pile flanges to be embedded in concrete must be prepared as specified in Section 6-07.3(9)F and must then receive a mist coat of the specified primer with a dry film thickness of 0.5 to 1.0 mils.

Provide access to the steel to allow inspection as accepted by the Engineer. The access must not mar or damage any freshly painted surfaces.

Do not paint high-strength field bolts before erection.

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6-07.3(9)H CONTAINMENT FOR FIELD COATING

The Contractor must use a containment system as specified in Section 6-07.3(10)A.

6-07.3(9)I APPLICATION OF FIELD COATINGS

Before applying field coatings, the Contractor must field install welded shear connectors on the steel girder top flanges as specified in Section 6-03.3(29)) and as shown on the Drawings.

Upon completion of erection Work, all uncoated areas remaining, including bolts, nuts, washers, and splice plates, must be prepared as specified in Section 6-07.3(9)F, followed by a field primer coat of an organic zinc paint selected from the same approved paint system and paint manufacturer as the other paint for the Structure. The intermediate and top coats must be applied per the manufacturer's written recommendations.

The minimum drying time between coats must be as described in the approved product data sheets, but not less than 12 hours. Determine whether the paint has cured sufficiently for proper application of succeeding coats.

The maximum time between intermediate and top coats must be as per the manufacturer's written recommendations. If the maximum time between coats is exceeded, prepare all newly coated surfaces per SSPC-SP 7, brush-off blast cleaning, and repaint with the same paint that was cleaned, at no additional cost to the Owner.

Dry film thickness measurements will be made as specified in Section 6-07.3(9)D.

All paint damage that occurs must be repaired per the manufacturer's written recommendations and as accepted by the Engineer. On bare areas or areas of insufficient primer thickness, the repair must include the application of the field-applied organic zinc primer system, and the final 2 coats of the paint system. On areas where the primer is at least equal to the minimum required dry film thickness, the repair must include the application of the final 2 coats of the paint system. All paint repair operations must be performed by the Contractor at no additional cost or time to the Owner

6-07.3(10) PAINTING EXISTING STEEL STRUCTURES

Painting existing steel structures includes providing containment, cleaning, preparing the surface, painting metal surfaces, and disposal of generated waste. Painting of existing steel structures must be done in the following sequence:

1. Containment.
2. Bird guano, fungus, and vegetation removal.
3. Dry cleaning.
4. Surface preparation.
5. Treatment of pack rust and gaps.
6. Paint system application.

6-07.3(10)A CONTAINMENT

The containment system must be as per SSPC Technology Guide 6, Guide for Containing Surface Preparation Debris Generated During Paint Removal Operations Class 2. Protect the surrounding environment from all debris or damage resulting from the Contractor's operations.

The containment length must not exceed the length of a span (defined as pier to pier). The containment system must not cause any damage to the existing structure. All clamps and other attachment devices must be padded or designed such that they do not mark or otherwise damage the steel member to which they are attached. All clamps and other attachment devices must be fully described in the Contractor's painting plan submittal as accepted by the Engineer. Field-welding of attachments to the existing structure is not allowed. Do not drill holes into the existing structure or through existing structural members except as described in the Contractor's painting plan submittal as accepted by the Engineer. All provisions for dust collection, ventilation, and auxiliary lighting within the containment system must be fully described in the Contractor's painting plan submittal as accepted by the Engineer.

The containment system must be quickly removable in case of high winds. The Engineer will make the final determination on whether operations must stop.

Emissions must be limited to the Level 2 Emissions standard in SSPC Technology Guide 6, Section 5.5, and assessed by Method A, Visible Emissions. If failure to the containment system occurs or if signs of failure to the containment system are present, the Contractor must stop work immediately. Work must not resume until the failure has been corrected to the satisfaction of the Engineer.

Do not remove the containment system until all cleaned and painted surfaces have been inspected and approved by the Engineer.

Before starting work each day, the Contractor must inspect all containment systems to verify they are in place and functioning properly. Any necessary maintenance to restore full function must be completed before starting work.

6-07.3(10)B BIRD GUANO, FUNGUS, AND VEGETATION REMOVAL

Bird guano and bird nesting materials must be removed in the dry. Following dry removal, apply a treatment solution as specified in Section 9-08.5(1), followed by hand-scrubbing and rinsing with water as specified in Section 9-08.5(3). The bird guano, bird nesting materials, and treatment solution must be contained and collected.

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Treat all areas of fungus growth and vegetative growth. Apply a treatment solution as specified in Section 9-08.5(2) to the fungus areas for a period recommended by the solution manufacturer or as specified by the Engineer, but in no case less than 5 minutes. The fungus, vegetative growth, and treatment solution must be contained and collected.

Bird guano, bird nesting materials, fungus, and vegetative growth must be disposed of at a land disposal site approved by the Engineer. Provide the Engineer with 1 copy of the disposal receipt, including a description of the disposed material.

6-07.3(10)C DRY CLEANING

Dry cleaning must include removal of accumulated dirt and debris on the surfaces to be painted. Collected dirt and debris must be disposed of at a land disposal site approved by the Engineer. The Contractor must provide the Engineer with 1 copy of the disposal receipt, must including a description of the disposed material.

6-07.3(10)D SURFACE PREPARATION BEFORE OVERCOAT PAINTING

The Contractor must remove any visible oil, grease, and road tar per SSPC SP 1.

Following any preparation by SSPC-SP1, all steel surfaces to be painted must be prepared per either SSPC-SP 12 WJ-4/LP WC water jetting surface cleaning or SSPC-SP 7, brush-off blast cleaning. Surfaces inaccessible to water jetting or brush-off blast must be prepared per SSPC-SP 15, commercial grade power tool cleaning, as allowed by the Engineer.

Following water jetting or brush-off blast cleaning, the Contractor must perform spot abrasive blast cleaning per SSPC-SP 6, commercial blast cleaning. Spot abrasive blast cleaning must be performed in such a manner that the adjacent areas of work are protected from damage. Areas exhibiting coating failure down to the steel substrate, and those exhibiting visible corrosion, must be prepared down to clean bare steel per SSPC-SP 6. Exposed steel areas that have an average exposed diameter of less than 1-1/2 inches and no other similar area closer than 4 inches do not require spot abrasive blast cleaning or edge feathering unless required by the Engineer. Provide a sharp angular surface profile by an abrasive blasting procedure as accepted by the Engineer. The profile must be 1 mil minimum or per the paint manufacturer's recommendations, whichever is greater. For small areas, as allowed by the Engineer, the Contractor may substitute cleaning per SSPC-SP 11, power tool cleaning. The prepared area must extend at least 2 inches into adjacent tightly adhering, intact coating.

Following spot abrasive blast cleaning of exposed steel surfaces, edges of tightly adherent coating remaining must be feathered so that the recoated surface has a smooth appearance. Water jetting must be performed with water conforming to Section 9-08.5(3). Immediately before painting, the Contractor must clean all steel surfaces and staging areas with dry, oil free compressed air per ASTM D 4285.

6-07.3(10)E SURFACE PREPARATION – FULL PAINT REMOVAL

For structures where full removal of existing paint is specified, all steel surfaces to be painted must be prepared per SSPC-SP 10, near-white metal blast cleaning. Surfaces inaccessible to near-white metal blast cleaning must be prepared per SSPC-SP 11, power tool cleaning to bare metal, as allowed by the Engineer.

6-07.3(10)F COLLECTING, TESTING, AND DISPOSAL OF CONTAINMENT WASTE

The sealed waste containers must be labeled as required by state and federal laws. All confined materials must be collected and secured in sealed containers at the end of each shift or daily at a minimum to prevent the weight of the confined materials from causing failure to the containment system. The sealed waste containers must be stored as specified in Section 1-06.4, the painting plan as accepted by the Engineer, and the following requirements:

1. Containers must be stored on an impermeable surface that accommodates sweeping or vacuuming.
2. Landside storage of the containers must be at an elevation above the ordinary high water level (OHWL) elevation. The container storage area must not be in a stormwater runoff course or an area of standing water.
3. The container storage area must be a fenced, secured site, separate from the storage facilities for paint materials and paint equipment.
4. The containers must not be stored at the on-site landside storage site for longer than 90 Calendar Days.

All material collected by and removed from the containment system must be taken to a landside staging area, provided by the Contractor and approved by the Engineer, for further processing and storage before transporting for disposal. Handling and storage of material collected by and removed from the containment system must conform to Section 1-06.4. Storage of containment waste materials must be in a facility separate from the storage facilities used for paint materials and paint equipment.

Containment waste is defined as all paint chips and debris removed from the steel surface and all abrasive blast media, as contained by the containment system. After all waste from the containment system has been collected, the Contractor must have a minimum of 3 samples of the wastes tested by an accredited analytical laboratory. Each sample must be taken from a different storage container unless directed otherwise by the Engineer.

The debris must be tested for metals using the Toxicity Characteristics Leaching Procedure (TCLP) and EPA Methods 1311 and 6010. At a minimum, the materials to be analyzed must include Arsenic, Barium, Cadmium, Chromium Coppers, Lead, Mercury, Selenium, and Silver.

If the average of the tested samples is at or above all threshold limits as stated in the Dangerous Waste Regulation, WAC 173-303, the containment waste will be designated as Dangerous Waste and must be disposed of at a permitted hazardous waste repository. If the average of the tested samples is below the threshold limits, the containment waste will be

designated as Solid Waste and must be disposed of at a permitted sanitary landfill that will accept the waste. Disposal must be per WAC 173-303 for waste designated Dangerous Waste or Extremely Hazardous Waste and per WAC 173-304 for waste designated as Solid Waste.

The Contractor must supply 2 copies of the transmittal documents or bill of lading listing the waste material shipped from the Job Site to the waste disposal site. 1 copy of the shipment list must show the signature of the Engineer and must have the waste site operator's confirmation for receipt of the waste.

If the containment wastes are designated as Dangerous Wastes or Extremely Hazardous Waste under WAC 173-303, Owner will provide to the Contractor the appropriate EPA identification number.

Unless noted otherwise, the Owner will not provide a waste site for the disposal of excess materials and debris.

Submit 1 copy of all TCLP results to the Engineer.

Submit waste disposal documentation to the Engineer within 15 Working Days of each disposal. This documentation must include the quantity and type of waste disposed of with each disposal shipment.

6-07.3(10)G TREATMENT OF PACK RUST AND GAPS

Pack rust is defined as the condition where 2 or more pieces of steel fastened together by rivets or bolts have been pressed apart by crevice corrosion caused by the buildup of corrosion products at the interface of the steel pieces.

Pack rust forming a gap between steel surfaces of 1/16 inch or greater must be cleaned to a depth of 1/2 of the gap width, up to a maximum of 1/4 inch. The cleaned gap must be treated with rust penetrating sealer and caulked to form a water tight seal along the top edge and the 2 sides of the steel pieces involved, using the rust penetrating sealer and caulk as approved by the Engineer. Do not caulk the bottom edge or lowest edge of the steel pieces involved.

The type of rust penetrating sealer and caulk used must be compatible with the paint system used and must be applied per the rust penetrating sealer and caulk manufacturer's instructions.

When caulking joints where only one steel piece edge is exposed, a fillet of caulk must be formed that is not less than 1/8 inch or the width of the pack rust gap. The fillet is not required where there is no separation of the steel pieces due to pack rust.

At locations where gaps between steel surfaces exceed 1/4 inch, the Contractor must fill the gap with foam backer rod material and sealant as approved by the Engineer. The foam backer rod material must be of sufficient diameter to fill the crevice or gap. Apply sealant over the foam backer rod material to form a water tight seal.

6-07.3(10)H PAINT SYSTEM

The 5-coat paint system applied to existing steel surfaces includes:

Coating	Section
Primer Coat	Section 9-08.1(2)F
Primer Stripe Coat	Section 9-08.1(2)F
Intermediate Coat	Section 9-08.1(2)G
Intermediate Stripe Coat	Section 9-08.1(2)G
Top Coat	Section 9-08.1(2)H

All paint coating components of the selected paint system must be produced by the same manufacturer. Do not change to a different paint system once the initial paint system has been applied to any portion of the bridge unless otherwise approved in writing by the Engineer.

6-07.3(10)I PAINT COLOR

Each of the 5 coats must be a contrasting color to the previously applied full coat. The color of the top coat must be as shown on the Drawings or Special Provisions and must be as specified in Section 9-08.1(8). Tinting must occur at the factory during manufacture and placement in containers, before initial shipment. Application Job Site tinting is not allowed except as otherwise approved by the Engineer.

6-07.3(10)J MIXING AND THINNING PAINT

The Contractor must thoroughly mix paint by mechanical means to ensure a uniform composition. Do not mix paint by air stream bubbling or boxing. Paint must be mixed in the original containers and mixing must continue until all pigment or metallic powder is in suspension. Take care to ensure that the solid material that has settled to the bottom of the container is thoroughly dispersed. After mixing, inspect the paint for uniformity and to ensure that no unmixed pigment or lumps are present.

Catalysts, curing agents, hardeners, initiators, or dry metallic powders that are packaged separately may be added to the base paint per the paint manufacturer's written recommendations and only after the paint is thoroughly mixed to achieve a uniform mixture with all particles wetted. Add the proper volume of curing agent to the correct volume of base and mix

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thoroughly. Use the mixture within the pot life specified by the manufacturer. Unused portions must be discarded at the end of each work day.

Do not add additional thinner at the application site except as approved by the Engineer. The quantity and type of thinner, if allowed, must be per the manufacturer's Specifications.

When recommended by the manufacturer, constantly agitate paint during application by use of paint pots equipped with mechanical agitators.

Strain all paint after mixing to remove undesirable matter, but without removing the pigment or metallic powder.

Paint must be stored and mixed in a secure, contained location to eliminate the potential for spills into State waters and onto the ground and highway surfaces.

6-07.3(10)K COATING THICKNESS

The minimum dry film thickness of each coat (primer, intermediate, top, and all stripe coats) must not be less than 3.0 mils. The dry film thickness must not be thicker than the paint manufacturer's recommended maximum thickness.

The minimum wet film thickness of each coat must be specified by the paint manufacturer to achieve the minimum dry film thickness.

Film thickness, wet and dry, will be measured by gages conforming to Section 6-07.3(8)A.

Wet measurements will be taken immediately after the paint is applied per ASTM D 4414. Dry measurements will be taken after the coating is dry and hard per SSPC Paint Application Section 2.

Each painter must be equipped with wet film thickness gages and is responsible for performing frequent checks of the paint film thickness throughout application.

Coating thickness measurements may be made by the Engineer after the application of each coat and before the application of the succeeding coat. In addition, the Engineer may inspect for uniform and complete coverage and appearance. 100 percent of all thickness measurements must comply with or exceed the minimum wet film thickness. In areas where wet film thickness measurements are impractical, dry film thickness measurements may be made. If a question arises about an individual coat's thickness or coverage, it may be verified by the use of a Tooke gage per ASTM D 4138.

If the specified number of coats does not produce a combined dry film thickness of at least the sum of the thicknesses required per coat, if an individual coat does not comply with the minimum thickness, or if visual inspection shows incomplete coverage, the coating system will be rejected and the Contractor must discontinue painting and surface preparation operations and must submit a proposal for repair to the Engineer. The repair proposal must include documentation demonstrating the cause of the less-than-minimum thickness, along with physical test results, as necessary, and modifications to Work methods to prevent similar results. Do not resume painting or surface preparation operations until receiving the Engineer's approval of the completed repair.

6-07.3(10)L ENVIRONMENTAL CONDITION REQUIREMENTS BEFORE APPLICATION OF PAINT

Paint must be applied only during periods when:

1. Air temperature and paint temperature are between 35 °F and 115 °F.
2. Steel surface temperature is between 35 °F and 115 °F.
3. Steel surface does not show wet drops and is not wet.
4. Relative humidity is within the manufacturer's recommended range.
5. The anticipated ambient temperature will remain above 35 °F during the paint drying period.

Application is not allowed if conditions are not favorable for proper application and performance of the paint.

Do not apply paint when weather conditions are unfavorable to proper curing. If a paint system manufacturer's recommendations allow for application of a paint under environmental conditions except those specified, submit a letter from the paint manufacturer specifying the environmental conditions under which the paint can be applied. Application of paint under environmental conditions except those specified in this Section is not allowed without the Engineer's approval.

6-07.3(10)M STEEL SURFACE CONDITION REQUIREMENTS BEFORE APPLICATION OF PAINT

The steel surface to be painted must be free of moisture, dirt, dust, grease, oil, loose, peeling or, chalky paint, abrupt paint edges, salts, rust, mill scale, and other foreign matter and substances that would prevent the bond of the succeeding application. Protect freshly painted surfaces from contamination by abrasives, dust, or foreign materials from any other source. Prepare contaminated surfaces to the satisfaction of the Engineer before applying additional paint.

Prepared surfaces must be kept clean at all times, before painting and between coats.

Edges of existing paint must be feathered per SSPC-PA 1, Note 16.9.

6-07.3(10)N FIELD COATING APPLICATION METHODS

The Contractor must apply paint materials per the manufacturer's recommendations by air or airless spray, brush, roller, or any combination of these methods unless otherwise specified. Spray application of the paint must be accomplished with spray nozzles and at pressures as recommended by the paint manufacturer to ensure application of paint at the specified film thickness. Use brushes to apply the stripe coat, to ensure complete coverage around structural geometric irregularities, and to

push the paint into gaps between existing steel surfaces and around rivets and bolts. All application techniques must be per Section 7, SSPC-PA 1. Painters using brushes must work from pails containing a maximum of 2 gallons of paint, to minimize the impact of any spill.

6-07.3(10)O APPLYING FIELD COATINGS

The first coat must be a primer coat applied to steel surfaces cleaned to bare metal. The second coat must be a primer stripe coat applied to all steel surfaces cleaned to bare metal and defined to receive a stripe coat. The third coat must be an intermediate coat. The fourth coat must be an intermediate stripe coat applied to steel surfaces defined to receive a stripe coat. The fifth coat must be the top coat. The intermediate (third) and top (fifth) coats must encapsulate the entire surface area of the structure members specified to be painted.

Before the application of paint, the Contractor must clean the bridge deck surface for the purpose of dust control.

During painting operations, the Contractor must furnish, install, and maintain drip tarps below the areas to be painted to contain all spilled paint, buckets, brushes, and other deleterious material, and prevent such materials from reaching the environment below or adjacent to the structure being painted. Drip tarps must be absorbent material and hung to minimize puddling.

In addition to the requirements of the Specifications, paint application must conform to:

1. The best practices of the trade.
2. The written recommendations of the paint manufacturer.
3. All applicable portions of the SSPC-PA 1.

Do not apply primer paint to any surface until the surface has been inspected and approved by the Engineer. Any area to which primer paint has been applied without the Engineer's inspection and approval will be considered improperly cleaned. The unauthorized application must be completely removed and the entire area recleaned to the satisfaction of the Engineer. After the area has been recleaned, inspected, and approved, the Contractor may again initiate the painting sequence. No additional payment or extension of time, as specified in Section 1-08.8, will be allowed for the removal of any unauthorized paint application and recleaning of the underlying surface.

All steel surfaces cleaned to bare metal by abrasive blast cleaning must receive the primer coat within the same work day as the cleaning to bare metal and before any rust forms. Each successive coat must be applied as soon as possible over the previous coat, accounting for drying time of the preceding coat, weather, atmospheric temperature and other environmental conditions, and the paint manufacturer's recommendations. Each coat must be dry before recoating and must be sufficiently cured so that succeeding or additional coats may be applied without causing damage to the previous coat. Recoat times must be per the paint manufacturer's recommendations, but not less than 12 hours. Revision of recoat times to except those recommended by the paint manufacturer require the approval of the Engineer. If the maximum time between coats is exceeded, all affected areas must be prepared to SSPC-SP 7, brush-off blast cleaning, and recoated with the Contract-specified system at no additional expense or time to the Owner.

Each coat must be applied in a uniform layer, completely covering the preceding coat. The Contractor must correct runs, sags, skips, or other deficiencies before application of succeeding coats. Such corrective work may require recleaning, application of additional paint, or other means as determined by the Engineer, at no additional cost to the Owner.

If fresh paint is damaged by the elements, replace or repair the paint to the satisfaction of the Engineer at no additional cost to the Owner.

After applying the primer or intermediate coats, apply a primer or intermediate stripe coat, respectively, on all edges, corners, seams, crevices, interior angles, junction of joint members, rivet or bolt heads, nuts and threads, weld lines, and any similar surface irregularities. The coverage of each stripe coat must extend at least 1 inch beyond the irregular surface. The stripe coat must be of sufficient thickness to completely hide the surface being covered and must be followed as soon as possible by the application of the subsequent coat to its specified thickness.

If the primer coat leaves unsealed cracks or crevices, these must be sealed with single-component urethane sealant conforming to Section 9-08.7 and applied per the manufacturer's recommendations before the intermediate coats are applied.

The Contractor must correct paint deficiencies before application of succeeding coats. Such corrective work may require recleaning, application of additional paint, or other corrective measures per the paint manufacturer's recommendations and as specified by the Engineer. Such corrective work must be completed at no additional expense or time to the Owner.

Each application of primer, primer stripe, intermediate, intermediate stripe, and top coat are considered as separately applied coats, including for the purposes of film thickness and coverage requirements. Do not use a preceding or subsequent coat to remedy a deficiency in another coat. Apply the top coat to at least the minimum specified top coat thickness, to provide a uniform appearance and consistent finish coverage, even if the total thickness of the prime and intermediate coats is found to exceed the specified total thickness for the primer and intermediate coats.

If roadway or sidewalk planks lie so close to the metal that they prevent proper cleaning and painting, remove or cut the planks to provide at least a 1-inch clearance. Any plank removal or cutting must be approved by the Engineer. Replace all planks after painting. If removal breaks or damages the planks and makes them unfit for reuse, the Contractor must replace them at no expense to the Owner

6-07.3(10)P FIELD COATING REPAIR

Paint repair must be per SSPC-PA 1. Repair areas must be cleaned of all damaged paint and the system reapplied using all coats typical to the paint system. Each coat must be thoroughly dry before applying subsequent coats. Paint repair must be per the paint manufacturer's recommendations and as approved by the Engineer. All paint repair operations must be performed by the Contractor at no additional cost or time to the Owner.

6-07.3(10)Q CLEANUP

Cleaning of equipment must not pollute the environment per Section 1-07.5. Solvents, paints, paint sludge, cans, buckets, rags, brushes, and other waste associated with this project must be collected and disposed of off-site.

Cleanup of the Project Site must conform to Sections 1-04.10 and 6-01.10.

6-07.3(11) PAINTING OR POWDER COATING OF GALVANIZED SURFACES

Galvanized surfaces specified to be coated after galvanizing must receive either paint as specified in Section 6-07.3(11)A or powder coating as specified in Section 6-07.3(11)B. The color of the finish coat must be as specified in the Special Provisions.

6-07.3(11)A PAINTING OF GALVANIZED SURFACES

All galvanized surfaces receiving paint must be prepared for painting per the ASTM D 6386. The method of preparation must be as agreed on by the paint manufacturer and the galvanizer. Do not start painting until receiving the Engineer's approval of the prepared galvanized surface.

6-07.3(11)A1 ENVIRONMENTAL CONDITIONS

Steel surfaces must be greater than 35 ºF and less than 115 ºF, or per the manufacturer's recommendations, whichever is more stringent.

6-07.3(11)A2 PAINT COAT MATERIALS

Paint the dry surface as follows:

Coating	Paint Type	Name
First Coat	Section 9-08.1(2)E	Epoxy polyamide
Second Coat	Section 9-08.1(2)H	Moisture-cured aliphatic polyurethane

Select all coats from the approved products listed in the current Qualified Products List. The coating material for the first and second coats must be from the same manufacturer.

Each coat must be dry before the next coat is applied. All coats applied in the shop must be dried hard before shipment.

6-07.3(11)B POWDER COATING OF GALVANIZED SURFACES

Powder coating of galvanized surfaces includes:

Coating	Paint Type	Name
First Coat	Section 9-08.2	Epoxy powder primer coat
Second Coat	Section 9-08.2	Polyester finish coat

6-07.3(11)B1 SUBMITTALS

Submit the following information to the Engineer for approval:

1. The name, location, and contact information (mail address, phone, and email) for the firm performing the powder coating operation.
2. Quality control (QC) programs established and followed by the firm performing the powder coating operation. Forms to record inspection and testing of coatings as part of the QC program must be included in the submittal.
3. Project-specific powder coating plan, including identification of the powder coating materials used (and manufacturer), and specific cleaning, surface preparation, preheating, powder coating application, curing, shop and field coating repair, handling, and storage processes to be taken for the assemblies being coated for this project.
4. Product data and MSDS sheets for all powder coating and coating repair materials.

6-07.3(11)B2 GALVANIZING

Before the galvanizing operation, identify to the galvanizer the specific assemblies and surfaces receiving the powder coating after galvanizing, to ensure that the galvanizing method used on these assemblies is compatible with subsequent

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application of a powder coating system. Specifically, such assemblies must neither be water-quenched nor receive a chromate conversion coating as part of the galvanizing operation.

6-07.3(11)B3 GALVANIZED SURFACE CLEANING AND PREPARATION

Galvanized surfaces receiving the powder coating must be cleaned and prepared for coating per ASTM D 6386, and the project-specific powder coating plan as accepted by the Engineer.

Assemblies conforming to the ASTM D 6386 definition for newly galvanized steel must receive surface smoothing and surface cleaning per ASTM D 6386, Section 5, and surface preparation per ASTM D 6386, Section 5.4.1.

Assemblies conforming to the ASTM D 6386 definition for partially weathered galvanized steel must be checked and prepared per ASTM D 6386, Section 6, before then receiving surface smoothing and surface cleaning per ASTM D 6386, Section 5, and surface preparation per ASTM D 6386, Section 5.4.1.

Assemblies conforming to the ASTM D 6386 definition for weathered galvanized steel must be prepared per ASTM D 6386, Section 7 before then receiving surface smoothing and surface cleaning per ASTM D 6386, Section 5, and surface preparation per ASTM D 6386, Section 5.4.1 except as follows:

1. Ferrous metal abrasives are prohibited as a blast media for surface preparation.
2. Surface preparation must be accomplished using dry abrasive blasting through a blast nozzle with compressed air. Abrasive blasting with a centrifugal wheel is prohibited.

The Contractor must notify the Engineer of all surface cleaning and preparation activities and must provide the Engineer opportunity to perform quality assurance inspection, as specified in Section 1-05.6, at the completion of surface cleaning and preparation activities before starting powder coating application.

6-07.3(11)B4 POWDER COATING APPLICATION AND CURING

After surface preparation, the 2-component powder coating must be applied per the powder coating manufacturer's recommendations, the project-specific powder coating plan as accepted by the Engineer, and as follows:

1. Preheat must be sufficient to prevent pinholes from forming in the finished coating system.
2. Apply the epoxy primer coat, followed by a partial cure.
3. Apply the polyester finish coat, followed by the finish cure.

6-07.3(11)B5 TESTING

The firm performing the powder coating operation must conduct, or make arrangements for, QC testing on all assemblies receiving powder coating for this project, per the powder coating firm's QC program as documented in item 2 of the Submittal Section above. Testing may be performed on coated surfaces of production manufactured items, or on a representative test panel coated alongside the production manufactured items being coated. There must be a minimum of 1 set of tests representing each cycle of production manufactured items coated and cured. Perform additional tests must at the Engineer's request. Repair of damaged coatings on production manufactured items is the responsibility of the firm applying the powder coating, and must be per the project-specific powder coating plan as accepted by the Engineer. At a minimum, the QC testing must test for:

1. Visual inspection for the presence of coating holidays and other unacceptable surface imperfections.
2. Coating thickness measurement as specified in Section 6-07.3(10)K. The minimum thickness of the epoxy primer coating and polyester finish coating must be 3 mils each.
3. Hardness testing per ASTM D 3363, with the finish coat providing a minimum hardness value of H.
4. Adhesion testing per ASTM D 4541 for 400 psi minimum adhesion for the complete 2-component coating system.
5. Powder Coating Institute (PCI) #8 recommended procedure for solvent cure test.

The results of the QC testing must be documented in a QC report and submitted to the Engineer for approval.

The Engineer must be provided notice and access to all assemblies at the powder coating facility for the purposes of Owner's acceptance inspection, including notice and access to witness all hardness and adhesion testing performed by the firm conducting the QC testing, as specified in Section 1-05.6.

Assemblies not meeting the above requirements will be subject to rejection by the Engineer. Rejected assemblies must be repaired or recoated by the Contractor, at no additional expense to the Owner per the project-specific powder coating plan as accepted by the Engineer, until the assemblies satisfy the acceptance testing requirements.

Do not ship assemblies must from the powder coating firm's facility to the Project Site until receiving the Engineer's approval of the QC Report and assembly inspection performed by the Engineer.

6-07.3(11)B6 COATING PROTECTION FOR SHIPPING, STORAGE, AND FIELD ERECTION

After curing and acceptance, the Contractor must protect the coated assemblies with multiple layers of bubble wrap or other protective wrapping materials specified in the project-specific powder coating plan as accepted by the Engineer.

During storage and shipping, each assembly must be separated from other assemblies by expanded polystyrene spacers and other spacing materials specified in the project-specific powder coating plan as accepted by the Engineer.

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After erection, all coating damage due to the Contractor's shipping, storage, handling, and erection operations must be repaired, at no additional expense to the Owner, per the project-specific powder coating plan as accepted by the Engineer. Provide the Engineer access to all locations of all powder-coated members for verification of coating conditions before and following all coating repairs.

6-07.3(12) PAINTING TIMBER STRUCTURES

6-07.3(12)A NUMBER OF COATS AND COLOR

Unless the Contract specifies otherwise:

1. Rails and rail posts on timber bridges must receive 2 coats (with the wheel guard painted only on its top edge and roadway side).
2. Other timber work must receive 3 coats if the Contract requires other timber work to be painted.

Paint color must be as specified in the Contract.

6-07.3(12)B APPLICATION

All wood surfaces to be painted must be prepared per the paint manufacturer's recommendations and be thoroughly dry and free from oil and dirt. Paint must be applied by brush, spread evenly, and worked thoroughly into all seasoning cracks, corners, and recesses. Do not apply a later coat until the full thickness of the previous coat has dried.

Final brush strokes with aluminum paint must be made in the same direction to ensure that powder particles leaf evenly.

If a painted surface has been stained by creosote, it must be given 1 or more coats of an approved shellac before repainting.

6-07.3(12)C PAINTING TREATED TIMBER

Do not paint timber treated with creosote or oil borne pentachlorophenol preservatives unless otherwise specified.

Timber treated with water borne preservatives must be clean and be reduced to no more than 18 percent moisture content before it is painted. Any visible salt crystals on the wood surface must be washed and brushed away with the moisture content reduced again to the specified level before painting. Stored timber awaiting painting must be covered and stacked with spreaders to ensure air circulation.

6-07.4 MEASUREMENT

Spot abrasive blast cleaning of steel surfaces as specified in Section 6-07.3(10)D will be measured by the square foot of surface area to be cleaned to bare metal as specified by the Engineer.

No specific unit of measurement will apply to the lump sum items of "Cleaning and Painting - _____" and "Containment of Abrasives".

6-07.5 PAYMENT

1. **"Cleaning and Painting - _____"**, lump sum.

The lump sum Contract price for "Cleaning and Painting - _____" will be full pay for the Work as specified, including developing all submittals, arranging for and accommodating contact and on-site attendance by the paint manufacturer's technical representative, furnishing and placing all necessary staging and rigging, furnishing, operating and mooring barges, furnishing and operating fixed and movable work platforms, accommodating Owner inspection access, conducting the Contractor's quality control inspection program, providing material, labor, tools, and equipment, furnishing containers for containment waste, collecting and storing containment waste, collecting, storing, testing, and disposing of all containment waste not conforming to the definition in Section 6-07.3(10)F, performing all cleaning and preparation of surfaces to be painted, applying all coats of paint and sealant, correcting coating deficiencies, completing coating repairs, and completing Project Site cleanup.

Progress payments for "Cleaning and Painting - _____" will be made on a monthly basis and will be based on the percentage of the total estimated area satisfactorily cleaned and coated as determined by the Engineer. Payment will not be made for areas that are otherwise complete but have repairs outstanding.

2. **"Spot Abrasive Blast Cleaning"**, per square foot.

The unit Contract Price per square foot for "Spot Abrasive Blast Cleaning" will be full pay for performing the spot abrasive blast cleaning work as specified in Section 6-07.3(10)D.

3. **"Containment of Abrasives"**, lump sum.

The lump sum Contract Price for "Containment of Abrasives" will be full payment for all costs incurred by the Contractor in complying with the requirements as specified in Section 6-07.3(10)A to design, construct, maintain, and remove containment systems for abrasive blasting operations.

All costs in connection with testing containment waste, transporting containment waste for disposal, and disposing of containment waste as specified in Section 6-07.3(10)F will be per the Special Provisions.

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No separate payment for painting new steel or timber structures will be made. All costs related to painting new steel structures and painting or powder coating of galvanized surfaces are included in payment items in Section 6-03.5. Payment for painting of timber structures will be as specified in Section 6-04.5.

SECTION 6-08 WATERPROOFING

6-08.1 DESCRIPTION

Section 6-08 describes applying waterproofing Materials to Portland cement concrete surfaces as required by the Contract.

6-08.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Material	Section
Asphalt for Waterproofing	Section 9-11.1
Waterproofing Fabric	Section 9-11.2
Portland Cement Mortar	Section 9-11.3
Mortar	Section 9-20.4
Waterproofing Admixture	Section 9-23.5

6-08.3 CONSTRUCTION REQUIREMENTS

6-08.3(1) STORAGE OF FABRIC

The fabric must be stored in a dry, protected place. Do not store rolls standing on end.

6-08.3(2) PREPARATION OF SURFACE

Preparation of surfaces must be per the manufacturer's recommendations. Concrete surfaces must be reasonably smooth and without projections or holes that might puncture the waterproofing membrane. The surfaces must be dry, with all dust and loose material removed. Do not apply waterproofing in wet weather or when the air temperature is below 35 °F unless the Engineer approves in writing.

6-08.3(3) APPLICATION OF WATERPROOFING

Unless the manufacturer's instructions state otherwise, waterproofing asphalt must be stirred frequently as it is heated to between 300 °F and 350 °F. Each heating kettle must have a thermometer.

Each coat of primer or asphalt must start at the low point of the surface so water runs over (not against or along) the laps.

In applying the waterproofing, the Contractor must:

1. Apply a coat of primer and let it dry before applying the first asphalt coat;
2. Mop hot asphalt on a band about 20 inches wide across the full length of the surface;
3. Immediately roll a starter strip of half width fabric into the asphalt, pressing it into place to rid it of all air bubbles and to conform it closely to the surface;
4. Mop hot asphalt over the starter strip and an adjacent section of surface so the fresh asphalt forms a band slightly wider than the full width of the fabric;
5. Immediately roll a full width strip of fabric into the fresh asphalt, pressing it into place as before;
6. Mop hot asphalt on the latest strip and on an adjacent band of the surface slightly wider that the full width of the fabric;
7. Immediately roll another strip of fabric into the asphalt, lapping the earlier strip by at least 2 inches and pressing it into place as before;
8. Repeat steps 6 and 7 until the entire surface is covered; and
9. Mop the entire surface with a final coating of hot asphalt.

The 3 complete moppings of asphalt must ensure that no fabric layer ever touches another fabric layer or the concrete surface. Examine all laps and ensure they are thoroughly sealed down.

Each mopping must cover completely, with a coat heavy enough to hide the fabric weave and all gray spots from the concrete. On horizontal surfaces, use at least 12 gallons of asphalt for every 100 square feet of finished work. On vertical surfaces, use at least 15 gallons per 100 square feet.

At the end of each day’s work, all fabric laid must have received its final mopping of asphalt.

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Wherever the membrane ends or is punctured by drains, pipes, or similar, seal the area to prevent water from entering between the waterproofing and the concrete surface.

All flashing, such as at curbs, against girders, and spandrel walls, must be made of separate sheets that lap the main membrane by at least 12 inches. Flashing must be sealed closely:

a. With full metal flashing; or

b. By imbedding its upper edges in a groove poured full of an acceptable joint cement.

At each expansion joint, the membrane must not be broken but must be folded to allow movement. At either end of the bridge, the membrane must run well down abutments and must allow for expansion and contraction.

6-08.3(4) PROTECTION COURSE

If the Drawings require, place a layer of mortar at least 1-1/2 inches thick over the whole surface of the membrane just after it has cooled to air temperature. This layer must be a mix of 1 part Portland cement to 2 parts sand. It must be distributed evenly over the membrane, tamped gently into place, finished by hand to a smooth, hard surface, then covered and kept moist for 1 week.

6-08.4 MEASUREMENT

Measurement for "Waterproofing" will be the number of square yards of the actual surface of the waterproofed area and will not include required overlap.

6-08.5 PAYMENT

1. **"Waterproofing"**, per square yard.

The Bid Item price for "Waterproofing" must include all costs for the work required to furnish and construct the waterproofing.

2. **Other payment information**

Waterproofing of construction joints not shown on the Drawings must be included in the Bid Item price for "Waterproofing".

SECTION 6-09 MODIFIED CONCRETE OVERLAYS

6-09.1 DESCRIPTION

Section 6-09 describes scarifying concrete bridge decks, preparing and repairing bridge deck surfaces designated and marked for further deck preparation, and placing, finishing, and curing modified concrete overlays.

6-09.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Material	Section
Portland Cement	Section 9-01.2(1)
Fine Aggregate	Section 9-03.1(2)
Coarse Aggregate	Section 9-03.1(3)
Mortar	Section 9-20.4
Burlap Cloth	Section 9-23.3
Admixtures	Section 9-23.4
Fly Ash	Section 9-23.6
Microsilica Fume	Section 9-23.8
Water	Section 9-25.1

Portland cement must be either Type I or Type II. Type III Portland cement is not allowed.

Fine aggregate must be Class 1. Coarse aggregate must be AASHTO grading No. 7 or No. 8.

Fly ash must be Class F only.

Microsilica admixture must be either a dry powder or a slurry admixture. Microsilica will be accepted based on submittal to the Engineer of a manufacturer's certificate of compliance conforming to Section 1-06.3. If the microsilica is a slurry admixture, the microsilica content of the slurry must be certified as a percent by mass.

Latex admixture must be a non-toxic, film-forming, polymeric emulsion in water to which all stabilizers have been added at the point of manufacture. The latex admixture must be homogeneous and uniform in composition, and must conform to the following:

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Polymer Type: Styrene Butadiene

Stabilizers: see table.

Stabilizer Requirements	
Latex	Non-ionic surfactants
Portland Cement	Polydimethyl siloxane
Percent Solids	46.0-49.0
Weight per Gallon	8.4 pounds at 77 ºF
Color	White
PH (as shipped)	9 minimum
Freeze/Thaw Stability	5 cycles (5 ºF to 77 ºF)
Shelf Life	2 years minimum
Latex	Non-ionic surfactants

Latex admixture will be accepted based on submittal to the Engineer of a manufacturer's certificate of compliance as specified in Section 1-06.3.

High Molecular Weight Methacrylate (HMWM) resin for crack and joint sealing must conform to the following:

HMWM Resin Requirements	
Viscosity	<25 cps (Brookfield RVT with UL adaptor, 50 rpm at 77 °F) … California Test 434
Density	8.5-8.8 pounds per gallon at 77 °F… ASTM D 2849
Flash Point	>200 °F, PMCC (Pinsky-Martens CC)
Vapor Pressure	<0.04 inches Hg at 77 °F, ASTM D 323
Tg (DSC)	>136 °F, ASTM D 3418
Gel Time	60 minutes minimum

The promoter/initiator system for the methacrylate resin must consist of a metal drier and peroxide.

Sand for abrasive finish must be crushed sand, oven dried, and stored in moisture proof bags. The sand must conform to the following gradation:

Sieve Size	Percent Passing[1]	
	Minimum	Maximum
No. 10	98	100
No. 16	55	75
No. 20	30	50
No. 30	8	25
No. 50	0	5
No. 100	0	3

1. NOTE: All percentages are by weight.

6-09.3 CONSTRUCTION REQUIREMENTS

6-09.3(1) EQUIPMENT

6-09.3(1)A POWER DRIVEN HAND TOOLS

Power driven hand tools may be used for concrete scarification in areas not accessible to scarification machines, and for further deck preparation Work, except for the following:

1. Jack hammers more forceful than the nominal 30 pound class.
2. Chipping hammers more forceful than the nominal 15 pound class.

The power driven hand tools must be operated at angles less than 45 degrees as measured from the surface of the deck to the tool.

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6-09.3(1)B ROTARY MILLING MACHINES

Rotary milling machines must have a maximum operating weight of 50,000 pounds and conform to the requirements in Section 1-07.7.

6-09.3(1)C HYDRO-DEMOLITION MACHINES

Hydro-demolition machines must consist of filtering and pumping units operating in conjunction with a remote-controlled robotic device, using high-velocity water jets to remove 1/2 inch of sound concrete with the simultaneous removal of all deteriorated concrete. Hydro demolition machines must also clean any exposed reinforcing steel of all rust and corrosion products.

6-09.3(1)D SHOT BLASTING MACHINES

Shot blasting machines must consist of a self-contained mobile unit, using steel abrasive to remove 1/2 inch of sound concrete. The shot blasting machine must vacuum and store all material removed from the scarified concrete surface into a self-contained unit.

6-09.3(1)E AIR COMPRESSOR

Air compressors must be equipped with oil traps to eliminate oil from being blown onto the bridge deck during sandblasting and air cleaning.

6-09.3(1)F VACUUM MACHINE

Vacuum machines must be capable of collecting all dust, concrete chips, freestanding water and other debris encountered while cleaning during deck preparation. The machines must be equipped with collection systems that allow the machines to be operated in air pollution sensitive areas and must be equipped to not contaminate the deck during final preparation for concrete placement.

6-09.3(1)G WATER SPRAYING SYSTEM

The water spraying system must include a portable high-pressure sprayer with a separate water supply of potable water. The sprayer must be readily available to all parts of the deck being overlaid and must be able to discharge water in a fine mist to prevent accumulation of free water on the deck. Sufficient water must be available to thoroughly soak the deck being overlaid and to keep the deck wet before concrete placement.

The Contractor must certify that the water spraying system meets these requirements:

1. Pressure: 2,200 psi minimum
2. Flow Rate: 4.5 gpm minimum
3. Fan Tip: 15 degree to 25 degree range

6-09.3(1)H MOBILE MIXER FOR LATEX MODIFIED CONCRETE

Proportioning and mixing must be accomplished in self-contained, self-propelled, continuous-mixing units conforming to the following requirements:

1) The mixer must be equipped so that it can be grounded.
2) The mixer must be equipped to provide positive measurement of the Portland cement being introduced into the mix. Use an approved recording meter, visible at all times and equipped with a ticket printout.
3) The mixer must be equipped to provide positive control of the flow of water and latex admixture into the mixing chamber. Water flow must be indicated by an approved flow meter with a minimum readability of 1/2 gallon per minute, accurate to ± 1 percent. The water system must have a bypass valve capable of completely diverting the flow of water. Latex flow must also be indicated by an approved flow meter with a minimum readability of 2 gallons per minute, accurate to ± 1 percent. The latex system must be equipped with a bypass valve suitable for obtaining a calibrated sample of admixture.
4) The mixer must be equipped to be calibrated to automatically proportion and blend all components of the specified mix on a continuous or intermittent basis as required by the finishing operation, and must discharge mixed material through a conventional chute directly in front of the finishing machine.

The Contractor must inspect each mobile mixer in the presence of the Engineer per these requirements:

a. Check the manufacturer's inspection plate or mix setting chart for the serial number, the proper operating revolutions per minute (rpm), and the approximate number of counts on the cement meter to deliver 94 pounds of cement.
b. Make a general inspection of the mobile mixer to ensure cleanliness and good maintenance practices.
c. Check to see that the aggregate bins are empty and clean and that the bin vibrators work.
d. Verify that the cement aeration system operates, that the vent is open, and that the mixer is equipped with a grounding strap. Check the cement meter feeder to ensure that all fins and pockets are clean and free from accumulated cement. If the operator cannot demonstrate, through visual inspection, that the cement meter feeder is clean, all cement must be removed from the bin and the cement meter feeder inspected. The aeration system must be equipped with a gauge or indicator to verify that the system is operating.

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e. Verify that the main belt is clean and free of any accumulated material.
f. Check the latex strainer to ensure cleanliness.

The initial calibration includes:

1. Cement Meter
   a. Refer to the truck manufacturer's mix setting chart to determine the specified operating rpm and the approximate number of counts required on the cement meter to deliver 94 pounds of cement.
   b. Place at least 40 bags (about 4,000 pounds) of cement in the cement bin.
   c. Ensure the mixer is resting on a level surface.
   d. Ensure the mixer is grounded.
   e. Adjust the engine throttle to obtain the specified rpm. Operate the unit, discharging cement until the belt has made 1 complete revolution. Stop the belt. Reset the cement meter to zero. Position a suitable container to catch the cement and discharge approximately 1 bag of cement. With a stopwatch, measure the time required to discharge the cement. Record the number of counts on the cement meter and determine the weight of the cement in the container. Repeat the process of discharging approximately 1 bag of cement until 6 runs are made. Reset the cement meter to 0 for each run.

   Example:

Run No.	Cement Counts	Weight of Cement	Time in Seconds
1	66	95	31
2	68	96	31.2
3	67	95.5	31.0
4	66	95	29.8
5	67	95.25	30.5
6	66	95	30.8
TOTAL	400	571.75	184.3

   Pounds of cement per count on cement meter:
   Weight of Cement / Number of Counts = 571.75 / 400 = 1.43 LB / Count

   Counts per bag (94 pounds):
   94 / 1.43 = 65.7 Counts Bag

   Pounds of cement discharged per second:
   Weight of Cement / Time in Seconds = 571.75 / 184.3 = 3.10 LB / SEC.

   Required time to discharge 1 bag:
   Time = 94 / 3.10 = 30.32 SEC / Bag

2. Latex Throttling Valve
   a. Check to be sure that the latex strainer is unobstructed.
   b. The latex throttling valve must be adjusted to deliver 3.5 gallons of latex (29.4 pounds) for each bag of cement. From the above calculation 30.32 seconds are required to deliver 1 bag of cement.
   c. With the unit operating at the specified rpm, discharge latex into a container for 30.3 seconds and determine the weight of latex. Continue adjusting the valve until 29.4 to 29.5 pounds of latex is discharged in 30.3 seconds. Verify the accuracy of this valve setting 3 times.
3. Water Flow Meter
   a. Set the water flow meter by adjusting it to flow at 1/2 gallon per minute.
   b. Collect and weigh the water discharged during a 1 minute interval with the equipment operating at the specified rpm. Divide the weight of water by 8.34 to determine the number of gallons.
   c. Repeat items a. and b., above, with the flow meter adjusted to 1-1/2 gallons per minute.
4. Aggregate Bin Gates

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a. Set the gate openings to provide the quantity of aggregate required to produce concrete having the specified proportions.

b. Discharge a representative sample of the aggregates through the gates and separate on the No. 4 sieve. Aggregates must comply with the requirements for proportions as specified in Section 6-09.3(3)E.

c. Adjust the gate openings if necessary to provide the proper ratio of fine aggregate to total aggregate.

5. Production of Trial Mix: Operate each mobile mixer to produce at least 1/2 cubic yard of concrete, which must be in compliance with these Specifications, before acceptance of the mobile mixer for project use. The Engineer will perform yield, slump, and air tests on the concrete produced by each mixer. Calibration of each mobile mixer must be done by the Contractor in the presence of the Engineer. A complete calibration is required on each mixer on each concrete placement unless, after the initial calibration, the personnel having the responsibility of mixer calibration on subsequent concrete placement were present during the initial calibration of the mixer and during the concrete placement operations and are able to verify the dial settings of the initial calibration and concrete placement.

   If these criteria are met, a complete calibration need not be repeated provided that a single trial run verifies the previous settings of the cement meter, latex throttling valve, water flow meter, and aggregate gradations, and that the mixer has not left the project and the Engineer is satisfied that a complete calibration is not needed.

6-09.3(1)I READY-MIX TRUCKS FOR FLY ASH MODIFIED AND MICROSILICA MODIFIED CONCRETE

Ready-mix trucks must conform to Section 6-02.3(4)A.

6-09.3(1)J FINISHING MACHINE

The finishing machine must comply with the requirements of Section 6-02.3(10)C and the following requirements:

The finishing machine must be equipped with a rotating cylindrical double drum screed not exceeding 60 inches in length preceded by a vibrating pan. The vibrating pan must be constructed of metal and be of sufficient length and width to properly consolidate the mixture. The vibrating frequency of the vibrating pan must be variable with positive control between 3,000 and 6,000 rpm. A machine with a vibrating pan as an integral part may be proposed and will be considered for approval by the Engineer. Other finishing machines are allowed subject to approval of the Engineer.

6-09.3(2) SUBMITTALS

The Contractor must submit the following items to the Engineer for approval as specified in Section 6-01.8:

1. The type of machine (rotary milling, hydro-demolition, or shot blasting) selected by the Contractor for use in this project to scarify concrete surfaces.
2. The axle loads and axle spacing of the rotary milling machine, if used.
3. The Runoff Water Disposal Plan, if a hydro-demolition machine is used. The Runoff Water Disposal Plan must describe all provisions for the containment, collection, filtering, and disposal of all runoff water and associated contaminants and debris generated by the hydro-demolition process, including containment, collection and disposal of runoff water and debris escaping through breaks in the bridge deck.
4. The method and materials used to contain, collect, and dispose of all concrete debris generated by the scarifying process, including provisions for protecting adjacent traffic from flying debris.
5. The mix design for concrete Class M, and either fly ash modified concrete, microsilica modified concrete, or latex modified concrete, as selected by the Contractor for use in this project as specified in Section 6-09.3(3).
6. Samples of the latex admixture and the Portland cement for testing and compatibility, if latex modified concrete is used).
7. Paving equipment Specifications and details of the screed rail support system, including details of anchoring the rails and providing rail continuity.

Do not start scarifying operations until receiving the Engineer's approval of items 1 through 4 as applicable for the Contractor's scarifying method. Do not start placing modified concrete overlay until receiving the Engineer's approval of items 5 through 7 as applicable for the Contractor's selected type of modified concrete.

6-09.3(3) CONCRETE OVERLAY MIXES

6-09.3(3)A GENERAL

For fly ash, microsilica, and latex modified concrete, adjust the slump to accommodate the gradient of the bridge deck, subject to the maximum slump specified.

For fly ash and microsilica modified concrete, calculate the maximum water-cement ratio using all available mix water, including the free water in both the coarse and fine aggregate, and in the microsilica slurry if a slurry is used.

For fly ash and microsilica modified concrete, all water-reducing and air entraining admixtures and superplasticizers must be used per the admixture manufacturer's recommendations, and as approved by the Engineer.

6-09.3(3)B CONCRETE CLASS M

Concrete Class M for further deck preparation patching concrete must be proportioned using the following mix design:

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Concrete Class M Mix Proportions

Material	Proportion
Portland Cement	705 pounds
Fine Aggregate	1,280 pounds
Coarse Aggregate	1,650 pounds
Water-Cement Ratio	0.37 maximum
Air (± 1-1/2%)	6%
Slump (± 1 inch)	5 inches

The use of a water-reducing admixture conforming to AASHTO M 194 Type A is required to produce patching concrete with the desired slump, and must be used per the admixture manufacturer's recommendations. Air entraining admixtures must be per AASHTO M 154 and the admixture manufacturer's recommendations. The use of accelerating admixtures or other types of admixtures is not allowed.

6-09.3(3)C FLY ASH MODIFIED CONCRETE

Fly ash modified concrete must be a workable mix, uniform in composition and consistency. Mix proportions per cubic yard are as follows:

Fly Ash Modified Concrete Mix Proportions

Material	Proportion
Portland Cement	611 pounds
Fly Ash	275 pounds
Fine Aggregate	38% of total aggregate
Coarse Aggregate	62% of total aggregate
Water-Cement Ratio	0.30 maximum
Air (± 1-1/2%)	6%
Slump	7 inches maximum

6-09.3(3)D MICROSILICA MODIFIED CONCRETE

Microsilica modified concrete must be a workable mix, uniform in composition and consistency. Mix proportions per cubic yard are as follows:

Microsilica Modified Concrete Mix Proportions

Material	Proportion
Portland Cement	658 pounds
Microsilica Fume	52 pounds
Fine Aggregate	1,515 pounds
Coarse Aggregate	1,515 pounds
Water-Cement Ratio	0.33 maximum
Air (± 1-1/2%)	6%
Slump	7 inches maximum

6-09.3(3)E LATEX MODIFIED CONCRETE

Latex modified concrete must be a workable mix, uniform in composition and consistency. Mix proportions per cubic yard are as follows:

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Latex Modified Concrete Mix Proportions

Material	Proportion
Portland Cement	1.00 parts by weight
Fine Aggregate	2.40-2.75 parts by weight
Coarse Aggregate	1.75-2.00 parts by weight
Latex Admixture	3.50 gallons per bag of cement
Water-Cement Ratio	0.33 maximum
Air Content of Plastic Mix	6% maximum
Slump	7 inches maximum

Proportion the aggregates must such that the quantity of aggregate passing the Number 4 sieve is 65 ± 5 percent of the total aggregate (fine plus course). All calculations must be based on dry weights.

The moisture content of the fine aggregate and coarse aggregate must be no more than 3.0 and 1.0 percent, respectively, above the saturated surface dry condition.

The water limit for calculating the water-cement ratio must include the added water, the free water in the aggregates, and 52 percent of the latex admixture.

6-09.3(4) STORING AND HANDLING

6-09.3(4)A AGGREGATE

Store and handle aggregates to prevent variations of more than 1.0 percent in moisture content of the stockpile.

For latex modified concrete, the moisture content of the aggregate when proportioning must be as specified in Section 6-09.3(3)E.

6-09.3(4)B LATEX ADMIXTURE

The admixture must be kept in suitable containers that will protect it from freezing and from exposure to temperatures in excess of 85 ºF. Do not store containers of the admixture in direct sunlight for periods in excess of 10 days. When stored in direct sunlight the top and sides of the containers must be covered with insulating blanket material.

Storage of the admixture may extend over a period greater than 10 days as long as the conditions specified above are maintained and the latex admixture is agitated or stirred once every 10 days. Stir or agitate the admixture mechanically per the manufacturer's recommendation and as approved by the Engineer. If the ambient temperature is higher than 85 ºF at any time during the storage period, cover the admixture with insulated blankets or other means that will maintain the admixture temperature below 85 ºF.

Strain the admixture through a Number 10 strainer when it is introduced into the mixing tank from the storage containers.

6-09.3(4)C HIGH MOLECULAR WEIGHT METHACRYLATE RESIN (HMWM)

Store HMWM resin in a cool dry place and protected from freezing and exposure to temperature in excess of 100 ºF. The promoter and initiator, if supplied separate from the resin, must not contact each other directly. Do not store containers of promoters and initiators together in a manner that will allow leakage or spillage from one to contact the containers or material of the other.

6-09.3(5) SCARIFYING CONCRETE SURFACE

6-09.3(5)A GENERAL

Do not start scarifying a concrete bridge deck surface unless completion of the scarification and concrete overlay can be accomplished within the current construction season.

Do not start scarifying a concrete bridge deck surface until receiving the Engineer's written approval of the machine to be used for scarifying.

Protect adjacent traffic from flying debris generated by the scarification process as specified in item 4 of Section 6-09.3(2) and as approved by the Engineer.

Collect, contain, and dispose of all concrete debris generated by the scarification process as specified in item 4 of Section 6-09.3(2) and as approved by the Engineer.

Scarify all areas of the deck that are inaccessible to the selected scarifying machine to remove the concrete surface matrix to a maximum depth of 1/2 inch by a method accepted by the Engineer. If these areas are hand-chipped then the equipment must comply with the requirements in Section 6-09.3(1)A.

Sufficiently scarify dense, sound areas of existing bridge deck repair material to provide 1 inch minimum clearance to the top of the fresh modified concrete overlay.

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6-09.3(5)B TESTING OF HYDRO-DEMOLITION AND SHOT BLASTING MACHINES

The Engineer will designate a trial area to test that the equipment and methods of operation are capable of producing results satisfactory. The trial area must consist of 2 patches each of approximately 30 square feet, one area in sound concrete and one area of deteriorated concrete as determined by the Engineer.

In the “sound” area of concrete, program the equipment to remove 1/2 inch of concrete.

Following the test over sound concrete, locate the equipment must over the deteriorated concrete and, using the same parameters for the sound concrete removal, remove all deteriorated concrete. The Engineer will grant approval of the equipment based on successful results from the trial area test.

6-09.3(5)C HYDRO-DEMOLISHING

Once the operating parameters of the Hydro-Demolition machine are defined by programming and calibration as specified in Section 6-09.3(5)B, they must not be changed as the machine progresses across the bridge deck, to prevent the unnecessary removal of sound concrete below the required minimum removal depth. Maintain a minimum production rate of 250 square feet per hour during the deck scarifying process.

All water used in the Hydro-Demolition process must be potable. Stream or lake water is not permitted.

All bridge drains and other outlets within 100 feet of the Hydro-Demolition machine must be temporarily plugged during the Hydro-Demolition operation. When scarifying a bridge deck passing over traffic lanes, protect the traffic below by restricting and containing scarifying operations, and implementing traffic control measures, as accepted by the Engineer.

The Contractor must provide for the collection, filtering and disposal of all runoff water generated by the Hydro-Demolition process, per the Runoff Water Disposal Plan as accepted by the Engineer as specified in item 3 of Section 6-09.3(2). Comply with applicable regulations concerning such water disposal.

6-09.3(5)D SHOT BLASTING

Once the operating parameters of the Shot Blasting machine are defined by programming and calibration, as specified in Section; 6-09.3(5)B, they must not be changed as the machine progresses across the bridge deck, to prevent the unnecessary removal of sound concrete below the required minimum removal depth. Maintain a minimum production rate of 250 square feet per hour during the deck scarifying process.

6-09.3(5)E ROTOMILLING

The entire concrete surface of the bridge deck must be scarified to remove the surface matrix to a maximum 1/2-inch depth of the concrete. The operating parameters of the rotary milling machine must be monitored to prevent the unnecessary removal of concrete below the 1/2-inch maximum removal depth.

6-09.3(5)F REPAIR OF STEEL REINFORCING BARS DAMAGED BY SCARIFYING OPERATIONS

The Contractor must repair all reinforcing steel damaged due to the Contractor’s operations. For bridge decks not constructed under the same Contract as the concrete overlay, damage to existing reinforcing steel must be repaired and is paid for as specified in Section 1-09.6 if the existing concrete cover is 1/2 inch or less. All other reinforcing steel damaged due to the Contractor’s operations must be repaired at the Contractor’s sole expense.

Repair must be as follows or as directed by the Engineer:

1. Damage to epoxy coating, when present on existing steel reinforcing bars: as specified in Section 6-02.3(24)H.
2. Damage to bars resulting in a section loss of 20 percent or more of the bar area: by chipping out the adjacent concrete and splicing a new bar of the same size. Concrete must be removed to provide a 3/4-inch minimum clearance around the bars. The splice bars must extend a minimum of 40 bar diameters beyond each end of the damage.
3. Any bars partially or completely removed from the deck: by removing the damaged portions and splicing with new bars as outlined in item 2 above.

6-09.3(5)G CLEANUP FOLLOWING SCARIFICATION

After scarifying is completed, the lane or strip being overlaid must be thoroughly cleaned of all dust, freestanding water and loose particles. Cleaning may be accomplished by using compressed air, water blasting, with a minimum pressure of 5,000 psi, or vacuum machines. Use vacuum cleaning when required by applicable air pollution ordinances.

6-09.3(6) FURTHER DECK PREPARATION

Once the lane or strip being overlaid has been cleaned of debris from scarifying, perform an inspection with the Engineer, as required to verify compliance with ASTM D 4580, Method B, except as otherwise noted for concrete surfaces scarified by hydro-demolition. Mark those areas of the existing bridge deck that are authorized by the Engineer for further deck preparation by the Contractor. When hydro-demolition is used as the method of scarification, the inspection for further deck preparation must be a visual inspection and must take place after 1 pass of the hydro demolition machine.

Further deck preparation will be required under any of the following conditions:

1. Unsound concrete.

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2. Lack of bond between existing concrete and reinforcing steel.
3. Existing nonconcrete patches as identified by the Engineer.
4. Additionally, for concrete surfaces scarified by rotomilling only, exposure of reinforcing steel to a depth of one-half of the periphery of a bar for a distance of 12 inches or more along the bar.

Further deck preparation performed beyond the areas authorized by the Engineer will be at the Contractor's expense as specified in Section 1-05.7. If the concrete overlay is placed on a bridge deck as part of the same Contract as the bridge deck construction, then all Work associated with the further deck preparation must be performed at no additional expense to the Owner.

6-09.3(6)A EQUIPMENT FOR FURTHER DECK PREPARATION

Further deck preparation must be performed using either hand operated tools conforming to Section 6-09.3(1)A, or hydro-demolishing machines conforming to Section 6-09.3(1)C.

6-09.3(6)B DECK REPAIR PREPARATION

All concrete in the repair area must be removed by chipping, hydro demolishing, or other approved mechanical means to a depth necessary to remove all loose and unsound concrete.

For concrete surfaces scarified by rotomilling, concrete must be removed to provide a 3/4-inch minimum clearance around the top mat of steel reinforcing bars only where unsound concrete exists around the top mat of steel reinforcing bars, or if the bond between concrete and top mat of steel is broken.

Take care in removing the deteriorated concrete to not damage any of the existing deck or steel reinforcing bars that are to remain in place. All removal must be accomplished by making neat vertical cuts and maintaining square edges at the boundaries of the repair area. Make cuts using sawing or hydro demolishing machines after sufficient concrete removal has been accomplished to establish the limits of the removal area. In no case may the depth of the vertical cut exceed 3/4 inch or to the top of the top steel reinforcing bars, whichever is less.

The exposed steel reinforcing bars and concrete in the repair area must be sandblasted or hydro-blasted and blown clean just before placing concrete. Bridge deck areas outside the repair area or steel reinforcing bar inside or outside the repair area damaged by the Contractor's operations, must be repaired at the Contractor's sole expense, and to the satisfaction of the Engineer.

All steel reinforcing bars damaged due to the Contractor's operations must be repaired as specified in Section 6-09.3(5)F.

6-09.3(6)C PLACING DECK REPAIR CONCRETE

Deck repair concrete for modified concrete overlays must be either modified concrete or concrete Class M as specified below.

Before placing any deck repair concrete, the Contractor must flush the existing concrete in the repair area with water and make sure that the existing concrete is well saturated. Remove any freestanding water before placing the deck repair concrete. Place the deck repair concrete onto the existing concrete while it is wet.

Type 1 deck repairs, defined as deck repair areas with a maximum depth of one-half the periphery of the bottom bar of the top layer of steel reinforcement and not to exceed 12 continuous inches along the length of the bar, may be filled during the placement of the concrete overlay.

Type 2 deck repairs, defined as deck repair areas not conforming to the definition of Type 1 deck repairs, must be repaired with concrete Class M and wet cured for 42 hours as specified in Section 6-09.3(13), before placing the concrete overlay. During the curing period, all vehicular and foot traffic is prohibited on the repair area.

6-09.3(7) SURFACE PREPARATION FOR CONCRETE OVERLAY

Following the completion of any required further deck preparation, clean the entire lane or strip being overlaid.

If either a rotary milling machine or a shot blasting machine is used for concrete scarification, then the concrete deck must be sandblasted or shot blasted, using equipment approved by the Engineer, until sound concrete is exposed. Take care to ensure that all exposed reinforcing steel and the surrounding concrete is completely blasted. Protect bridge grate inlets, expansion dams and barriers above the surface to be blasted.

If a hydro-demolition machine is used for concrete scarification, then the concrete deck must be cleaned by an approved method of water blasting with 7,000 psi minimum pressure, until sound concrete is exposed.

The final surface of the deck must be free from oil and grease, rust and other foreign material that may reduce the bond of the new concrete to the old. These materials must be removed by detergent-cleaning or other method as approved by the Engineer followed by sandblasting.

After all scarifying, chipping, sandblasting and cleaning is completed, the entire lane or strip being overlaid must be cleaned in final preparation for placing concrete using either compressed air or vacuum machines. Use vacuum machines when warranted by applicable air pollution ordinances.

Scarifying with either rotary milling machines or shot blasting machines, hand tool chipping, sandblasting and cleaning in areas adjacent to a lane or strip being cleaned in final preparation for placing concrete must be discontinued when final

preparation is begun. Scarifying and hand tool chipping must remain suspended until the concrete has been placed and the requirement for curing time has been satisfied. Sandblasting and cleaning must remain suspended for the first 24 hours of curing time after the completion of concrete placing.

If the hydro demolishing scarification process is used, scarification may proceed during the final cleaning and overlay placement phases of the Work on adjacent portions of the Structure so long as the hydro demolisher operations are confined to areas which are a minimum of 100 feet away from the defined limits of the final cleaning or overlay placement in progress. If the hydro demolisher impedes or interferes in any way with the final cleaning or overlay placement as determined by the Engineer, the hydro demolishing Work must be stopped immediately and the hydro demolishing equipment removed sufficiently away from the area being prepared or overlaid to eliminate the conflict. If the grade is such that water and contaminates from the hydro demolishing operation will flow into the area being prepared or overlaid, the hydro demolishing operation must be stopped and must remain suspended for the first 24 hours of curing time after the completion of concrete placement.

If, after final cleaning, the lane or strip being overlaid becomes wet, must flush the surface with high-pressure water, before placement of the overlay. Remove all freestanding water before concrete placement. Concrete placement must start within 24 hours of the completion of deck preparation for the portion of the deck to be overlaid. If concrete placement has not begun within 24 hours, the lane or strip being overlaid must be cleaned by a light sand blasting followed by washing with the high-pressure water spray or by cleaning with the high-pressure spray as approved by the Engineer.

Traffic except required construction equipment is not permitted on any portion of the lane or strip being overlaid that has undergone final preparation for placing concrete unless approved by the Engineer. To prevent contamination, all equipment allowed on the deck after final cleaning must be equipped with drip guards.

6-09.3(8) QUALITY ASSURANCE

6-09.3(8)A QUALITY ASSURANCE FOR MICROSILICA MODIFIED AND FLY ASH MODIFIED CONCRETE OVERLAYS

The Engineer will perform slump, temperature, and entrained air tests for acceptance as specified in Section 6-02.3(5)D and as specified in this Section after the Contractor indicates that the concrete is ready for placement. Concrete from the first truckload must not be placed until tests for acceptance have been completed by the Engineer and the results indicate that the concrete is within acceptable limits. Sampling and testing will continue for each load until 2 successive loads comply with all applicable acceptance test requirements. Except for the first load of concrete, up to 1/2 cubic yard may be placed before testing for acceptance. After 2 successive tests indicate that the concrete is within specified limits, the sampling and testing frequency may decrease to 1 for every 3 truckloads. Loads to be sampled will be selected using the random selection process outlined in FOP for WAQTC TM2.

When the results of any subsequent acceptance test indicates that the concrete does not conform to the specified limits, the sampling and testing frequency will be resumed for each truckload. Whenever 2 successive subsequent tests indicate that the concrete is within the specified limits, the random sampling and testing frequency of 1 for every 3 truckloads may resume.

The Engineer will test for slump and/or air any load of concrete the Engineer deems necessary.

6-09.3(8)B QUALITY ASSURANCE FOR LATEX MODIFIED CONCRETE OVERLAYS

The Engineer will perform operational control testing as the concrete is being placed. The Contractor must provide the Engineer with a 1/4 cubic yard container and assistance in obtaining and handling samples. The 1/4 cubic yard container must have a 9-inch minimum depth and must be placed on a level surface. A minimum of 1 test per mobile mixer per shift will be conducted. The test will be conducted after 8 minutes of mixer operation.

The Engineer will perform slump, temperature, and entrained air tests for acceptance as specified in Section 6-02.3(5)D and in this Section. The Engineer will perform slump and air tests as the concrete is being placed. The minimum number of tests will be 1 slump test and 1 air test per mobile mixer, starting with the first charge and every other charge thereafter. The sample will be taken after the first 2 minutes of continuous mixer operation. The concrete will be sampled as follows:

1. While concrete is being deposited onto the bridge deck, the stream will be diverted into a wheelbarrow or other suitable container. Approximately 1 cubic foot of concrete will be sufficient to conduct 1 slump test and 1 air test.
2. Take the sample to the test site. The test site must be located away from the mobile mixer and off the end of the bridge if practical.
3. Allow the sample to stand undisturbed. The fresh concrete sample must be protected from sunlight and wind until the conclusion of the testing. Total time from discharge to time of start of slump testing will not exceed 6 1/2 minutes.

During the initial proportioning, mixing, placing, and finishing operations, the Engineer may require the presence of a technical representative from the latex admixture manufacturer. The technical representative must be capable of performing, demonstrating, inspecting, and testing all functions required for placement of the latex modified concrete as specified in Section 6-09.3(11) and as approved by the Engineer. This technical representative must aid in the proper installation of the latex modified concrete. Recommendations made by the technical representative on or off the Job Site, and approved by the Engineer, must be adhered to by the Contractor at no additional expense to the Owner. The Engineer will advise the Contractor in writing a minimum of 5 Working Days before such services are required.

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6-09.3(9) MIXING CONCRETE FOR CONCRETE OVERLAY

6-09.3(9)A MIXING MICROSILICA MODIFIED OR FLY ASH MODIFIED CONCRETE

Mixing of concrete is specified in Section 6-02, with the following exceptions:

1. The mixing must be done at a batch plant.
2. The volume of concrete transported by truck must not exceed 6 cubic yards per truck.

6-09.3(9)B MIXING LATEX MODIFIED CONCRETE

The equipment used for mixing the concrete must be operated with strict adherence to the procedures set forth by its manufacturer.

A minimum of 2 mixers will be required at the overlay site for each concrete placement when the total volume of concrete to be placed during the concrete placement exceeds the material storage capacity of a single mixer. Additional mixers may be required if conditions require that material be stockpiled away from the Job Site. The Contractor must have sufficient mixers on hand to ensure a consistent and continuous delivery and placement of concrete throughout the concrete placement.

Charging the mobile mixer must be done in the presence of the Engineer. Mixing capabilities must be such that the finishing operation can proceed at a steady pace.

6-09.3(10) OVERLAY PROFILE AND SCREED RAILS

6-09.3(10)A SURVEY OF EXISTING BRIDGE DECK BEFORE SCARIFICATION

Before starting the scarifying concrete surface finish work specified under Section 6-09.3(5), the Contractor must complete a survey of the existing bridge deck specified to receive modified concrete overlay for use in establishing the existing cross-section and grade profile elevations.

The Engineer will provide the Contractor with primary survey control information consisting of descriptions of 2 primary control points used for the horizontal and vertical control. Primary control points will be described by reference to the bridge or project-specific stationing and elevation datum. The Engineer will also provide horizontal coordinates for the starting and ending points and for each Point of Intersection (PI) on each centerline alignment included in the project. Provide the Engineer 21 Calendar Days notice in advance of scheduled concrete surface scarification work to allow the Engineer time to provide the primary survey control information.

Verify the primary survey control information furnished by the Engineer and expand the survey control information to include secondary horizontal and vertical control points as needed for the project. The Contractor's survey records must include descriptions of all survey control points, including coordinates and elevations of all secondary control points.

Maintain detailed survey records, including a description of the work performed on each shift, the methods used to conduct the survey, and the control points used. The document must be of sufficient detail to allow the survey to be reproduced. A copy of each day's survey document must be provided to the Engineer within 3 Working Days after the end of the shift. Compile the survey information in an electronic file format acceptable to the Engineer (Excel spreadsheet format is preferred).

Survey information collected must include station, offset, and elevation for each lane line and curb line. Survey information must be collected at even 20-foot station intervals and also at the centerline of each bridge expansion joint. Ensure a surveying accuracy to within ± 0.01 feet for vertical control and ± 0.2 feet for horizontal control. The survey must extend 100 feet beyond the bridge back of pavement seat.

Except for the primary survey control information furnished by the Engineer, the Contractor is responsible for all calculations, surveying, and measuring required for setting, maintaining, and resetting equipment and materials necessary for the construction of the overlay to the final grade profile. The Engineer may post-check the Contractor's surveying, but these post-checks do not relieve the Contractor of responsibility for internal survey quality control.

The Engineer will establish the final grade profile based on the Contractor's survey, and will provide the final grade profile to the Contractor within 3 Working Days after receiving the Contractor's survey information.

Do not start scarifying concrete surface work specified under Section 6-09.3(5) until receiving the final grade profile from the Engineer.

6-09.3(10)B ESTABLISHING FINISH OVERLAY PROFILE

The finish grade profile must be +1/4 inch to -1/8 inch from the Engineer's final grade profile. The final grade profile must be verified before the placement of modified concrete overlay with the screed rails in place. The finishing machine must pass over the entire surface to be overlaid and the final screed rail adjustments must be made. If the resultant overlay thickness is not compatible with the finish grade profile generated by the Contractor's screed rail setup, the Contractor must make profile adjustments as approved by the Engineer. After the finish overlay profile has been verified, changing the finishing machine elevation controls is not allowed. The Contractor is responsible for setting screed control to obtain the specified finish grade overlay profile as well as the finished surface smoothness requirements specified in Section 6-02.3(10).

Screed rails on which the finishing machine travels must be placed outside the area to be overlaid, as specified in item 7 of Section 6-09.3(2), and as approved by the Engineer. Interlocking rail sections or other approved methods of providing rail continuity are required.

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Hold-down devices shot into the concrete are not permitted unless the concrete is to be subsequently overlaid. Hold-down devices of other types leaving holes in the exposed area will be allowed provided the holes are subsequently filled with mortar conforming to Section 9-20.4(2) mixed at a 1:2 cement/aggregate ratio. Hold-down devices must not penetrate the existing deck by more than 3/4 inch.

Screed rails may be removed at any time after the concrete has taken an initial set. Take adequate precautions during the removal of the finishing machine and rails to protect the edges of the new surfaces.

6-09.3(11) PLACING CONCRETE OVERLAY

5 to 10 Working Days before modified concrete overlay placement, a pre-overlay conference must be held to discuss equipment, construction procedures, personnel, and previous results. Inspection procedures must also be reviewed to ensure coordination. These persons are required to attend:

1. (Representing the Contractor) The superintendent and all foremen in charge of placing and finishing the modified concrete overlay, and
2. (Representing the Owner) The Engineer and key inspection Assistants.

If the project includes more than 1 bridge deck, an additional conference must be held just before placing modified concrete overlay for each subsequent bridge deck.

Do not place modified concrete overlay until the Engineer agrees that:

a. Modified concrete overlay producing and placement rates will be high enough to meet placing and finishing deadlines;

b. Finishers with enough experience have been used; and

c. Adequate finishing tools and equipment are at the Project Site.

Concrete placement must be as specified in Section 6-02 and the following requirements:

1) After the lane or strip to be overlaid has been prepared and immediately before placing the concrete, it must be thoroughly soaked and kept continuously wet with water for a minimum period of 6 hours before placement of the concrete. All freestanding water must be removed before concrete placement. During concrete placement, the lane or strip must be kept moist.

   The concrete must then be promptly and continuously delivered and deposited on the placement side of the finishing machine.

   If latex modified concrete is used, the concrete must be thoroughly brushed into the surface and then brought up to final grade. If either microsilica modified concrete or fly ash modified concrete are used, a slurry of the concrete, except aggregate, must be thoroughly brushed into the surface before the overlay placement.

   Take care to ensure that the surface receives a thorough, even coating and that the rate of progress is limited so that the brushed concrete does not become dry before it is covered with additional concrete as required for the final grade. All aggregate which is segregated from the mix during the brushing operation must be removed from the deck and disposed of by the Contractor.

   If either microsilica modified concrete or fly ash modified concrete are used, must ensure that enough trucks are used for concrete delivery to obtain a consistent and continuous delivery and placement of concrete throughout the concrete placement operation.

   When concrete is to be placed against the concrete in a previously placed transverse joint, lane, or strip, the previously placed concrete must be sawed back 6 inches to straight and vertical edges and must be sandblasted or water blasted before new concrete is placed. The Engineer may decrease the 6-inch saw back requirement to 2 inches minimum, if a bulkhead was used during previous concrete placement and the concrete was hand vibrated along the bulkhead.

2) Do not start concrete placement if rain is expected. Take adequate precautions to protect freshly placed concrete if rain starts during placement. Concrete that is damaged by rain must be removed and replaced by the Contractor at no additional expense to the Owner, and to the satisfaction of the Engineer.

3) Do not place concrete when the temperature of the concrete surface is less than 45 ºF or greater than 75 ºF, when the combination of air temperature, relative humidity, fresh concrete temperature, and wind velocity at the Job Site produces an evaporation rate of 0.15 pound per square foot of surface per hour as determined from the Surface Evaporation from Concrete figure in Section 6-02.3(6)A2, or when winds are in excess of 10 mph. If the Contractor elects to Work at night to comply with these criteria, adequate lighting must be provided at no additional expense to the Owner, and as approved by the Engineer.

4) If concrete placement is stopped for a period of 1/2 hour or more, the Contractor must install a bulkhead transverse to the direction of placement at a position where the overlay can be finished full width up to the bulkhead. The bulkhead must be full depth of the overlay and must be installed to grade. The concrete must be finished and cured per these Specifications.

   Further placement is permitted only after a period of 12 hours unless a gap is left in the lane or strip. The gap must be of sufficient width for the finishing machine to clear the transverse bulkhead installed where concrete placement was

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stopped. The previously placed concrete must be sawed back from the bulkhead, to a point designated by the Engineer, to straight and vertical edges and must be sandblasted or water blasted before new concrete is placed.

5) Do not place concrete against the edge of an adjacent lane or strip that is less than 36 hours old.

6-09.3(12) FINISHING CONCRETE OVERLAY

Finishing must be accomplished as specified in applicable portions of Section 6-02.3(10) and as follows. Concrete must be placed and struck-off approximately 1/2 inch above final grade and then consolidated and finished to final grade with a single pass (the Engineer may require additional passes) of the finishing machine. Hand finishing may be necessary to close up or seal off the surface. The final product must be a dense uniform surface.

Do not spray latex on a freshly placed latex modified concrete surface; however, a light fog spray of water is permitted if required for finishing, as determined by the Engineer.

As the finishing machine progresses along the placed concrete, the surface must be given a final finish by texturing with a comb perpendicular to the centerline of the bridge. The texture must be applied immediately behind the finishing machine. The comb must consist of a single row of metal tines capable of producing 1/8-inch wide striations approximately 0.015 foot in depth at approximately 1/2-inch spacing. The combs may be operated manually or mechanically, either singly or in gangs (several combs placed end to end). This operation must be done in a manner that will minimize the displacement of the aggregate particles. The texture must not extend into areas within 2 feet of the curb line. The non-textured concrete within 2 feet of the curb line must be hand finished with a steel or magnesium trowel.

Construction dams must be separated from the newly placed concrete by passing a pointing trowel along the inside surfaces of the dams. Take care to ensure that this trowel cut is made for the entire depth and length of the dams after the concrete has stiffened sufficiently that it does not flow back.

After the burlap cover has been removed and the concrete surface has dried, but before opening to traffic, all joints and visible cracks must be filled and sealed with a high molecular weight methacrylate resin (HMWM). Cracks 1/16 inch and greater in width must receive 2 applications of HMWM. Immediately following the application of HMWM, the wetted surface must be coated with sand for abrasive finish.

6-09.3(13) CURING CONCRETE OVERLAY

As the texturing portion of the finishing operation progresses, the concrete must be immediately covered with a single layer of clean, new or used, wet burlap. The burlap must have a maximum width of 6 feet. The Engineer will determine the suitability of the burlap for reuse, based on the cleanliness and absorption ability of the burlap. Take care to ensure that the burlap is well drained and laid flat with no wrinkles on the deck surface. Adjacent strips of burlap must have a minimum overlap of 6 inches.

Once in place the burlap must be lightly fog sprayed with water. A separate layer of white, reflective type polyethylene sheeting must immediately be placed over the wet burlap. The concrete must then be wet cured by keeping the burlap wet for a minimum of 42 hours after which the polyethylene sheeting and burlap may be removed.

Traffic is not permitted on the finished concrete until the specified curing time is satisfied and until the concrete has reached a minimum compressive strength of 3,000 psi as verified by rebound number determined per ASTM C 805.

6-09.3(14) CHECKING FOR BOND

After the requirements for curing have been met, the entire overlaid surface must be sounded by the Contractor, as approved by and in the presence of the Engineer, to ensure total bond of the concrete to the bridge deck. Concrete in un-bonded areas must be removed and replaced by the Contractor with the same modified concrete as used in the overlay at no additional expense to the Owner, as specified in Section 6-09.3(6) except as modified here.

All removal must maintain square edges at the boundaries of the repair area. Concrete for patching must be the same modified concrete as used in the overlay.

The repair area must be wet cured for 42 hours in accordance with Section 6-09.3(13). After curing requirements have been met, all repaired areas must be sounded by the Contractor in accordance with this Section.

6-09.3(15) SEALING AND TEXTURING CONCRETE OVERLAY

After the requirements for checking for bond have been met as specified in Section 6-09.3(14), all joints and visible cracks must be filled and sealed with a high molecular weight methacrylate resin (HMWM). Cracks 1/16 inch and greater in width must receive two applications of HMWM. Immediately following the application of HMWM, the wetted surface must be coated with sand for abrasive finish. After all cracks have been filled and sealed and the HMWM resin has cured, the concrete overlay surface must receive a longitudinally sawn texture in accordance with Section 6-02.3(10)D. Traffic must not be permitted on the finished concrete until it has reached a minimum compressive strength of 3,000 psi, as verified by rebound number determined in accordance with ASTM C805, and the longitudinally sawn texture is completed.

6-09.4 MEASUREMENT

Scarifying concrete surface will be measured by the square yard of surface actually scarified.

Modified concrete overlay will be measured by the cubic foot of material placed. For latex modified concrete overlay, the volume will be determined by the theoretical yield of the design mix and documented by the counts of the cement meter less

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waste. For both microsilica modified concrete overlay and fly ash modified concrete overlay, the volume will be determined from the concrete Supplier's certificate of compliance for each batch delivered less waste. Waste is defined as the following:

1. Material not placed.
2. Material placed in excess of 6 inches outside a longitudinal joint or transverse joint.

Finishing and curing modified concrete overlay will be measured by the square yard of overlay surface actually finished and cured.

When further deck preparation is measured by volume, it will be measured by the cubic foot of material removed from the deck repair locations. The depth measurement at each deck repair location will be the average depth beneath a straight edge placed at the level of the existing deck surface. The area measurement at each deck repair location will be the surface area of the removed concrete.

6-09.5 PAYMENT

1. **"Scarifying Conc. Surface"**, per square yard.

The unit Contract Price per square yard for "Scarifying Conc. Surface" will be full pay for performing the Work as specified, including testing and calibration of the machines and tools used, containment, collection, and disposal of all water and abrasives used and debris created by the scarifying operation, measures taken to protect adjacent traffic from flying debris, and final cleanup following the scarifying operation.

2. **"Modified Conc. Overlay"**, per cubic foot.

The unit Contract Price per cubic foot for "Modified Conc. Overlay" will be full pay for furnishing the modified concrete overlay, including the overlay material placed into Type 1 deck repairs as specified in Section 6-09.3(6)C.

3. **"Finishing and Curing Modified Conc. Overlay"**, per square yard.

The unit Contract price per square yard for "Finishing and Curing Modified Conc. Overlay" will be full pay for performing the Work as specified, including placing, finishing, and curing the modified concrete overlay, checking for bond, and sealing all cracks.

4. **"Further Deck Preparation"**, per cubic foot.

When "Further Deck Preparation" is measured by volume, the unit Contract price per cubic foot for "Further Deck Preparation" will be full pay for performing the Work as specified, including removing and disposing of the concrete within the repair area, and furnishing, placing, finishing, and curing the repair concrete.

5. **"Further Deck Preparation"**, force account.

When "Further Deck Preparation" is not measured by volume, payment for the Work required will be by force account as specified in Section 1-09.6.

6. **"Structure Surveying"**, lump sum.

The lump sum Contract Price for "Structure Surveying" will be full pay to perform the Work as specified, including establishing secondary survey control points, performing survey quality control, and recording, compiling, and submitting the survey records to the Engineer.

SECTION 6-10 CONCRETE BARRIER

6-10.1 DESCRIPTION

Section 6-10 describes building precast or cast in place cement concrete barriers as required by the Contract.

6-10.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Material	Section
Portland Cement	Section 9-01
Aggregates	Section 9-03
Premolded Joint Fillers	Section 9-04.1
Reinforcing Steel	Section 9-07
Grout	Section 9-20.3

Wire rope must be Class 6 x 19, made of improved plow steel galvanized and preformed. Galvanizing must comply with ASTM A 603. The wire rope must have right regular lay and a fiber core. It must be 5/8 inch in diameter and have a minimum breaking strength of 15 tons.

All hardware (such as connecting pins, drift pins, nuts, and washers) must be galvanized per AASHTO M 232.

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Connecting pins, drift pins and steel pins for Type 3 anchors must conform to Section 9-06.4(3) and be galvanized per AASHTO M232. All other hardware must conform to Section 9-06.4(1) and be galvanized per AASHTO M232.

Grout for permanent installations of precast single slope barrier must conform to Section 9-20.3(3) and must be placed as specified in Section 6-02.3(20).

6-10.3 CONSTRUCTION REQUIREMENTS

Single slope barrier must be cast-in-place or slip formed, except when precast single slope barrier is specified in the Plans or approved by the Engineer. Concrete barrier installed in conjunction with light standard foundations and sign bridge foundations, regardless of the barrier shape, must be cast-in-place using stationary forms.

Concrete barrier transition Type 2 to bridge f-shape must be precast.

Steel welded wire reinforcement deformed, conforming to Section 9-07.7, may be substituted in concrete barrier in place of deformed steel bars conforming to Section 9-07.2, subject to the following conditions:

1. Steel welded wire reinforcement spacing must be the same as the deformed steel bar spacing shown on the Standard Plans.
2. The minimum cross-sectional area for steel welded wire reinforcement must be no less than 86 percent of the cross-sectional area for the deformed steel bars being substituted.
3. Development lengths and splice lengths must conform to requirements specified in the AASHTO LRFD Bridge Design Specifications, current edition.

6-10.3(1) PRECAST CONCRETE BARRIER

The concrete in precast barrier must reach a compressive strength of at least 4,000 psi at 28 days. Do not ship concrete barrier until test cylinders made of the same concrete and cured under the same conditions show the concrete has reached this strength. Class 4000 concrete that complies with Section 6-02 will comply with this strength requirement. The Contractor may, however, change the mix and aggregate grading if:

1. The Contractor indicates the substitution as specified in Section 1-05.3(5);
2. The altered mix meets the requirement of a Contractor provided mix design; and
3. No aggregate is used that is larger than the maximum for Class 4000 concrete.

The Contractor may use Type III Portland cement at no additional cost to the Owner.

Precast barrier must be cast in steel forms. After release, the barrier must be finished to an even, smooth, dense surface, free from any rock pockets or holes larger than 1/4 inch across. Toweling must remove all projecting concrete from the bearing surface.

Precast concrete barrier must be cured as specified in Section 6-02.3(25)D except that the barrier must be cured in the forms until a rebound number test, or test cylinders cured under the same conditions as the barrier, indicate that the concrete has reached a compressive strength of at least 2,500 psi. No additional curing is required once the barrier is removed from the forms.

All barrier must be the same length, except end sections and variable length units needed for closure. All barrier must be new and unused. The manufacturer is responsible for any damage or distortion that results from manufacturing.

Only 1 section less than 10 feet long may be used in any single run of precast barrier, and it must be at least 8 feet long. It may be precast or cast in place. Hardware identical to that used with other sections must interlock such a section with adjacent precast sections.

When the barrier is being built adjacent to roadway lanes open to traffic, a terminal section must be connected temporarily to the end of the barrier built each day.

6-10.3(2) CAST IN PLACE CONCRETE BARRIER

Forms for cast in place barrier must be made of steel or of exterior plywood coated with plastic. At the Contractor's option, the barrier may be constructed by the slip form method.

The barrier must be made of Class 4000 concrete that meets the requirements of Section 6-02. The Contractor may use Portland cement Type III if it is provided at no additional cost to the Owner.

Immediately after removing the forms, the Contractor must complete any finishing work needed to produce a uniformly smooth, dense surface. The surface must not have rock pockets or holes larger than 1/4 inch across. The barrier must be cured as specified in Section 6-02.3(11)A.

The maximum allowable deviation from a 10-foot straight edge held longitudinally on all surfaces is 1/4 inch.

The Contractor may build cast in place concrete barrier by the slip form method. Concrete for slip form barrier must comply with the requirements for concrete Class 4000 as outlined in Section 6-02, except that the fine aggregate gradation may be Class 1 or Class 2. Slip form barrier must be finished and cured as specified in Section 6-02.3(11)A.

At least 3 Working Days in advance of delivery to the Project Site, the Contractor must request that the Engineer verify the concrete barrier to be free from stains, smears, and any discoloration.

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6-10.3(3) REMOVING AND RESETTING CONCRETE BARRIER

The Contractor must reset concrete barrier as specified in the Contract. If resetting is impossible immediately after removal, the Contractor must store the barrier at locations approved by the Engineer.

6-10.3(4) JOINING PRECAST CONCRETE BARRIER TO CAST IN-PLACE BARRIER

The Contractor may join segments of cast in place barrier to precast barrier where transitions, split barriers, or gaps shorter than 10 feet require it. At each joint of this type, the cast in place segment must include hardware that ties both its ends to abutting precast sections.

6-10.3(5) TEMPORARY CONCRETE BARRIER

For temporary concrete barrier, the Contractor may use new or used precast barrier that complies with WSDOT Standard Plan requirements and cross-sectional dimensions, except that:

1. It may be made in other lengths than those shown on the WSDOT Standard Plan; and
2. It may have permanent lifting holes no larger than 4 inches in diameter or lifting loops.

The word temporary must be visibly stamped or stencil painted on each barrier segment.

All barrier must be in good condition, without cracks, chips, spalls, dirt, or traffic marks. If any barrier segment is damaged during or after placement, the Contractor, at no additional cost to the Owner, must immediately repair the damage to a condition acceptable to the Engineer, or replace it with an undamaged section.

Temporary barrier no longer needed must be removed from the Project Site.

6-10.3(6) PLACING CONCRETE BARRIER

Precast concrete barrier must rest on a paved foundation shaped to a uniform grade and section. The foundation surface must comply with this test for uniformity:

When a 10-foot straight edge is placed on the surface parallel to the centerline for the barrier, the surface must not vary more than 1/4 inch from the lower edge of the straight edge. If deviations exceed 1/4 inch, the Contractor must correct them as specified in Section 5-04.3(11).

The Contractor must align the joints of all precast segments so that they offset no more than 1/4 inch transversely and no more than 3/4 inch vertically. Grouting is not permitted. If foundation grade and section are acceptable, the Engineer may allow the Contractor to obtain vertical alignment of the barrier by shimming. Shimming must be done with a polystyrene, foam pad (12” x 24”) under the end 12 inches of bearing surface.

Precast barrier must be handled and placed with equipment that does not damage or disfigure it.

6-10.4 MEASUREMENT

Precast concrete barrier will be measured by the linear foot along its completed line and slope.

Temporary concrete barrier will be measured by the linear foot along the completed line and slope of the barrier, 1 time only for each setup of barrier protected area. Any intermediate moving or resetting will not be measured.

Cast in place concrete barrier will be measured by the linear foot along its completed line unless the Contract specifies measurement per cubic yard for concrete Class 4000 and per pound for steel reinforcing bar per Section 6-02.4.

Cast in place concrete barrier light standard section will be by the unit for each light standard section installed.

Removing and resetting existing permanent barrier will be measured by the linear foot and will be measured 1 time only for removing, storage, and resetting. No measurement will be made for barrier that has been removed and reset for the convenience of the Contractor.

Concrete Barrier transition Type 2 to bridge F-shape will be measured by the linear foot installed.

Single slope concrete barrier light standard foundation will be measured by the unit for each light standard foundation installed.

Traffic barrier, traffic pedestrian barrier, and pedestrian barrier will be measured as specified for cast-in-place concrete barrier.

6-10.5 PAYMENT

1. **“Precast Concrete Barrier, Type ____”**, per linear foot.
2. **“Cast In Place Concrete Barrier”**, per linear foot.
3. **“Concrete Class (Strength) _____”**, per cubic yard.
4. **“St. Reinf. Bar _____”**, per pound.
5. **“Removing and Resetting Existing Permanent Barrier”**, per linear foot.

The Bid Item prices for “Precast Concrete Barrier, Type ____” and for “Cast In Place Concrete Barrier” include all costs for the work required for excavation, forms, placement, special construction features, and all other materials, tools, equipment, and labor necessary to complete the work as specified; except that when the Contract specifies, the Bid Item price per cubic yard for “Concrete Class (Strength)” and the per pound Bid Item price for “Steel Reinforcing Bar” will be full pay for excavation,

forms, placement, special construction features, and all other materials, tools, equipment, and labor necessary to complete the work as specified.

6. **"Cast In Place Concrete Barrier Light Standard Section"**, per each.
7. **"Temporary Concrete Barrier"**, per linear foot.

The Bid Item prices for "Cast In Place Concrete Barrier Light Standard Section" and for "Temporary Concrete Barrier" include all costs for the work required to furnish, install, connect, anchor, maintain, temporary storage, and final removal of the temporary barrier. Contractor furnished barrier must remain the property of the Contractor.

Payment for transition sections between different types of barrier will be made at the Bid Item price for the type of barrier indicated on the Drawings for each transition section.

SECTION 6-11 REINFORCED CONCRETE WALLS

6-11.1 DESCRIPTION

Section 6-11 describes constructing reinforced concrete retaining walls, including those shown on the WSDOT Standard Plans, L walls, and counterfort walls.

6-11.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Material	Section
Cement	Section 9-01
Aggregates for Portland Cement Concrete	Section 9-03.1
Gravel Backfill	Section 9-03.10
Premolded Joint Filler	Section 9-04.1(2)
Steel Reinforcing Bar	Section 9-07.2
Epoxy-Coated Steel Reinforcing Bar	Section 9-07.3
Concrete Curing Materials and Admixtures	Section 9-23
Fly Ash	Section 9-23.6
Water	Section 9-25

Other required materials as specified.

6-11.3 CONSTRUCTION REQUIREMENTS

6-11.3(1) SUBMITTALS

The Contractor must submit all excavation shoring plans to the Engineer for approval as specified in Section 2-07.3.

Submit all falsework and formwork plans to the Engineer for approval as specified in Sections 6-02.3(16) and 6-02.3(17).

If the Contractor elects to manufacture and erect precast concrete wall stem panels, the following information must be submitted to the Engineer for approval as specified in Sections 6-01.8 and 6-02.3(28)A:

1. Working drawings for fabrication of the wall stem panels, showing dimensions, steel reinforcing bars, joint and joint filler details, surface finish details, lifting devices with the manufacturer's recommended safe working capacity, and material Specifications.
2. Working drawings and design calculations for the erection of the wall stem panels showing dimensions, support points, support footing sizes, erection blockouts, member sizes, connections, and material Specifications.
3. Design calculations for the precast wall stem panels, the connection between the precast panels and the cast-in-place footing, and all modifications to the cast-in-place footing details as shown on the Drawings or Standard Plans.

Do not start excavation and construction operations for the retaining walls until receiving the Engineer's approval of the above submittals.

6-11.3(2) EXCAVATION AND FOUNDATION PREPARATION

Excavation must conform to Section 2-04.3(5), and to the limits and construction stages shown on the Drawings. Foundation soils found to be unsuitable must be removed and replaced as specified in Section 2-04.3(1)I.

6-11.3(3) PRECAST CONCRETE WALL STEM PANELS

The Contractor may manufacture precast concrete wall stem panels for construction of Standard Plan Retaining Walls. Precast concrete wall stem panels may be used for construction of non-Standard Plan retaining walls if allowed by the Drawings or Special Provisions. Precast concrete wall stem panels must conform to Section 6-02.3(28), and must be cast with

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Class 4000 concrete. If self-consolidating concrete is used, the concrete must conform to Sections 6-02.3(27)B and 6-02.3(27)C.

The precast concrete wall stem panels must be designed per the following codes:

1. For all loads except as otherwise noted: AASHTO LRFD Bridge Design Specifications, latest edition and current interims. The seismic design must use the acceleration coefficient and soil profile type as specified in the Drawings.
2. For all wind loads: AASHTO Guide Specifications for Structural Design of Sound Barriers, latest edition and current interims.

The precast concrete wall stem panels must be manufactured per the dimensions and details shown on the Drawings, except as modified in the Shop Drawings as approved by the Engineer.

The precast concrete wall stem panels must be manufactured full height, in widths of 8, 16, and 24 feet.

The construction tolerances for the precast concrete wall stem panels are:

Wall Stem Panel Component	Tolerance
Height	± 1/4 inch
Width	± 1/4 inch
Thickness	+ 1/4 inch - 1/8 inch
Concrete cover for steel reinforcing bar	+ 3/8 inch - 1/8 inch
Width of precast concrete wall stem panel joints	± 1/4 inch
Offset of precast concrete wall stem panels	± 1/4 inch

NOTE: Deviation is from a straight line extending 5 feet on each side of the panel joint.

The precast concrete wall stem panels must be constructed with a mating shear key between adjacent panels. The shear key must have beveled corners and must be 1-1/2 inches thick. The width of the shear key must be 3 1/2 inches minimum and 5 1/2 inches maximum. The shear key must be continuous and of uniform width over the entire height of the wall stem.

Provide the specified surface finish as noted, and to the limits shown, in the Drawings to the exterior concrete surfaces. Special surface finishes achieved with form liners must conform to Sections 6-02.2 and 6-02.3(14) as supplemented in the Special Provisions. Do not use rolled on textured finishes. Precast concrete wall stem panels must be cast in a vertical position if the Drawings call for a form liner texture on both sides of the wall stem panel.

The precast concrete wall stem panel must be rigidly held in place during placement and curing of the footing concrete.

The precast concrete wall stem panels must be placed a minimum of 1 inch into the footing to provide a shear key. The base of the precast concrete wall stem panel must be sloped 1/2 inch per foot to facilitate proper concrete placement.

To ensure an even flow of concrete under and against the base of the wall panel, a form must be placed parallel to the precast concrete wall stem panel, above the footing, to allow a minimum 1-foot head to develop in the concrete during concrete placement.

The steel reinforcing bars must be shifted to clear the erection blockouts in the precast concrete wall stem panel by 1-1/2 inches minimum.

All precast concrete wall stem panel joints must be constructed with joint filler installed on the rear (backfill) side of the wall. The joint filler material must extend from 2 feet below the final ground level in front of the wall to the top of the wall. The joint filler must be a nonorganic flexible material and must be installed to create a waterproof seal at panel joints.

The soil bearing pressure beneath the falsework supports for the precast concrete wall stem panels must not exceed the maximum design soil pressure shown on the Drawings for the retaining wall.

6-11.3(4) CAST-IN-PLACE CONCRETE CONSTRUCTION

Cast-in-place concrete for concrete retaining walls must be formed, reinforced, cast, cured, and finished as specified in Section 6-02, and the details shown on the Drawings. All cast-in-place concrete must be Class 4000.

The Contractor must provide the specified surface finish as noted, and to the limits shown, in the Drawings to the exterior concrete surfaces. Special surface finishes achieved with form liners must conform to Sections 6-02.2 and 6-02.3(14) as supplemented in the Special Provisions.

Cast-in-place concrete for adjacent wall stem sections (between vertical expansion joints) must be formed and placed separately, with a minimum 12 hour time period between concrete placement operations.

Premolded joint filler, 1/2 inch thick, must be placed full height of all vertical wall stem expansion joints as specified in Section 6-01.12.

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6-11.3(5) BACKFILL, WEEPHOLES, AND GUTTERS

Unless the Drawings specify otherwise, backfill and weepholes must be placed as shown on the Standard Plans and specified in Section 6-02.3(22).

Cement concrete gutter must be constructed as shown on the Standard Plans.

6-11.3(6) TRAFFIC BARRIER AND PEDESTRIAN BARRIER

When shown on the Drawings, traffic barrier and pedestrian barrier must be constructed as specified in Sections 6-02.3(11)A and 6-10.3(2), and the details shown on the Drawings and Standard Plans.

6-11.4 MEASUREMENT

Concrete Class 4000 for retaining wall will be measured as specified in Section 6-02.4.

Steel reinforcing bar for retaining wall and epoxy-coated steel reinforcing bar for retaining wall will be measured as specified in Section 6-02.4.

Traffic barrier and pedestrian barrier will be measured as specified in Section 6-10.4 for cast-in-place concrete barrier.

6-11.5 PAYMENT

1. **"Conc. Class 4000 For Retaining Wall"**, per cubic yard.

All costs in connection with furnishing and installing weep holes and premolded joint filler are included in the unit Contract price per cubic yard for "Conc. Class 4000 for Retaining Wall".

2. **"St. Reinf. Bar For Retaining Wall"**, per pound.
3. **"Epoxy-Coated St. Reinf. Bar For Retaining Wall"**, per pound.
4. **"Traffic Barrier"**, per linear foot.
5. **"Pedestrian Barrier"**, per linear foot.

The unit Contract price per linear foot for "___ Barrier" will be full pay for constructing the barrier on top of the retaining wall, except that when these Bid Items are not included in the Proposal, all costs in connection with performing the Work as specified are included in the unit Contract price per cubic yard for "Conc. Class 4000 For Retaining Wall", and the unit Contract price per pound for "___ Bar For Retaining Wall".

SECTION 6-12 SHAFTS

6-12.1 DESCRIPTION

This Section describes constructing shafts as shown on the Drawings, these specifications, and as designated by the Engineer.

6-12.2 MATERIALS

Materials must meet the requirements of the following Sections:

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Material	Section
Portland Cement and Blended Hydraulic Cement	Section 9-01
Aggregates for Portland Cement Concrete	Section 9-03.1
Deformed Steel Bars	Section 9-07.2
Epoxy Coated Steel Reinforcing Bars	Section 9-07.3
Concrete Curing Materials, Pozzolans and Admixtures	Section 9-23
Fly Ash	Section 9-23.6
Ground Granulated Blast Furnace Slag (GGBFS)	Section 9-23.7
Microsilica Fume	Section 9-23.8
Water for Concrete	Section 9-25.1
Permanent Casing	Section 9-39.1(1)
Temporary Casing	Section 9-39.1(2)
Mineral Slurry	Section 9-39.2(1)
Synthetic Slurry	Section 9-39.2(2)
Water Slurry	Section 9-39.2(3)
Steel Reinforcing Bar Centralizers	Section 9-39.3
Crosshole Sonic (CSL) Access Tubes and Caps	Section 9-39.4
Grout for CSL Access Tubes	Section 9-39.5

6-12.3 CONSTRUCTION REQUIREMENTS

6-12.3(1) QUALITY ASSURANCE

6-12.3(1)A SHAFT CONSTRUCTION TOLERANCES

Shafts must be constructed so that the center at the top of the shaft is within the following horizontal tolerances:

Shaft Diameter (feet)	Tolerance (inches)
Less than or equal to 2	3
Greater than 2 and less than 5	4
5 or larger	6

Shafts must be within 1.5 percent of plumb. For rock excavation, allowable tolerance can be increased to 2 percent maximum.

During drilling or excavation of the shaft, the Contractor must make frequent checks on the plumbness, alignment, and dimensions of the shaft. Deviations exceeding the allowable tolerances must be corrected with a procedure approved by the Engineer.

Shaft steel reinforcing bar placement tolerances must be as specified in Section 6-02.3(24)C.

6-12.3(1)B NONDESTRUCTIVE TESTING OF SHAFTS

6-12.3(1)B1 NONDESTRUCTIVE QUALITY ASSURANCE (QA) TESTING OF SHAFTS

The Contractor must perform nondestructive QA testing of shafts, except for those constructed completely in the dry. Either crosshole sonic log (CSL) testing in accordance with ASTM D 6760 or thermal integrity profiling (TIP) testing in accordance with ASTM D 7949 must be used.

6-12.3(1)B2 NONDESTRUCTIVE QUALITY VERIFICATION (QV) TESTING OF SHAFTS

The Owner may perform QV nondestructive testing of shafts that have been QA tested by the Contractor. The Owner may test up to 10 percent of the shafts. The Engineer will identify the shafts selected for QV testing and the testing method the Owner will use.

The Contractor must accommodate the Owner's nondestructive testing.

6-12.3(1)C SHAFT PRECONSTRUCTION CONFERENCE

A shaft preconstruction conference must be held at least 5 Working Days prior to the Contractor beginning shaft construction Work at the site to discuss construction procedures, personnel, and equipment to be used, and other elements of the approved shaft installation narrative as specified in Section 6-12.3(2)B. Those attending must include:

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1. Representing the Contractor – The superintendent, on site supervisors, and all foremen in charge of excavating the shaft, placing the casing and slurry as applicable, placing the steel reinforcing bars, and placing the concrete. If synthetic slurry is used to construct the shafts, the slurry manufacturer's representative or approved Contractor's employees trained in the use of the synthetic slurry must also attend.
2. Representing the Owner – The Engineer, key inspection personnel, and representatives from the Owner.

If the Contractor proposes a significant revision of the approved shaft installation narrative, as determined by the Engineer, an additional conference must be held before additional shaft construction operations are performed.

6-12.3(2) SHAFT CONSTRUCTION SUBMITTAL

The shaft construction submittal must be comprised of the following four components: construction experience, shaft installation narrative, shaft slurry technical assistance, and nondestructive QA testing personnel. The submittal must be submitted in a PDF format.

The construction experience and shaft installation narrative components of the submittal must be submitted to allow the Engineer a minimum review time as specified in Section 1-05.3. The Contractor must not proceed with shaft construction until all comments from the Engineer have been addressed.

The slurry technical assistance and nondestructive QA testing components of the submittal must be submitted a minimum of 5 Working Days prior to the start of the work. These components are for the Owner's information.

6-12.3(2)A CONSTRUCTION EXPERIENCE

The Contractor must submit a project reference list to the Engineer for approval verifying the successful completion by the Contractor of at least three separate foundation projects with shafts of diameters and depths similar to or larger than those shown on the Drawings, and ground conditions similar to those identified in the Contract. Provide a brief description of each listed project including the name and current phone number of the project owner or the owner's Contractor.

The Contractor must submit a list identifying the on-site supervisors and drill rig operators potentially assigned to the project to the Engineer. The list must contain a brief description of each individual's experience in shaft excavation operations and placement of assembled steel reinforcing bar cages and concrete in shafts. The individual experience lists must be limited to a single page for each supervisor or operator.

1. On-site supervisors must have a minimum of 2 years of experience in supervising construction of shaft foundations of similar diameter, depth, and scope to those shown on the Drawings, and similar geotechnical conditions to those described in the boring logs and summary of geotechnical conditions. Work experience must be direct supervisory responsibility for the on-site shaft construction operations. Project management level positions indirectly supervising on-site shaft construction operations are not acceptable for this experience requirement.
2. Drill rig operators must have a minimum of 1 year of experience in construction of shaft foundations.

The Engineer may suspend the shaft construction if the Contractor substitutes unapproved personnel. The Contractor is fully liable for the additional costs resulting from the suspension of work, and no adjustments in Contract Time resulting from the suspension of work will be allowed.

6-12.3(2)B SHAFT INSTALLATION NARRATIVE

The Contractor must submit a shaft installation narrative to the Engineer. In preparing the narrative, the Contractor must reference the available subsurface data provided in the contract test hole boring logs, the summary of geotechnical conditions, and the geotechnical reports prepared for this project. This narrative must provide at least the following information:

1. Proposed overall construction operation sequence.
2. Description, size, and capacities of proposed equipment, including cranes, drills, auger, bailing buckets, final cleaning equipment, and drilling unit. The narrative must describe why the equipment was selected and describe equipment suitability to the anticipated site conditions and work methods. The narrative must include a project history of the drilling equipment demonstrating the successful use of the equipment on shafts of equal or greater size in similar soil/rock conditions. The narrative must also include details of shaft excavation and cleanout methods.
3. Details of the methods to be used during excavation, excavation pauses or stoppages, and concrete placement, to ensure shaft stability including prevention of caving, bottom heave, using temporary casing, slurry, or other means. If permanent casings are required, casing dimensions and detailed procedures for installation must be provided.
4. A slurry mix design, including all additives and their specific purpose in the slurry mix, with a discussion of its suitability to the anticipated subsurface conditions, must be submitted and include the procedures for mixing, using, and maintaining the slurry. A detailed plan for quality control of the selected slurry, including tests to be performed, test methods to be used, and minimum and maximum property requirements which must be met to ensure the slurry functions as intended, considering the anticipated subsurface conditions and shaft construction methods, in accordance with the slurry manufacturer's recommendations and these specifications must be included. As a minimum, the slurry quality control plan must include the following tests:

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Property	Test Method
Density	Mud Weight (Density), API 13B-1, Section 1
Viscosity	Marsh Funnel and Cup, API 13B-1, Section 2.2
pH	Glass Electrode, pH Meter, or pH Paper
Sand Content	Sand, API 13B-1, Section 5

5. Description of the method used to fill or eliminate all voids below the top of shaft between the plan shaft diameter and excavated shaft diameter, when permanent casing is specified.
6. Details of concrete placement, including proposed operational procedures for pumping methods, and a sample uniform yield form to be used by the Contractor for plotting the approximate volume of concrete placed versus the depth of shaft for all shaft concrete placement, except concrete placement in the dry.
7. When shafts are constructed in water, the submittal must include seal thickness calculations, seal placement procedure, and descriptions of provisions for casing shoring dewatering and flooding.
8. Description and details of the storage and disposal plan for excavated material and drilling slurry, if applicable.
9. Reinforcing steel Shop Drawings with details of reinforcement placement, including bracing, centering, and lifting methods, and the method to ensure the reinforcing cage position is maintained during construction, including use of bar boots and rebar cage base plates, and including placement of rock backfill below the bottom of shaft elevation, provided the conditions of Section 6-12.3(5)D are satisfied.

The reinforcing steel Shop Drawings and shaft installation narrative must include, at a minimum:

a. Procedure and sequence of steel reinforcing bar cage assembly.
b. The tie pattern, tie types, and tie wire gages for all ties on permanent reinforcing and temporary bracing.
c. Number and location of primary handling steel reinforcing bars used during lifting operations.
d. Type and location of all steel reinforcing bar splices.
e. Details and orientation of all internal cross-bracing, including a description of connections to the steel reinforcing bar cage.
f. Description of how temporary bracing will be removed.
g. Location of support points during transportation.
h. Cage weight and location of the center of gravity.
i. Number and location of pick points used for lifting for installation and for transport, if assembled off-site.
j. Crane charts and a description and/or catalog cuts for all spreaders, blocks, sheaves, and chockers used to equalize or control lifting loads.
k. The sequence and minimum inclination angle at which intermediate belly rigging lines, if used, are released.
l. Pick point loads at 0, 45, 60, and 90 degrees and at all intermediate stages of inclination where rigging lines are engaged or slackened.
m. Methods and temporary supports required for cage splicing.
n. For picks involving multiple cranes, the relative locations of the boom tips at various stages of lifting, along with corresponding net horizontal forces imposed on each crane.

The Engineer will evaluate the shaft installation narrative for conformance with the Contract within the review time specified. The Engineer may schedule a Shaft Installation Narrative Submittal Teleconference Meeting following review of the Contractor's initial submittal of the narrative and prior to Owner's formal response to the initial submittal. Teleconference participants must include the superintendent, on-site supervisors, and other Contractor personnel involved in the preparation of the shaft installation narrative. The Engineer, key inspection personnel, and other representatives from the Owner will also participate in the teleconference.

6-12.3(2)C SHAFT SLURRY TECHNICAL ASSISTANCE

If slurry other than water slurry is used to construct the shafts, the Contractor must provide or arrange for technical assistance in the use of the slurry as specified in Section 6-12.3(4)A. The Contractor must submit the following to the Engineer:

1. The name and current phone number of the slurry manufacturer's technical representative assigned to the project, and the frequency of scheduled visits to the project site by the synthetic slurry manufacturer's representative.
2. The names of the Contractor's personnel assigned to the project and trained by the slurry manufacturer in the proper use of the slurry. The submittal must include a signed training certification letter from the slurry manufacturer for each trained Contractor's employee listed, including the date of the training.

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6-12.3(2)D NONDESTRUCTIVE QA TESTING ORGANIZATION AND PERSONNEL

The Contractor must submit the names of the testing organizations, and the names of the personnel who will conduct nondestructive QA testing of shafts. The submittal must include documentation that the qualifications specified below are satisfied. For TIP testing, the testing organization is the group that performs the data analysis and produces the final report. The testing organizations and the testing personnel must meet the following minimum qualifications:

1. The testing organization must have performed nondestructive tests on a minimum of 3 deep foundation projects in the last 2 years.
2. Personnel conducting the tests for the testing organization must have a minimum of 1 year of experience in nondestructive testing and interpretation.
3. The experience requirements for the organization and personnel must be consistent with the testing methods the Contractor has selected for nondestructive testing of shafts.
4. Personnel preparing test reports must be a Professional Engineer, licensed under Title 18 RCW, State of Washington, and seal the report in accordance with WAC 196-23-020.

6-12.3(3) SHAFT EXCAVATION

Shafts must be excavated to the required depth as shown on the Drawings. Shaft excavation operations must be as specified in this Section and the shaft installation narrative approved by the Engineer.

Shaft excavation must not be started until the Contractor has received the Engineer's acceptance for the reinforcing steel centralizers required when the casing will be pulled during concrete placement.

The Contractor must not commence subsequent shaft excavations, except as approved by the Engineer under this Section, until receiving the Engineer's acceptance of the first shaft, based on the results and analysis of the nondestructive testing for the first shaft.

The Engineer may permit continuing with shaft construction based on the Engineer's observations of the construction of the first shaft, including conformance to the shaft installation narrative as specified in Section 6-12.3(2)B, and the Engineer's review of Contractor's daily reports and Inspector's daily logs concerning excavation, steel reinforcing bar placement, and concrete placement.

6-12.3(3)A CONDUCT OF SHAFT EXCAVATION OPERATIONS

Once the excavation operation has been started, the excavation must be conducted in a continuous operation until the excavation of the shaft is completed using approved equipment capable of excavating through the type of material expected. Pauses during this excavation operation are not allowed, except for casing splicing, tooling changes, slurry maintenance, and removal of obstructions.

Pauses are defined as momentary interruptions of the excavation operation for casing splicing, tooling changes, slurry maintenance, and removal of obstructions. Shaft excavation operation interruptions not conforming to this definition are considered stops. Stops for uncased and partially cased excavations must not exceed a 16-hour duration. Stops for fully cased excavations, excavations in rock, and excavations with casing seated into rock, must not exceed 65-hour duration.

For stops exceeding the time durations specified above, the Contractor must stabilize the excavation using one or both of the following methods:

1. For an uncased excavation, before the end of the work Day, install casing in the hole to the depth of the excavation. The outside diameter of the casing must not be smaller than 6 inches less than either the plan diameter of the shaft or the actual excavated diameter of the hole, whichever is greater. Prior to removing the casing and resumption of shaft excavation, the annular space between the casing and the excavation must be sounded. If the sounding operation indicates that caving has occurred, the casing must not be removed, and shaft excavation must not resume until the Contractor has stabilized the excavation per the approved shaft installation narrative, see Section 6-12.3(2)B, item 3.
2. For both a cased and uncased excavation, backfill the hole with either CDF or granular material. The Contractor must backfill the hole to the ground surface, if the excavation is not cased, or to a minimum of 5 feet above the bottom of casing (temporary or permanent), if the excavation is cased. Backfilling of shafts with casing fully seated into rock, as determined by the Engineer, will not be required.

During stops, the Contractor must stabilize the shaft excavation to prevent bottom heave, caving, head loss, and loss of ground. The Contractor bears full responsibility for selection and execution of the methods of stabilizing and maintaining the shaft excavation, see Section 1-07.13. Shaft stabilization must be per the approved shaft installation narrative, see Section 6-12.3(2)B, item 3.

If slurry is present in the shaft excavation, the maintenance of the slurry and the minimum level of drilling slurry throughout the stoppage of the shaft excavation operation must be as specified in Section 6-12.3(4)B. Recondition the slurry to the required slurry properties as specified in Section 9-39.2 before restarting shaft excavation operations.

6-12.3(3)B TEMPORARY AND PERMANENT SHAFT CASING

The Contractor must furnish and install required temporary and permanent shaft casings as shown on the Drawings and as specified.

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6-12.3(3)B1 GENERAL SHAFT CASING REQUIREMENTS

Shaft casing must be watertight and clean prior to placement in the excavation.

The outside diameter of the casing must not be less than the specified diameter of the shaft. The inside diameter of the casing must not be greater than the specified diameter of the shaft plus 6 inches, except as otherwise noted for shafts 5 feet or less in diameter, and as otherwise noted in Section 6-12.3(3)B4 for temporary telescoping casing. The inside diameter of casings for shafts 5 feet or less in diameter must not be greater than the specified diameter of the shaft plus 1 foot.

6-12.3(3)B2 PERMANENT SHAFT CASING

Permanent casing is defined as casing designed as part of the shaft structure and installed to remain in place after construction is complete. All permanent casing must be of ample strength to resist damage and deformation from transportation and handling, installation stresses, and all pressures and forces acting on the casing. Where the minimum thickness of permanent casing is specified in the Drawings, it is specified to satisfy structural design requirements only. The Contractor must increase the casing thickness as necessary to satisfy the requirements of this Section.

6-12.3(3)B3 TEMPORARY SHAFT CASING

Temporary casing is defined as casing installed to facilitate shaft construction only, which is not designed as part of the shaft structure, and which must be completely removed after shaft construction is complete unless otherwise shown on the Drawings. All temporary casing must be of ample strength to resist damage and deformation from transportation and handling, installation and extraction stresses, and all pressures and forces acting on the casing. The casing must be capable of being removed without deforming and causing damage to the completed shaft and without disturbing the surrounding soil.

To maintain stable excavations and to facilitate construction, the Contractor may furnish and install temporary casing in addition to the required casing specified. The Contractor must provide temporary casing at the site in sufficient quantities to meet the needs of the anticipated construction method.

6-12.3(3)B4 TEMPORARY TELESCOPING SHAFT CASING

Where the acceleration coefficient used for seismic design of the structure, as specified in the general notes and foundation notes on the Drawings, is less than or equal to 0.16, the Contractor may use temporary telescoping casing for the shafts at any bridge intermediate or interior pier, subject to the following conditions:

1. The Contractor must submit the request to use temporary telescoping casing to the Engineer for approval. The request must specify the diameters of the temporary telescoping casing and must specify the shafts where use is requested. The Contractor must not proceed with the use of temporary telescoping casing until receiving the Engineer's approval.
2. The minimum diameter of the shaft must be as shown on the Drawings.
3. The temporary telescoping casing must be as specified in Sections 6-12.3(3)B1, 6-12.3(3)B3, and must be a smooth wall structure of steel base metal, except where corrugated metal pipe is shown on the Drawings as an acceptable alternative material.

The Contractor may use temporary telescoping casing for the shafts of any bridge end pier, regardless of the acceleration coefficient used for the seismic design of the structure, subject to conditions 2 and 3 specified above and the following two additional conditions:

a. A maximum of two telescoping casing diameter changes will be allowed.
b. The maximum diameter change at each casing diameter transition is 12 inches.

6-12.3(3)B5 PERMANENT SLIP CASING

Permanent slip casing is defined as casing installed vertically inside the temporary casing within the limits of the column-shaft splice zone, and wet-set into the shaft concrete no more than 3 feet below the column-shaft construction joint, allowing subsequent removal of the temporary casing. The casing diameter requirements of Section 6-12.3(3)B1 do not apply to permanent slip casing, but the inside diameter of the permanent slip casing must provide the steel reinforcing bar clearance specified in Section 6-12.3(5)C.

6-12.3(3)C CONDUCT OF SHAFT CASING INSTALLATION AND REMOVAL AND SHAFT EXCACATION OPERATIONS

The Contractor must conduct casing installation and removal operations and shaft excavation operations to ensure the adjacent soil outside the casing and shaft excavation for the full height of the shaft is not disturbed. Disturbed soil is defined as soil whose geotechnical properties have been changed from those of the original in situ soil, and whose altered condition adversely affects the structural integrity of the shaft foundation. Shaft excavation and casing placement must not extend below the bottom of shaft excavation shown on the Drawings.

6-12.3(3)D BOTTOM OF SHAFT EXCAVATION

The Contractor must use appropriate means such as a cleanout bucket or air lift to clean the bottom of the excavation of all shafts. No more than 2 inches of loose or disturbed material may be present at the bottom of the shaft prior to placing concrete.

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The excavated shaft must be inspected and approved by the Engineer prior to proceeding with construction. The bottom of the excavated shaft must be sounded with an airlift pipe, a tape with a heavy weight attached to the end of the tape, or other means acceptable to the Engineer to determine that the shaft bottom meets the requirements in the Contract.

6-12.3(3)E SHAFT OBSTRUCTIONS

When obstructions are encountered, the Contractor must notify the Engineer promptly. An obstruction is defined as a specific object, including boulders, logs, and man-made objects, encountered during the shaft excavation operation which prevents or hinders the advance of the shaft excavation. When efforts to advance past the obstruction to the design shaft tip elevation result in the rate of advance of the shaft drilling equipment being significantly reduced relative to the rate of advance for the portion of the shaft excavation in the geological unit that contains the obstruction, then the Contractor must remove, break up, or push aside the obstruction.

Such conditions are considered differing site conditions as specified in Section 1-04.6. The method of dealing with such obstructions, and the continuation of excavation must be as proposed by the Contractor and approved by the Engineer. The method of dealing with potential obstructions must be reviewed and approved by the Engineer prior to commencement of shaft excavation.

6-12.3(3)F VOIDS BETWEEN PERMANENT CASING AND SHAFT EXCAVATION

When permanent casing is specified, excavation must conform to the specified outside diameter of the shaft. After the casing has been filled with concrete, all void space occurring between the casing and shaft excavation must be filled with a material which approximates the geotechnical properties of the in-situ soils, per the approved shaft installation narrative, see Section 6-12.3(2)B, item 5, and as approved by the Engineer.

6-12.3(3)G OPERATING SHAFT EXCAVATION EQUIPMENT FROM AN EXISTING BRIDGE

Drilling equipment must not be operated from an existing bridge, without written approval from the Engineer. The Contractor must submit a written request to operate drilling equipment from an existing bridge to the Engineer for approval as specified in Section 6-01.5. The request must include documentation that such operation is required to complete the Work, and that such operation can be completed safely.

6-12.3(3)H SEALS FOR SHAFT EXCAVATION IN WATER

When shafts are constructed in water and the Drawings show a seal between the casing shoring and the upper portion of the permanent casing of the shaft, the Contractor must construct a seal per the approved shaft installation narrative, see Section 6-12.3(2)B, item 7.

Concrete for the casing shoring seal must be Class 4000W as specified in Section 6-02.

The seal thickness shown on the Drawings is designed to resist the hydrostatic uplift force with the corresponding seal weight and adhesion of the seal to the permanent casing and the casing shoring of 20 psi, based on the casing shoring dimension and the seal vent water surface elevation specified in the Drawings. If the Contractor uses a casing shoring diameter other than that specified in the Drawings, the Contractor must submit a revised seal design to the Engineer for approval, see Section 6-12.3(2)B, item 7.

6-12.3(3)I REQUIRED USE OF SLURRY IN SHAFT EXCAVATION

If at any time the rate of water entering the shaft is 12 inches per hour or more, the Contractor must use slurry, see Section 6-12.3(4), to maintain a stable shaft during excavation and concrete placement operations. If concrete will be placed in the dry, the Contractor must pump all accumulated water in the shaft excavation down to a 3-inch maximum depth prior to beginning concrete placement operations.

6-12.3(4) SLURRY INSTALLATION REQUIREMENTS

6-12.3(4)A SLURRY TECHNICAL ASSISTANCE

If slurry other than water slurry is used, the approved manufacturer's representative, see Section 6-12.3(2)C, must:

1. Provide technical assistance for the use of the slurry,
2. Be at the site prior to introduction of the slurry into the first drilled hole requiring slurry, and
3. Remain at the site during the construction of at least the first shaft excavated to adjust the slurry mix to the specific site conditions.

After the manufacturer's representative is no longer present at the site, the Contractor's employee trained in the use of the slurry, see Section 6-12.3(2)C, must be present at the site throughout the remainder of shaft slurry operations for this project to perform the duties specified in items 1 through 3 above.

6-12.3(4)B MINIMUM LEVEL OF SLURRY IN THE EXCAVATION

When slurry is used in a shaft excavation the following is required:

1. The height of the slurry must be as required to provide and maintain a stable hole to prevent bottom heave, caving, or sloughing of all unstable zones.
2. The Contractor must provide casing, or other means, as necessary to meet these requirements.

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3. The slurry level in the shaft while excavating must be maintained above the groundwater level the greater of the following dimensions:
   a. Not less than 5 feet for mineral slurries.
   b. Not less than 10 feet for water slurries.
   c. Not less than 10 feet for synthetic slurries.
4. The slurry level in the shaft throughout all stops as specified in Section 6-12.3(3)A and during concrete placement as specified in Section 6-12.3(7) must be no lower than the water level elevation outside the shaft.

6-12.3(4)C SLURRY SAMPLING AND TESTING

Mineral slurry and synthetic slurry must be mixed and thoroughly hydrated in slurry tanks, ponds, or storage areas. The Contractor must draw sample sets from the slurry storage facility and test the samples for conformance with the specified viscosity and pH properties before beginning slurry placement in the drilled hole. Mineral slurry must be as specified in Section 9-39.2(1). Synthetic slurry must be as specified in Section 9-39.2(2) and 6-12.3(2)B item 4, and as approved by the Engineer. A sample set must be composed of samples taken at mid-height and within 2 feet of the bottom of the storage area.

When synthetic slurry is used, the Contractor must keep a written record of all additives and concentrations of the additives in the synthetic slurry. These records must be provided to the Engineer once the slurry system has been established in the first drilled shaft on the project. The Contractor must provide revised data to the Engineer if changes are made to the type or concentration of additives during construction.

The Contractor must sample and test all slurry in the presence of the Engineer, unless otherwise directed. The date, time, names of the persons sampling and testing the slurry, and the results of the tests must be recorded. A copy of the recorded slurry test results must be submitted to the Engineer at the completion of each shaft, and during construction of each shaft when requested by the Engineer.

Sample sets of all slurry, composed of samples taken at mid-height and within 2 feet of the bottom of the shaft and the storage area, must be taken and tested once every 4 hours minimum at the beginning and during drilling shifts and prior to cleaning the bottom of the hole to verify the control of the viscosity and pH properties of the slurry. Sample sets of all slurry must be taken and tested at least once every 2 hours if the previous sample set did not have consistent viscosity and pH properties. All slurry must be recirculated, or agitated with the drilling equipment, when tests show that the sample sets do not have consistent viscosity and pH properties. Cleaning of the bottom of the hole must not begin until tests show that the samples taken at mid-height and within 2 feet of the bottom of the hole have consistent viscosity and pH properties.

Sample sets of all slurry, as specified in the Contract, must be taken and tested to verify control of the viscosity, pH, density, and sand content properties after final cleaning of the bottom of the hole just prior to placing concrete. Placement of the concrete must not start until tests show that the samples taken at mid-height and within 2 feet of the bottom of the hole have consistent specified properties.

6-12.3(4)D MAINTENANCE OF REQUIRED SLURRY PROPERTIES

The Contractor must clean, recirculate, de-sand, or replace the slurry to maintain the required slurry properties.

6-12.3(4)E MAINTENANCE OF A STABLE SHAFT EXCAVATION

The Contractor must demonstrate to the satisfaction of the Engineer that stable conditions are being maintained. If the Engineer determines that stable conditions are not being maintained, the Contractor must immediately stabilize the shaft. The Contractor must submit a revised shaft installation narrative that addresses the problem and prevents future instability. Do not continue with shaft construction until all damage is repaired per the specifications, and until receiving the Engineer's approval of the revised shaft installation narrative.

When mineral slurry as specified in Section 9-39.2(1) is used to stabilize the unfilled portion of the shaft, the Contractor must remove the excess slurry buildup inside of the shaft diameter prior to continuing with concrete placement. The Contractor must use the same methods of shaft excavation and the same diameter of drill tools to remove the excess slurry buildup as was used to excavate the shaft to its current depth.

6-12.3(4)F DISPOSAL OF SLURRY AND SLURRY CONTACTED SPOILS

The Contractor must manage and dispose of the slurry wastewater as specified in Section 8-01.3. Slurry-contacted spoils must be disposed of as specified in the shaft installation narrative, see Section 6-12.3(2)B, item 8, and as specified below:

1. Uncontaminated spoils in contact with water-only slurry may be disposed of as clean fill.
2. Uncontaminated spoils in contact with water slurry mixed with flocculants approved in Section 8-01.3(2)D1 may be disposed of as clean fill away from areas that drain to surface waters of the state or that could impact groundwater as specified under 8-01.3(2)D1.
3. Spoils in contact with synthetic slurry or water slurry with polymer-based additives or flocculants not approved in Section 8-01.3(2)D1 must be disposed of as specified in Section 1-07.3. With permission of the Engineer, the Contractor may re-use these spoils on-site.
4. Spoils in contact with mineral slurry must be disposed of as specified in Section 1-07.3. With permission of the Engineer, the Contractor may re-use these spoils on-site.

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6-12.3(5) ASSEMBLY AND PLACEMENT OF REINFORCING STEEL

6-12.3(5)A STEEL REINFORCING BAR CAGE ASSEMBLY

The reinforcing cage must be rigidly braced to retain its configuration during handling and construction. Individual or loose bars will not be permitted. The Contractor must show bracing and extra reinforcing steel required for fabrication of the cage on the Shop Drawings. Shaft reinforcing bar cages must be supported on a continuous surface to the extent possible. All rigging connections must be located at primary handling bars, as identified in the reinforcing steel assembly and installation plan as approved by the Engineer. Internal bracing is required at each support and lift point.

The reinforcement must be carefully positioned and securely fastened to provide the minimum clearances listed below, and to ensure no displacement of the reinforcing steel bars occurs during placement of the concrete. The steel reinforcing bars must be securely held in position throughout the concrete placement operation.

6-12.3(5)B STEEL REINFORCING BAR CAGE CENTRALIZERS

The Contractor must submit details of the proposed reinforcing cage centralizers along with the shop drawings. The reinforcing steel centralizers at each longitudinal space plane must be placed at least at the quarter points around the circumference of the steel reinforcing bar cage, and at a maximum longitudinal spacing of either 2.5 times the shaft diameter or 20 feet, whichever is less. The Contractor must furnish and install additional centralizers as required to maintain the specified concrete cover throughout the length of the shaft.

6-12.3(5)C CONCRETE COVER OVER STEEL REINFORCING BARS

Steel reinforcing bars must be placed as shown on the Drawings with minimum concrete cover as shown below:

Shaft Diameter (feet)	Minimum Concrete Cover, Except at Permanent Slip Casing (Inches)	Concrete Cover Tolerance, Except at Permanent Slip Casing (Inches)	Minimum Concrete Cover at Permanent Slip Casing (inches)
Less than or equal to 3	3	-1 1/2	1 1/2
Greater than 3 and less than 4	4	-2	1 1/2
Greater than or equal to 4 and less than 5	4	-2	2
5 or larger	6	-3	3

The concrete cover tolerances specified above apply to the concrete cover specified in the Drawings, even if they exceed the minimum concrete cover.

6-12.3(5)D STEEL REINFORCING BAR CAGE SUPPORT AT BASE OF SHAFT EXCAVATION

For shafts with temporary casing within 15 feet of the bottom of shaft elevation as shown on the Drawings, the Contractor may place quarry spalls or other rock backfill approved by the Engineer into the shaft below the specified bottom of shaft elevation as a means to support the steel reinforcing bar cage, provided that the materials and means to accomplish this have been addressed by the shaft installation narrative, as specified in Section 6-12.3(2)B, item 9. The use of bar boots and/or rebar cage base plates is required when quarry spalls or other rock backfill is placed at the base of the shaft excavation.

6-12.3(6) CONTRACTOR FURNISHED ACCESSORIES FOR NONDESTRUCTIVE QA TESTING

6-12.3(6)A SHAFTS REQUIRING ACCESS TUBES

The Contractor must furnish and install access tubes in all shafts receiving CSL testing or the thermal probe method of TIP testing except as specified in Section 6-12.3(1)B1.

6-12.3(6)B ORIENTATION AND ASSEMBLY OF THE ACCESS TUBES

The Contractor must securely attach the access tubes to the interior of the reinforcement cage of the shaft. One access tube must be furnished and installed for each foot of shaft diameter, rounded to the nearest whole number, as shown on the Drawings. The number of access tubes for shaft diameters specified as “X feet Y inches”, where Y is equal to or larger than 6, must be rounded up to the next higher whole number. The access tubes must be placed around the shaft, inside the spiral or hoop reinforcement, and bundled with the vertical reinforcement. Where circumferential components of the rebar cage bracing system prevent bundling the access tubes directly to the vertical reinforcement, the access tubes must be placed inside the circumferential components of the rebar cage bracing system as close as possible to the nearest vertical steel reinforcement bar.

The access tubes must be installed in straight alignment and as near to parallel to the vertical axis of the reinforcement cage as possible. The access tubes must extend from the bottom of the reinforcement cage to a minimum of 2 feet above

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finished ground. Splice joints in the access tubes, if required to achieve full length access tubes, must be watertight. The Contractor must clear the access tubes of all debris and extraneous materials before installing the access tubes. The tops of access tubes must be deburred. Prevent damage to the access tubes during reinforcement cage installation and concrete placement operations in the shaft excavation.

6-12.3(6)C CARE FOR ACCESS TUBES

The access tubes must be filled with potable water before concrete placement, and the top watertight PVC caps must be reinstalled and secured as specified in Section 9-39.4. The Contractor must keep all of a shaft's access tubes full of water through the completion of nondestructive QA testing of that shaft. When temperatures below freezing are possible, the Contractor must protect the access tubes against freezing by wrapping the exposed tubes with insulating material, adding antifreeze to the water in the tubes, or other methods as approved by the Engineer.

6-12.3(6)D SHAFTS REQUIRING THERMAL WIRE

The Contractor must furnish and install thermal wire in all shafts receiving the thermal wire method of TIP testing, except as otherwise specified in Section 6-12.3(1)B1.

6-12.3(6)E THERMAL WIRE AND THERMAL ACCESS POINTS (TAPS)

The thermal wire and associated couplers must be obtained from an approved source unless specified in the Contract.

The Contractor must securely attach the thermal wire to the interior of the reinforcement cage of the shaft in conformance with the Supplier's instructions. At a minimum, one thermal wire must be furnished and installed for each foot of shaft diameter, rounded to the nearest whole number. The number of thermal wires for shaft diameters specified as "X feet 6 inches", must be rounded up to the next higher whole number. The thermal wires must be placed around the shaft, inside the spiral or hoop reinforcement, and tied to the vertical reinforcement with plastic ties at a maximum spacing of 2 feet. Steel tie wire must not be used.

The thermal wire must be installed in straight alignment and taut, but with enough slack to not be damaged during reinforcing cage lofting. The wires must be as near to parallel to the vertical axis of the reinforcement cage as possible. The thermal wire must extend from the bottom of the reinforcement cage to the top of the shaft, with a minimum of 5 feet of slack wire provided above the top of shaft. All thermal wires in a shaft must be of equal length. Prevent damaging the thermal wires during reinforcement cage installation and concrete placement operations in the shaft excavation.

After completing shaft reinforcement cage fabrication at the site and prior to installation of the cage into the shaft excavation, the Contractor must install and connect thermal access points (TAPs) to the thermal wires. The TAPs must record data for at least 1 hour after the cage is placed in the excavation to measure the slurry temperature and ensure the steel and slurry temperatures have equilibrated prior to placing concrete in the shaft. The TAPs must record and store data every 15 minutes. The TAPs must remain active for a minimum of 36 hours.

Prior to beginning concrete placement, the TAPs must be checked to ensure they are recording data and that the wires have not been damaged. If a TAP unit is not functioning due to a damaged wire, the Contractor must repair or replace the wire. If a TAP unit fails or a wire breaks after concrete placement has started, the Contractor must not stop the concrete placement operation to repair the wire.

6-12.3(6)F ACCESS TUBES FOR THERMAL PROBE METHOD TIP TESTING

The Contractor may use access tubes for TIP testing under the thermal probe method. Access tubes must be cared for as specified in Section 6-12.3(6)C. Prior to TIP testing under the thermal probe method, the water in each tube must be removed, collected, and stored in an insulated container. The access tube must be blown dry and swabbed to remove residual water. After TIP testing, the collected and stored tube water must be introduced back into the access tube. New potable water may be used, provided the water temperature is not more than 10 degrees F cooler than the average concrete temperature measured by the probe.

6-12.3(7) PLACING CONCRETE

6-12.3(7)A CONCRETE CLASS FOR SHAFT CONCRETE

Shaft concrete must be Class 5000P as specified in Section 6-02.

6-12.3(7)B CONCRETE PLACEMENT REQUIREMENTS

Concrete placement must begin immediately after completion of excavation by the Contractor and inspection by the Engineer. Immediately before starting concrete placement, the shaft excavation and the properties of the slurry must be as specified in Sections 6-12.3(3)D and 6-12.3(4), respectively. Concrete placement must continue in one operation to the top of the shaft, or as shown on the Drawings. The Contractor must place concrete between the upper construction joint of the shaft and the top of the shaft in the dry.

During concrete placement, the Contractor must monitor, and minimize, the difference in the level of concrete inside and outside of the steel reinforcing bar cage. The Contractor must conduct concrete placement operations to maintain the differential concrete head as 1-foot maximum.

If water is not present, the concrete must be deposited through the center of the reinforcement cage by a method that prevents segregation of aggregates and splashing of concrete on the reinforcement cage. The concrete must be placed such

that the free-fall is vertical down the center of the shaft without hitting the sides, the steel reinforcing bars, or the steel reinforcing bar cage bracing. The Section 6-02.3(6) restriction for 5 feet maximum free fall does not apply to placement of concrete into a shaft.

6-12.3(7)C CONCRETE VIBRATION REQUIREMENTS

When placing concrete in the dry, only the top 5 feet of concrete must be vibrated, as specified in Section 6-02.3(9), except that the entire depth of concrete placed in the shaft-column steel reinforcing bar splice zone must be vibrated. If a temporary casing is used, it must be removed before vibration. This requirement may be waived if a temporary casing is used and removed with a vibratory hammer during the concrete placement operation. Vibration of concrete does not affect the maximum slump allowed for the concrete class specified.

6-12.3(7)D PLACING CONCRETE UNDERWATER

When placing concrete underwater, including when water in a shaft excavation exceeds 3 inches in depth, the Contractor must place the concrete by pressure feed using a concrete pump, with a watertight tube having a minimum diameter of 4 inches. The discharge end of the tube on the concrete pump must include a device to seal out water while the tube is first filled with concrete. Alternatively, the Contractor may use a plug that is inserted at the hopper of the concrete pump and travels through the tube to keep the concrete separated from the water and slurry. Concrete placement by gravity feed is not allowed.

Throughout the underwater concrete placement operation, the discharge end of the tube must remain submerged in the concrete at least 5 feet and the tube must always contain enough concrete to prevent water from entering. The concrete placement must be continuous until the work is completed, resulting in a seamless, uniform shaft.

6-12.3(7)E TESTING AND REPAIR OF SHAFT CONCRETE PLACED UNDERWATER

If the underwater concrete placement operation is interrupted, the Engineer may require the Contractor to prove by core drilling or other tests that the shaft contains no voids or horizontal joints. If testing reveals voids or joints, the Contractor must repair them or replace the shaft at no expense to the Owner. Responsibility for coring costs, and calculation of time extension, must be as specified in Section 6-12.3(9)H.

6-12.3(7)F CLEANING AND REMOVAL OF PREVIOUSLY PLACED SHAFT CONCRETE

Before placing fresh concrete against concrete deposited in water or slurry, the Contractor must remove all scum, laitance, loose gravel, and sediment on the upper surface of the concrete deposited in water or slurry and chip off high spots on the upper surface of the existing concrete that would prevent the steel reinforcing bar cage from being placed in the position shown on the Drawings.

Prior to performing QA testing operations specified in Section 6-12.3(9), the Contractor must remove the concrete at the top of the shaft down to sound concrete.

6-12.3(7)G PROTECTION OF FRESH AND CURING CONCRETE FROM VIBRATION

The Contractor's construction operation in the vicinity of a shaft excavation with freshly placed concrete and curing concrete must be as specified in Section 6-02.3(6)D.

6-12.3(7)H UNIFORM YIELD FORM

Except for shafts where the shaft concrete is placed in the dry, the Contractor must complete a uniform yield form, consistent with the sample form submitted to the Engineer as part of the shaft installation narrative as specified in Section 6-12.3(2)B, item 6, for each shaft and must submit the completed form to the Engineer within 24 hours of completing the concrete placement in the shaft.

6-12.3(7)I REQUIREMENTS FOR PLACING CONCRETE ABOVE THE TOP OF SHAFT

Concrete must not be placed above the top of shaft for column splice zones, columns, footings, or shaft caps until the Contractor receives the Engineer's acceptance of nondestructive QA testing, if performed at that shaft, and acceptance of the shaft.

6-12.3(8) CASING REMOVAL

6-12.3(8)A CONCRETE HEAD REQUIREMENTS DURING TEMPORARY CASING REMOVAL

As the temporary casing is withdrawn, the Contractor must maintain the concrete and slurry inside the casing at a level sufficient to balance the hydrostatic pressure outside the casing.

6-12.3(8)B REMOVING PORTIONS OF PERMANENT CASING ABOVE THE TOP OF SHAFT

Tops of permanent casings for the shafts must be removed to the top of the shaft or finished groundline, whichever is lower, unless shown otherwise in the Drawings or directed otherwise by the Engineer. For those shafts constructed within a permanent body of water, tops of permanent casings for shafts must be removed to the low water elevation, unless directed otherwise by the Engineer.

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6-12.3(8)C REQUIREMENTS FOR LEAVING TEMPORARY CASING IN PLACE

The Contractor must completely remove all temporary casings, except as noted. The Contractor may leave some or all of the temporary casing in place provided the following Structural Shop Drawing submittals, prepared as specified in Section 1-05.3(12), are provided and approved:

1. Complete description of the portion of the temporary casing to remain.
2. Specific reasons for leaving the portion of the temporary casing in place.
3. Structural calculations, using the design specifications and design criteria specified in the General Notes of structure Drawings, as specified in Section 6-01.8, indicating that leaving the temporary casing in place is compatible with the structure as designed in the Drawings.

6-12.3(9) NONDESTRUCTIVE QA TESTING OF SHAFTS

The Contractor must provide nondestructive QA testing and analysis on all shafts with access tubes or thermal wires and TAPs facilitating the testing (See Section 6-12.3(1)B). The testing and analysis must be performed by the testing organizations identified by the Contractor's Submittal as specified in Section 6-12.3(2)D.

The Engineer may direct that additional testing be performed at a shaft if anomalies or a soft bottom are detected by the Contractor's testing. If additional testing at a shaft confirms the presence of a defects in the shaft, the testing costs and the delay costs resulting from the additional testing must be borne by the Contractor as specified in Section 1-05.6. If the additional testing indicates that the shaft has no defect, the testing costs and the delay costs resulting from the additional testing will be paid by the Owner as specified in Section 1-05.6, and, if the shaft construction is on the critical path of the Contractor's schedule, a time extension equal to the delay created by the additional testing may be granted as specified in Section 1-08.8.

6-12.3(9)A TIP TESTING USING THERMAL PROBE OR CSL TESTING

TIP or CSL testing must be performed after the shaft concrete has cured at least 96 hours. Additional curing time prior to testing may be required if the shaft concrete contains admixtures, such as set retarding admixture or water-reducing admixture, added as specified in Section 6-02.3(3). The additional curing time prior to testing required under these circumstances is not grounds for additional compensation or extension of time to the Contractor as specified in Section 1-08.8.

6-12.3(9)B INSPECTION OF ACCESS TUBES

After placing the shaft concrete and before beginning the crosshole sonic log testing of a shaft, the Contractor must inspect the access tubes. Each access tube that the test probe cannot pass through must be replaced, at the Contractor's expense, with a 2-inch diameter hole cored through the concrete for the entire length of the shaft.

Unless directed otherwise by the Engineer, cored holes must be located approximately 6 inches inside the reinforcement and must not damage the shaft reinforcement. The Contractor must submit to the Engineer, for review and approval per Section 1-05.3(3), a plan describing the conduct of the core hole drilling operation including measures to ensure core hole verticality and avoidance of reinforcement. Descriptions of inclusions and voids in cored holes must be logged and a copy of the log must be submitted to the Engineer. Findings from cored holes must be preserved, identified as to location, and made available for inspection by the Engineer.

6-12.3(9)C TIP TESTING WITH THERMAL WIRES AND TAPS

If selected as the nondestructive QA testing method by the Contractor, TIP testing with thermal wires and TAPs, see Section 6-12.3(6)E, must be performed. The TIP testing must commence at the beginning of the concrete placement operation, recording temperature readings at 15-minute intervals until the peak temperature is captured in the data. Additional curing time may be required if the shaft concrete contains admixtures, such as set retarding admixture or water-reducing admixture, added as specified in Section 6-02.3(3). The additional curing time required under these circumstances is not grounds for additional compensation or extension of time to the Contractor as specified in Section 1-08.8.

TIP testing must be conducted at all shafts in which thermal wires and TAPs have been installed for thermal wire analysis, see Section 6-12.3(6)A.

6-12.3(9)D NONDESTRUCTIVE QA TESTING RESULTS SUBMITTAL

The Contractor must submit the results and analysis of the nondestructive QA testing for each shaft tested. The Contractor must submit the test results within 3 Working Days of testing. Results must be presented in a written report prepared as specified in Section 1-05.3(12).

TIP reports must include:

a) A map or plot of the wire/tube location within the shaft and their position relative to a known and identifiable location, such as North.

b) Graphical displays of temperature measurements versus depth of each wire or tube for the analysis time selected, overall average temperature with depth, shaft radius or diameter with depth, concrete cover versus cage position with depth, and effective radius.

c) Identification of unusual temperatures, particularly significantly cooler local deviations from the overall average.

d) The location and extent where satisfactory or questionable concrete is identified. Satisfactory (S) concrete is identified where effective radius reduction is 0 to 6 percent and cover criteria is met. Questionable (Q) concrete is identified where effective local radius reduction is greater than 6 percent, where effective local average diameter reduction is greater than 4 percent, or where cover criteria is not met.

e) Variations in temperature between wire/tubes (at each depth) which in turn correspond to variations in cage alignment.

f) Where shaft specific construction information is available (e.g. elevations of the top of shaft, bottom of casing, bottom of shaft, etc.), these values must be noted on all pertinent graphical displays in the reports.

CSL reports must include:

1. A map or plot of the tube location within the shaft and their position relative to a known and identifiable location, such as North.
2. Graphical displays of CSL Energy versus Depth and CSL signal arrival time versus depth or velocity versus depth.
3. The location and extent where good, questionable, and poor concrete is identified, where no signal was received, or where water is present.
   a. Good (G) - No signal distortion and decrease in signal velocity of 10 percent or less is indicative of good quality concrete.
   b. Questionable (Q) - Minor signal distortion and a lower signal amplitude with a decrease in signal velocity between 10 percent and 20 percent.
   c. Poor (P) - Severe signal distortion and much lower signal amplitude with a decrease in signal velocity of 20 percent or more.
   d. No Signal (NS) - No signal was received.
   e. Water (W) - A measured signal velocity of nominally V = 4,800 to 5,000 fps.

All QA test reports will provide a recommendation to accept the shaft as-is, recommendation for further review by the Engineer, or will provide a plan for further testing, investigation, or repair to address all deficiencies identified by the testing.

6-12.3(9)E RESERVED

6-12.3(9)F CONTRACTOR'S INVESTIGATION AND REMEDIAL ACTION PLAN

For all shafts determined to be unacceptable, the Contractor must submit a plan for further investigation or remedial action to the Engineer for approval. All modifications to the dimensions of the shafts, as shown on the Drawings, required by the investigation and remedial action plan must be supported by calculations and shop drawings as specified in Section 6-01.8. All investigation and remedial correction procedures and designs must be submitted to the Engineer for approval.

6-12.3(9)G SHAFT REJECTION AND CONCRETE PLACEMENT OPERATION REVISIONS

If the Engineer determines that the concrete placed under slurry for a given shaft is structurally inadequate, that shaft will be rejected. The placement of concrete under slurry must be suspended until the Contractor submits to the Engineer written changes to the methods of shaft construction needed to prevent future structurally inadequate shafts and receives the Engineer's written approval of the submittal.

6-12.3(9)H CORED HOLES

At the Engineer's request, the Contractor must drill a corehole in any questionable quality shaft, as determined from CSL testing, or TIP testing, and analysis or by observation of the Engineer, to explore the shaft condition.

Prior to beginning coring, the Contractor must submit the method and equipment used to drill and remove cores from shaft concrete to the Engineer and receive the Engineer's written approval. The coring method and equipment must provide for complete core recovery and must minimize abrasion and erosion of the core.

If a defect is confirmed, the Contractor must pay for all coring costs as specified in Section 1-05.6. If no defect is encountered, the Owner will pay for all coring costs as specified in Section 1-05.6, and, if the shaft construction is on the critical path of the Contractor's schedule, compensation for the delay will be granted by an appropriate time extension as specified in Section 1-08.8. Materials and work necessary, including engineering analysis and redesign, to effect corrections for shaft defects must be furnished to the Engineer's satisfaction at no additional cost to the Owner.

6-12.3(9)I REQUIREMENTS FOR ACCESS TUBES AND CORED HOLES AFTER TESTING

All access tubes and cored holes must be dewatered and filled with grout as specified in Section 9-39.5 after tests are completed. The access tubes and cored holes must be filled using grout tubes that extend to the bottom of the tube or hole or into the grout already placed.

6-12.3(10) ENGINEER'S FINAL ACCEPTANCE OF SHAFTS

The Engineer will determine final acceptance of each shaft, based on the nondestructive QA test results and analysis for the tested shaft and will provide a response to the Contractor within 3 Working Days after receiving the test results and analysis submittal.

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6-12.4 MEASUREMENT

Constructing shafts will be measured by the linear foot. The linear foot measurement will be calculated using the top of shaft elevation and the bottom of shaft elevation for each shaft as shown on the Drawings.

Rock excavation for shaft, including haul, will be measured by the linear foot of shaft excavated. The linear feet measurement will be computed using the top of the rock line, defined as the highest bedrock point within the shaft diameter, and the bottom elevation shown on the Drawings.

QA shaft test will be measured per each shaft tested.

6-12.5 PAYMENT

1. **"Constructing (Size) Diam. Shaft"**, per linear foot.

The unit Contract Price per linear foot for "Constructing (Size) Diam. Shaft" must be full pay for performing the Work as specified in the Contract Documents, including:

a. Soil excavation for shaft, including all costs in connection with furnishing, mixing, placing, maintaining, containing, collecting, and disposing of all mineral, synthetic and water slurry, and disposing of groundwater collected by the excavated shaft.

b. Furnishing and placing temporary shaft casing, including temporary casing in addition to the required casing specified in the Special Provisions, and including all costs in connection with completely removing the casing after completing shaft construction.

c. Furnishing and placing permanent casing for shaft.

d. Furnishing and placing column silos and covers.

e. Casing shoring, including all costs in connection with furnishing and installing casing shoring above the specified upper limit for casing shoring but necessary to provide for sufficient water head pressure to resist artesian water pressure present in the shaft excavation, removing casing shoring, and placing seals when required.

f. Furnishing and placing steel reinforcing bar and epoxy-coated steel reinforcing bar, including furnishing and installing steel reinforcing bar centralizers.

g. Installation of CSL access tubes or thermal wires and TAPs.

h. Furnishing, placing and curing concrete to the top of shaft or to the construction joint at the base of the shaft-column splice zone as applicable.

Payment for "Constructing (Size) Diam. Shaft" will be made upon Engineer acceptance of the shaft, including completion of satisfactory QA shaft tests as applicable.

2. **"QA Shaft Test (Type)"**, per each.

The unit Contract Price per each for "QA Shaft Test (Type)" must be full pay for performing the Work as specified, including operating all associated accessories necessary to record and process data and develop the summary QA test reports.

3. **Other payment information**.

Payment for removing, breaking-up, or pushing aside shaft obstructions, will be made for the changes in shaft construction methods necessary to deal with the obstruction as specified in Section 1-09.4 and 1-09.6.

If drilled shaft tools, cutting teeth, casing or Kelly bar is damaged as a result of the obstruction removal work, the Contractor will be compensated for the costs to repair this equipment as specified in Section 1-09.6.

If shaft construction equipment is idled as a result of the Work required to deal with the obstruction and cannot be reasonably reassigned within the project, then standby payment for the idled equipment will be added to the payment calculations.

If labor is idled as a result of the Work required to deal with the obstruction and cannot be reasonably reassigned within the project, then all labor costs resulting from Contractor labor agreements and established Contractor policies will be added to the payment calculations.

END OF DIVISION

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DIVISION 7 STORM DRAIN, SANITARY AND COMBINED SEWERS, WATER MAINS AND RELATED STRUCTURES

SECTION 7-01 SUBSURFACE DRAINS

7-01.1 DESCRIPTION

Section 7-01 describes Work consisting of constructing subsurface drains as specified in the Contract. This Work includes installation of solid, slotted (see Standard Plan 291), and perforated pipe; filter Material; and filter fabric (geotextile). Subsurface drains must be constructed of gravel filter Material and may include perforated pipe and filter fabric as shown on the Drawings.

7-01.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Material	Section
Gravel Backfill for Drains	Section 9-03.10(4)
Pipe and Tubing	Section 9-05
Geotextiles	Section 9-37

Corrugated polyethylene drainage tubing drain pipe must be limited to less than 10 inches.

Corrugated polyethylene drain pipe must be limited to 12 inches minimum to 36 inches maximum.

PVC subsurface drain pipe must be limited to 6 inches minimum to 10 inches maximum.

Unless indicated otherwise in the Contract the above pipe sizes are inside diameter.

All reference to filter fabric means a geotextile Material as specified in Section 9-37. Class to be specified in Contract.

7-01.3 CONSTRUCTION REQUIREMENTS

7-01.3(1) EXCAVATION

Trenching is subject to the provisions of Section 2-04. Backfill and compaction is subject to the provisions of Section 2-10 and Section 2-11.

Work in excavation over 4 feet deep is subject to the provisions of Section 2-07.

Excavate trenches to the grade, line, and dimensions shown on the Drawings.

7-01.3(2) PLACING PIPE AND FILTER MATERIAL

See Section 2-15.3 for construction requirements except subsurface drains.

The filter Material for pipe must be damp when placed in the trench and be deposited uniformly on both sides of the pipe for the full width of the trench and to the springline of the pipe. Tamp the Material in 4-inch lifts to provide thorough compaction under and on each side of the pipe. Deposit succeeding lifts of gravel in 8-inch lifts and thoroughly compact to the depth shown on the Drawings.

Place the geotextile in the manner and at the locations as specified in the Contract. The surface to receive the geotextile, and the trench into which the geotextile is to be placed, must be free of obstructions and debris.

Should the geotextile be damaged during construction, repair the torn or punctured section by placing a piece of geotextile of sufficient size to cover the damaged area including a minimum 12-inch overlap with all surrounding geotextile. In places where the trench width is less than 1 foot, the minimum overlap must be the trench width.

Subsurface drains, as specified in Section 9-05, must be located as specified in the Contract.

Maintain clearances between drains and other utilities as specified in Section 1-07.17(2).

Install all drain pipe with the bell or larger end upstream. Drain pipe must be open, clean, clear of debris, and free draining.

7-01.3(3) JOINTS

Polyvinyl chloride drain pipe must be installed upstream with the bell end upstream, or solvent welded per manufacturer's instructions. Corrugated polyethylene drain pipe must be jointed with snap on, screw on, or wraparound coupling bands as recommended by the pipe manufacturer.

7-01.4 MEASUREMENT

Measurement for "Filter Material, (Type)" will be per cubic yard based on the neat line cross-section shown on the Drawings.

Measurement for geotextile will be as specified in Section 2-15.4.

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Measurement for "Pipe, Subsurface Drain, (Material), (Size)" will be by the linear foot measured along the centerline of the pipe from pipe end to pipe end.

7-01.5 PAYMENT

1. **"Pipe, Subsurface Drain, (Material), (Size)"**, per linear foot

The Bid Item price for "Pipe, Subsurface Drain, (Material), (Size)" includes all costs for the work required to furnish and install the pipe, excavate the pipe trench, backfill, compact and haul and dispose of excess excavated Material.

2. **"Filter Material, (Type)"**, per cubic yard

The Bid Item price for "Filter Material, (Type)" includes all costs for the work required to furnish, install, and compact the Mineral Aggregate filter Material shown on the Drawings, and also includes, when the subsurface drain is constructed of only gravel filter Material, the costs of the work required to excavate the trench and to haul and dispose of excess excavated Material.

3. **Other payment information**

Any part of the trench excavated below grade or to a greater width than specified in the Contract must be backfilled with filter Material as specified in the Contract at the Contractor's sole expense.

Payment for geotextile will be as specified in Section 2-15.5.

Payment for protective systems will be as specified in Section 2-07.5.

SECTION 7-02 RESERVED

SECTION 7-03 RESERVED

SECTION 7-04 RESERVED

SECTION 7-05 MAINTENANCE HOLES, CATCH BASINS, INLETS, JUNCTION BOXES AND BRIDGE DRAINS

7-05.1 DESCRIPTION

Section 7-05 describes Work consisting of constructing maintenance holes, catch basins, inlets, junction boxes, bridge drains, and the rebuilding or rechanneling of existing maintenance holes as specified in the Contract.

This Work also includes excavation, backfilling, and compaction as specified in Section 2-04, Section 2-10 and Section 2-11.

Work in excavations over 4 feet deep must comply with Section 2-07.

7-05.2 MATERIALS

Maintenance holes, catch basins, inlets, junction boxes, appurtenances, and related are specified in Section 9-12.

Maintenance holes, catch basins, and inlets must be constructed per the following Standard Plans:

Drainage Structure	Standard Plan
Maintenance Holes	204a through 212b
Catch Basins	240 through 243b and 260a through 261
Inlets	250 and 252 and 260a and 260b
Junction Boxes	277
Bridge Drains	290

Deviations from Standard Plans, except Material substitutions allowed in Section 9-12, require a Shop Drawing submitted by the Contractor and approval by the Engineer as specified in Section 1-05.3. Substitutions in Materials shown on the Standard Plans and allowed in Section 9-12 must comply with the requirements in Section 1-06.1. Concrete masonry units or concrete masonry rings may be used for adjustment of the casting to final street grade.

Joints between maintenance hole components must be rubber gaskets, conforming to ASTM C443.

The concrete mix for maintenance hole channels must be Class 3000, see Section 6-02.

Concrete for maintenance hole, catch basin, and inlet Structures must be Class 4000, see Section 6-02.

Precast maintenance hole components must conform to ASTM C 478 except as modified in Section 7-05.

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7-05.3 CONSTRUCTION REQUIREMENTS

7-05.3(1) MAINTENANCE HOLE

7-05.3(1)A FOUNDATION PREPARATION

7-05.3(1)A1 DEWATERING

Dewatering of maintenance hole and catch basin excavations must be as specified in Section 2-08.

7-05.3(1)A2 FOUNDATION PREPARATION

The foundation preparation for maintenance holes, catch basins and inlets is specified in Section 2-09.

7-05.3(1)B BEDDING AND FOUNDATION SUPPORT

Maintenance holes and catch basins constructed with precast base sections must be placed to grade on a 6-inch minimum thickness of Mineral Aggregate Type 9 per Section 9-03 mixed with 4 sacks of Portland cement per cubic yard of Mineral Aggregate, with sufficient water added to form a stabilized foundation. The mixed Material must be placed across the area of the excavation for the base to a minimum distance beyond the face of the maintenance hole as shown on the Standard Plans and must be graded to provide uniform bearing support with the precast base section.

All cast in place bases for maintenance holes and catch basins must be poured to grade on a properly prepared foundation as shown on the Standard Plans. Imported Mineral Aggregate Type 2, when required in the Contract, must be placed and compacted to the same limits specified in the paragraph above. The concrete base must comply with the requirements shown on the Standard Plans.

7-05.3(1)C REINFORCED CONCRETE

7-05.3(1)C1 CONCRETE MIXTURE

Concrete must comply with the requirements of Section 9-12.1.

7-05.3(1)C2 CURING

Upon completion of concrete casting, the precast components must be protected and cured in a moist atmosphere maintained by injection of steam for the requisite length of time and at the required temperature to develop the compressive strength required for maintenance hole components.

Precast components may also be water cured by any approved method that keeps the components continuously moist during the curing period. Type III Portland cement concrete must be cured for at least 3 Days. All other cast in place components must be moist cured for at least 7 Days.

A pigmented membrane curing compound may be applied instead of moist curing with prior approval of the Engineer.

7-05.3(1)D BASE SLAB

7-05.3(1)D1 GENERAL

Base slab thickness and reinforcement of the base slab must be per Standard Plan 204a through 212b.

7-05.3(1)D2 PRECAST BASE

The base section must be carefully placed on the prepared bedding so as to be fully and uniformly supported in true alignment and ensuring that all entering pipes can be inserted on proper grade.

All lift holes must be thoroughly wetted and then completely filled with mortar and smoothed both inside and out to ensure water tightness.

Reinforcement for precast base slab with integral risers must extend into the wall of the maintenance hole section and be tied to the longitudinal steel.

7-05.3(1)D3 CAST IN PLACE BASE

When the Drawings call for cast-in-place base, or the Contractor elects a cast-in-place base, the Contractor must submit a Shop Drawing of the reinforcing mat that meets the requirements of the Standard Plans.

Do not pour concrete before inspection by the Engineer.

7-05.3(1)E PRECAST WALL SECTIONS

Precast wall sections must comply with the requirements of ASTM C478.

All joints between precast sections must be rubber-gasketed and comply with the requirements of ASTM C443.

Place and align precast sections so as to provide vertical sides and vertical alignment of the ladder rungs.

The completed maintenance hole must be rigid, true to dimension, and water tight. No more than 2 lift holes must be cast into each section. Locate holes so as to not damage reinforcing or expose it to corrosion. All lift holes must be thoroughly wetted and then completely filled with mortar and smoothed both inside and out to ensure water tightness. At the manufacturer's option, steel loops may be provided for handling instead of lift holes. When loops have been provided instead

of lift holes, the loops must be removed flush with the inside wall surface. No sharp cutoff protrusion is permitted. If concrete spalling occurs as a result of the loop removal, restore the spalled area to a uniform smooth surface with mortar.

7-05.3(1)F PRECAST CONES

Precast cone sections must comply with the requirements of the Standard Plans, ASTM C478 and Section 7-05.3(1)E.

Precast cones must provide reduction in diameter within a range of height from not less than 18 inches to a maximum 36 inches.

Jointing of a cone section to the riser sections must be similar to jointing between riser sections, but the top surface of the cone section must be flat and at least 5 inches wide radially, to receive adjustment bricks or precast risers.

7-05.3(1)G TOP SLAB

Top slabs must be as shown on the Standard Plans, including details of opening location and reinforcing.

7-05.3(1)H T TOP PIPE MAINTENANCE HOLES

T Top pipe maintenance holes must conform to the Drawings and be provided with foundation and bedding.

7-05.3(1)I JOINTS

Joints between precast maintenance hole components must be rubber gasketed as similar to pipe joints conforming to ASTM C 443. Submit Shop Drawings of joint details and end details in conformance with Standard Plans 204a - 212b to the Engineer for approval at least 5 Working Days before manufacture. Completed joints must not show visible leakage and must conform to the dimensions of ASTM C 478.

7-05.3(1)J MAINTENANCE HOLE CHANNELS

All maintenance holes must be channeled unless otherwise specified in Contract.

Maintenance hole channels must conform to the curvature of the connecting pipes. Maintenance hole channel slopes must conform accurately to the Sewer grade and be brought together smoothly with well-rounded junctions. Where pipe connections have differing grades, differing invert elevations, or differing inside diameters, a smooth transition in channel grade or side is required. Channel sides for each pipe must be carried up vertically from the inside diameter at the springline to the crown elevation of the pipe. The concrete shelf between channels must be smoothly finished and warped evenly with slopes to drain.

Channel must be Class 3000 concrete or prepack concrete mix as approved by the Engineer.

7-05.3(1)K MAINTENANCE HOLE PIPE CONNECTIONS

All pipes, except corrugated metal pipe, entering or leaving the maintenance hole must have flexible joints within 1/2 of a pipe inside diameter or 12 inches, whichever is greater, from the outside face of the maintenance hole structure and must be placed on firmly compacted bedding, particularly within the area of the maintenance hole excavation which normally is deeper than that of the Sewer trench. Openings surrounding pipes entering the maintenance hole must be completely filled with a non-shrink cement sand grout and be finished flush with the remaining maintenance hole concrete wall surfaces to ensure water tightness. PVC pipe connecting to maintenance hole must have a maintenance hole adapter, complete with gasket and approved by the Engineer.

Vitrified clay pipe connecting to the maintenance hole must have a second flexible joint connected to the first flexible joint entering or leaving the maintenance hole, as shown in Standard Plan 215. The second flexible joint must be a maximum of 24 inches from the first joint, and must be placed firmly on compacted bedding.

The flexible joint connections specified in this Section must be the joint system manufactured with the pipe, typically bell and spigot, unless otherwise approved by the Engineer.

7-05.3(1)L MAINTENANCE HOLE GRADE ADJUSTMENT

The Contractor is responsible for selecting the appropriate precast concrete maintenance hole components, allowing for a maximum height of 2’-2” from the top of the cone section or top slab to the finished surface grade for installation of the maintenance hole frame and cover including 8 inches minimum for leveling or adjustment brick, or concrete collar. The surface grade for frame and cover on unimproved roadways must match the adjacent existing roadway surface.

Final elevation and slope of the frame and cover must conform to the restored and adjacent street surface. No warping of grades instead of maintenance hole frame adjustment will be allowed. All joints in the brick or ring adjustment must be filled with mortar to a thickness of 1/4 inch minimum to 1/2 inch maximum, and the casting must be seated in mortar a thickness of 1/4 inch minimum to 1/2 inch maximum placed on the top brick course. Lay bricks in a running bond pattern. When the frame is circular, use radial bricks or concrete grade rings .

7-05.3(1)M LADDER, STEPS AND HANDHOLDS

The Contractor must submit to the Engineer for approval at least 5 Working Days in advance, the single Material of choice for step, handhold, and ladder from Section 9-12.2, and must consistently use this single chosen Material in every maintenance hole. Steps, handholds, and ladder made of copolymer polypropylene plastic manufactured by Lane International

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Corp., M. A. Industries or approved equal will be accepted. Should the Contractor request a different Material between or among different maintenance holes, then the submittal must clearly identify which Material is used in each maintenance hole.

Ladders, steps, and handholds must be as shown on Standard Plans 232a and 232b and provide regular 1'-0" vertical spacing, except for: up to 1'-6" spacing is allowed between the top step or handhold and the rim; and up to 1'-4" spacing is allowed between the bottom step and the channel shelf.

The minimum horizontal clear opening, measured at the shortest dimension, must be 1'-6".

Penetrations of the precast wall sections to attach steps, handholds, and ladders must be kept clear of the joints by 2 inches minimum.

Install vertical handholds 4 feet above the channel shelf when described in the plan view of Standard Plans 204b - 212b or on the Drawings.

Where a concentric cone section is required, provide an additional step on the side opposite the ladder steps at mid-height of the cone section.

7-05.3(1)N FRAME AND COVER

The casting must be as shown on Standard Plan 230.

Where Standard Plan 230 casting is located within the concrete pavement or within the rigid concrete pavement base, reinforcing in the concrete pavement slab must be installed as specified in Section 5-05.3(9) and per Standard Plan 406. Standard Plan 230 casting located across, or located within 18 inches of a concrete pavement joint as measured from the casting barrel (not the flange), does not require Section 5-05.3(9) pavement reinforcing.

Total height of casting and leveling brick must not exceed 26 inches.

7-05.3(1)O CONNECTIONS TO EXISTING MAINTENANCE HOLES

The Contractor must verify invert elevations before construction. Discrepancies in invert elevations must be immediately brought to the attention of the Engineer. The crown elevation of lateral pipes must be the same as the crown elevation of the existing incoming pipe. Reshape the existing base to provide a channel as specified in Section 7-05.3(1)P.

Excavate completely around the maintenance hole to prevent unbalanced loading. Keep the maintenance hole in operation at all times, and take all necessary precautions to prevent debris or other Material from entering the Sewer. This includes building a tight pipeline sewage bypass as required.

The Contractor must core drill, line drill, or wall saw an opening to match the size of pipe to be inserted. Where line drilling is the method used, the method of drilling holes must prevent overbreakage. All openings must provide a minimum and a maximum clearance around the outside circumference of the pipe as shown on the Standard Plans. Place upstream pipes penetrating the walls of maintenance holes with the bell facing out. Pipe leaving or entering maintenance holes must have a flexible joint within 1/2 of a pipe inside diameter, or 12 inches, whichever is greater from the outside wall of the maintenance hole. After pipes have been placed in their final position, the surface area around the opening in the maintenance hole and the surface of the pipe must be cleaned of all dirt, dust, grease, oil and other contaminants and then roughened and wetted with water. Grout the opening between pipe and broken out concrete as specified in Section 7-05.3(1)K.

7-05.3(1)P RECHANNEL EXISTING MAINTENANCE HOLE

Rechanneling of an existing maintenance hole includes all necessary work such as; excavating shelf and maintenance hole bottom, filling existing channels with concrete, installing the new channels, constructing new pipe opening or openings, and finishing the channel and shelves. It also includes the work of connecting the pipe to the maintenance hole as specified in Section 7-05.3(1)O. Rechanneling must comply with the requirements specified in Section 7-05.3(1)J.

7-05.3(1)Q REBUILD EXISTING BRICK MAINTENANCE HOLE

Where noted on the Drawings, the Contractor must rebuild the existing brick maintenance hole per Standard Plan 220 to accommodate a new maintenance hole frame and cover meeting the requirements of Standard Plan 230. Work required to rebuild an existing brick maintenance hole includes excavation around the maintenance hole, removal and salvage of the existing maintenance hole frame and cover, removal of leveling or adjustment bricks or rings, and removal of the upper portion of the cone section to a depth yielding an opening of inside diameter as shown on Standard Plan 220. Rebuild the cone section using a running bond pattern with leveling bricks or rings, new maintenance hole steps and handholds, and a new frame and cover installed as specified in Section 7-05.3(1)N.

Salvage is specified in Section 2-02.3(7).

7-05.3(2) CATCH BASINS AND INLETS

7-05.3(2)A GENERAL

Construction requirements for catch basins and inlets must be as specified in Section 7-05.3(1) for maintenance holes and maintenance hole pipe connections.

Catch basins must be installed as indicated on Standard Plan 240 through 242 and 260a and 260b unless the Contract indicates otherwise. Establish staking points at the centerline of grate at the face of curb for drainage Structures along a curb line.

Make connections to the catch basin only at either the predrilled holes or the concrete knockouts provided in the walls of the catch basin. To meet this requirement, determine beforehand the approximate elevation of the proposed inflow and outflow pipes by taking into account the length of inlet connection pipe, the throw in the roadway, including drainage transition zone, and any existing utilities or obstructions that may interfere with installing the inlet connection or catch basin connection pipe. All these items have a bearing on the depth of the pipes at the catch basin and the bottom elevation of the catch basin.

7-05.3(2)B PIPE CONNECTIONS FOR CATCH BASINS AND INLETS

All new catch basins must be provided with openings or concrete knockouts for insertion of pipe connections and with a trap for the outlet pipe. When connections will be made to existing catch basins with no available hole or knockout, or where a knockout of adequate size is not provided, provide for pipe connections by core drilling, line drilling, or wall sawing. All openings must provide a minimum of 1-1/2 inch and a maximum of 2-1/2 inches clearance around the circumference of the pipe. Where line drilling is the method used, the method of drilling holes must prevent overbreakage. After pipes have been placed in position, grout the opening between pipe and wall of catch basin or inlet as specified in Section 7-05.3(1)K. See Sections 7-08.3(4) and 7-08.3(5) for additional pipe connection requirements.

Locate the outlet trap and the frame and grate as shown on the Standard Plans and align it vertically to allow reasonable access for removal and replacement of the outlet trap for vactor cleaning maintenance operations.

Furnish and install new outlet traps for relocated and rebuilt catch basins.

7-05.3(2)C CATCH BASIN GRADE ADJUSTMENT

The Contractor is responsible for selecting the appropriate precast concrete catch basin components, allowing for a maximum and minimum height of the leveling bricks or riser as shown on the Standard Plan for the catch basin type.

Final elevation and slope of the grate or cover must conform to the restored and adjacent street surface and drainage transition zone; see Standard Plan 260a and Section 7-20.3(1). Warping of grades instead of catch basin frame adjustment is not allowed. On projects calling for regrading and pavement improvements, determine grades and perform surveying as specified in Sections 1-05.4 and 1-05.5.

7-05.3(2)D INLET GRADE ADJUSTMENT

Place the inlet frame on a minimum 4-inch thick leveling brick or precast risers. It must not, in any case, be mortared to final grade until the final elevation of the pavement in which it is to be placed has been established and permission has been provided by the Engineer to mortar the frame in place. Location of inlet will be established by the Engineer. Slope the bottom of the inlet to drain level with the invert of the outlet pipe.

Final elevation and slope of the frame and cover must conform to the restored and adjacent street surface and account for the drainage transition zone as shown on Standard Plans 260a and 260b and specified in Section 7-20.3(1). Warping of grades instead of inlet frame adjustment is not allowed.

Adjust existing Type 164 inlets as shown on Standard Plan 268 with new grate as shown on Standard Plan 266 only for pavement resurfacing projects.

7-05.3(2)E RELOCATE EXISTING CATCH BASIN OR INLET

Work required for relocation of existing catch basin or inlet includes necessary excavation to remove without damage the existing catch basin or inlet and its frame and grate or cover, and transporting and installing the components at the new location. Grade adjustment is specified in Sections 7-05.3(2)C or 7-05.3(2)D.

Furnish and install new outlet traps, see Section 7-05.3(2)B for outlet trap location requirements.

7-05.3(2)F REBUILD EXISTING CATCH BASIN

Where noted on the Drawings, the Contractor must rebuild existing catch basin to accommodate a new frame and grate or cover as specified in the Contract. Work required to rebuild catch basin includes excavation; the removal of the existing frame and grate or cover, leveling or adjustment bricks, and upper portion of catch basin chamber; and installing a new cone section, leveling or adjustment bricks, and new frame and grate or cover. Excavation, backfill, and compaction must conform to the applicable portions of Section 7-17. Salvage is specified in Section 2-02.3(7). Grade adjustment is specified in Sections 7-05.3(2)C.

Furnish and install new outlet traps as specified in Section 7-05.3(2)B .

7-05.3(3) JUNCTION BOX

Install junction boxes as shown on the Drawings. See Standard Plan 277 and Sections 9-12.8 and 9-04.3(2)B. Fill the bottom of the structure to match the invert of the lowest pipe and slope to drain.

7-05.3(4) BRIDGE DRAIN

Locate and install bridge drains as shown on the Drawings. See Standard Plan 290 and Section 7-08.3(9).

Furnish bridge drains with vaned grates as shown on Standard Plan 265. The grate must be fitted to the frame and ground to rest evenly and without rocking.

Furnish bridge drains with 6-inch diameter standard weight galvanized steel pipe, shop welded to bridge drain box.

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The assembled bridge drain must be galvanized per ASTM A53, Black and Hot-Dipped Zinc-Coated Welded and Seamless Steel Pipe for Ordinary Uses. Coat the assembled and galvanized bridge drain inside and outside with an asphaltic base, black dipping paint. The asphaltic coating must extend to cover all welds.

When encased in concrete, the drain pipe must be fully encased in a sponge rubber compound 1/2 inch thick and meeting the requirements of ASTM D 1752, Type No. 1. The color requirement is waived.

The Contractor must submit to the Engineer at least 5 Working Days in advance of delivering the bridge drain to the Project Site, a combined Shop Drawing of the bridge drain and bridge downspout per Section 7-08.3(9) and connection details.

7-05.4 MEASUREMENT

Measurement for "Extra Depth (Type) Maintenance hole" will be by the vertical foot for all depth in excess of 10 feet measured from the invert of the outlet pipe to the top of the casting.

Measurement for Extra Depth for the type of maintenance holes which are built on top of and are fully supported by large diameter pipe, will be by the vertical foot for extra depth in excess of the 10 feet measured from the springline of the "supporting" pipe to the top of the maintenance hole casting.

Measurement for "Extra Excavation" will be as specified in Section 2-04.4.

7-05.5 PAYMENT

1. **"Maintenance Hole, (Type)"**, per each

The Bid Item price for "Maintenance Hole, (Type)" includes all costs for the work required to furnish and install the maintenance hole complete to finish grade, including excavation, bedding, mortar, non-shrink grout, brick, block, castings, channeling, ladder, steps, connections to pipelines, and haul, stockpile and or disposal of soil, backfill and compaction with suitable native Material for a maintenance hole depth up to and including 10 feet.

2. **"Extra Depth**, **(Type) Maintenance Hole"**, per vertical foot

The Bid Item price for "Extra Depth, (Type) Maintenance Hole" includes all costs for the work required to construct the portion of a maintenance hole excavation in excess of 10 vertical feet.

3. **"Rechannel Maintenance Hole"**, per each

The Bid Item price for "Rechannel Maintenance Hole" includes all costs for the work required to complete the maintenance hole rechanneling work as specified in Section 7-05.3(1)P and of core drilling openings for new pipes to the maintenance hole when performed in an existing maintenance hole.

If connecting a new pipe to an existing maintenance hole requires rechanneling of the maintenance hole, the work involved in connecting such pipe to the maintenance hole is incidental to "Rechannel Maintenance hole", per each, and will be performed as specified in Section 7-05.3(1)P. If the work involves only the cutting of an opening and connecting the pipe without rechanneling, then this work is considered included in the Bid Item price for installation of the pipe and no other payment will be made.

4. **"Catch Basin**, **(Type)"**, per each

The Bid Item price for "Catch Basin, (Type)" includes all costs for the work required to furnish and install the catch basin including trap, excavation, haul, stockpile and or disposal of soil, backfill and compaction, adjustment brick and blocks, mortar, non-shrink grout, plaster, and castings.

5. **"Inlet**, **(Type)"**, per each

The Bid Item price for "Inlet, (Type)" includes all costs for the work required to furnish and install the inlet including excavation, haul, stockpile and or disposal of soil, backfill and compaction, brick, block, mortar, grout, and castings.

6. **"Junction Box, (Type)"**, per each

The Bid Item price for "Junction Box, (Type)" includes all cost for the work required to furnish and install the junction box complete to finish grade including but not limited to excavation, mortar, grout, brick, block, castings, haul, stockpile and or disposal of soil, backfill and compaction with suitable native material.

7. **"Bridge Drain"**, per each

The Bid Item price for "Bridge Drain" includes all costs for the work required to furnish and install drain, including outlet pipe through the bridge deck, reducer, if needed, and grate to structure complete. All costs in connection with maintaining and cleaning of bridge drains is considered incidental to the construction of the bridge drain.

8. **"Rebuild (Item)"**, per each

The Bid Item price for "Rebuild (Item)" includes all costs for the work required, including the new casting, to completely rebuild the existing item to finished street grade as specified in Sections 7-05.3(1)Q or 7-05.3(2)F as applicable.

9. **"Relocate (Item)"**, per each

The Bid Item price for "Relocate (Item)" includes all costs for the work required to relocate the catch basin or inlet including furnishing and installing new outlet trap, excavation, haul, stockpile and or disposal of soil, backfill and compaction with native Material, adjustment brick and blocks, mortar, non-shrink grout, plaster and castings as specified in Section 7-05.3(2)E.

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10. **Other payment information**

When Mineral Aggregate Type 17, or other mineral aggregate type designated by the Engineer, is used as backfill, payment will be as specified in Section 1-09.4.

Payment for "Extra Excavation", will be as specified in Section 2-04.5.

Foundation Material will be paid as "Mineral Aggregate, (Type)", as specified in Section 4-01.5.

When it is determined by the Engineer that the existing foundation is unsuitable and where foundation Material is not specified in the Contract and no Bid Item for "Mineral Aggregate, (Type)" of the type required by the Engineer is included in the Bid Form, payment will be made as specified in Section 1-04.1(2).

Final adjustment of the casting for new construction of maintenance hole, catch basin, and inlet is considered incidental to and included in the Bid Item price for the maintenance hole, catch basin, and inlet.

Payment for protective systems, when applicable, will be as specified in Section 2-07.5.

SECTION 7-06 RESERVED

SECTION 7-07 CLEANING EXISTING DRAINAGE STRUCTURES

7-07.1 DESCRIPTION

Section 7-07 describes Work consisting of cleaning and removing all debris and obstructions from existing Culvert pipes, sanitary Sewer pipes, combined Sewer pipes, drains, inlet Structures, maintenance holes, box culverts, grates, trash racks, or other drainage features in conjunction with the Work within the Project Site.

7-07.2 RESERVED

7-07.3 CONSTRUCTION REQUIREMENTS

Existing drainage facilities connecting to new work must be cleaned as a first order of Work to enhance drainage off and through the Project Site. These facilities must be kept clean up to the Physical Completion Date.

Clean all existing pipes and drainage Structures connecting to new work by flushing, or by rodding, or by such manner as may be necessary as approved by the Engineer to provide unobstructed drainage. All catch basin sumps, maintenance holes, inlet and outlet Structures, and debris racks must also be freed of all dirt, rock, and debris.

7-07.4 MEASUREMENT

Work described in Section 7-07 will not be measured for payment.

7-07.5 PAYMENT

All work described in Section 7-07 is considered incidental to the various Bid Items comprising the Work.

SECTION 7-08 MISCELLANEOUS PIPE CONNECTIONS

7-08.1 DESCRIPTION

Section 7-08 describes Work consisting of excavation, foundation preparation, bedding, backfilling and compacting for the construction of miscellaneous Sewer and drain pipe connections except those described in Section 7-01, Section 7-17, and Section 7-18.

7-08.2 MATERIALS

Materials must comply with the requirements in Section 9-04 and Section 9-05.

7-08.3 CONSTRUCTION REQUIREMENTS

7-08.3(1) EXCAVATION, FOUNDATION PREPARATION, BEDDING, AND BACKFILL

Work in trench excavations over 4 feet deep is subject to the provisions of Section 2-07.

Trench excavation, backfill, and compaction is specified in Section 2-04, Section 2-10, and Section 2-11.

7-08.3(2) CONNECTIONS TO EXISTING SANITARY SEWERS

When making a connection to an existing Sewer line or maintenance hole, excavate and expose the existing facility where shown on the Drawings. In the event there is no existing tee or wye, refer to Section 7-17.3(2)C3. See Section 7-05.3(1)O for connections to existing maintenance holes.

7-08.3(3) PIPE INSTALLING, JOINTING, AND TESTING

Pipe installing, bedding, jointing, and pipe connections must conform to the applicable requirements of Section 7-17.

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7-08.3(4) CATCH BASIN CONNECTIONS

Catch basin connections are pipe lines connecting outlets of catch basins to a Storm Drain or other facility. Install catch basin connections up-grade from Storm Drain or other originations. Catch basin connection slopes must be at least 2 percent but less than 50 percent within 1 foot of the catch basin, nor more than 100 percent.

Alignment must be as shown on Standard Plan 261. Type 240A, 240B, and 241 catch basin connections must be straight with the exception of maintaining clearances as specified in Section 1-07.17(2), or to meet the slope requirement of not more than 50 percent within 1 foot of the catch basin. Type 240C, 240D, 242A, and 242B catch basin connections must be aligned so that the outlet is at the narrow end and directly below the frame opening to allow for tool insertion.

Maximum bends are 22.5 degrees. Between each bend, install a minimum 1 foot section of straight pipe, or an equivalent manufactured sweep.

When the catch basin connection Material is ductile iron pipe and is connecting to a mainline by core tap and an inserted tee, connection must include a 1 foot long plain end by plain end section of ductile iron pipe inserted into the bell end of the tee manufactured to accept ductile iron pipe. Connect the 1 foot section to the upstream pipe using a flexible gasketed coupling with stainless steel shielding as specified in Section 9-05.18.

Do not connect to the catch basin outlet pipe until the excavation around the catch basin has been backfilled and compacted to an elevation which provides support for pipe bedding and the connection pipe. Bedding for catch basin connection pipe must be as specified in Section 7-17.3(1) for the pipe material used.

Furnish and install a new outlet trap to the new outlet of the existing catch basin. See Section 7-05.3(2)B for outlet trap location and catch basin pipe connection requirements.

Television inspections in conformance with Section 7-17 are required for catch basin connections.

7-08.3(5) INLET CONNECTIONS

Inlet connections are pipe connections from drainage inlets to catch basins or other approved outlets. Install inlet connections up-grade from catch basin openings or other originations. Inlet connection slopes must be at least 5 percent but less than 50 percent.

Where a straight alignment or a uniform slope is not possible and curves are necessary, change the alignment either by deflecting each pipe into a smooth curve, or with fittings.

When using deflection, submit the manufacturer's pipe joint deflection criteria to the Engineer for approval. Such deflection must be water tight and allow rodding the pipe in a relatively easy manner. Under no circumstances will deflection or change of direction be allowed by cutting or trimming the end of the pipe on a bias or an angle. All pipe ends must be normal angle.

When using fittings, maximum bends are 22.5 degrees. Between each bend, install a minimum 1 foot section of straight pipe , or an equivalent manufactured sweep.

Do not connect to the catch basin or other approved outlet until the excavation around the catch basin has been backfilled and compacted to an elevation which provides support for pipe bedding and the inlet connection pipe. Bedding for inlet connection pipe must be as specified in Section 7-17.3(1) for the pipe material used.

See Section 7-05.3(2)B for inlet pipe connection requirements.

7-08.3(6) DROP CONNECTIONS

Inside and outside drop connections to allow for abrupt drop in elevation of the inflow must be constructed as shown on Standard Plan 233a and 233b, and at locations shown on the Drawings. The invert elevation of the outside drop connection are shown on the Drawings. The crown elevation of the inside drop connection must match the crown elevation of the maintenance hole outlet pipe.

7-08.3(7) VERTICAL CONNECTIONS

Vertical connections must be constructed per Standard Plan 234a or 234b, and at locations shown on the Drawings.

7-08.3(8) DETENTION PIPE OUTLET CONNECTIONS

Detention pipe outlet connections must be constructed as shown on the Drawings. Install pipe up-grade from Storm Drain or other originations. When connection is to an existing maintenance hole on the mainline, rechannel the maintenance hole. Where a straight alignment and uniform slope is not feasible, changes to the alignment can be made using fittings with written acceptance from the Engineer. Maximum bends are 22.5 degrees. Between each bend, install a minimum 1 foot section of straight pipe , or an equivalent manufactured sweep.

Do not connect to the flow control structure until the excavation around the flow control structure has been backfilled and compacted to an elevation which provides support for pipe bedding and the detention pipe outlet connection pipe. Bedding for detention pipe outlet connection must be Class B bedding.

7-08.3(9) BRIDGE DOWNSPOUTS

The Contractor furnish and install standard weight steel pipe or ductile iron pipe bridge downspouts, whichever is shown on the Drawings. Inside diameter must be 6-inch minimum.

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The bridge downspout must be full length pipe section in all straight runs. The Contractor may propose types of couplings and fittings except grooved couplings and fittings, provided they are equal performance and are included in the submittal specified in the last paragraph of this Section.

Drain pipe encased in concrete must be fully encased in a sponge rubber compound 1/2 inch thick and meeting the requirements of ASTM D 1752, Type No. 1. The color requirement is waived.

All pipe bends, whether encased in concrete or not and whether they are fittings or bent steel pipe, must have a bend radius of at least 4 feet. All straight run pipe must have a minimum slope of 10 percent.

Verify all downspout lengths by field measurements before fabrication and determine the exact lengths of pipe and hangers required for each bridge downspout.

Install pipe hangers per the Manufacturer's written direction.

When the Contract requires clean outs, they must be of the size and type specified, and be installed as shown on the Drawings.

The Contractor must submit to the Engineer at least 5 Working Days in advance of delivering the bridge downspout to the site, a combined Shop Drawing of the bridge downspout and bridge drain per Section 7-05.3(4) and connection details. Shop Drawings must show each downspout pipe layout including size of pipe and fittings; spacing and type of pipe hangers; manufacturer's directions on hanger installation; concrete inserts; radius of bends; and details of pipe connections to receiving pipe or drainage structure, cleanouts, slopes of straight run pipe, and bridge drain.

7-08.4 MEASUREMENT

Measurement for "Pipe, Catch Basin Connection, (Material), (Class), (Size)" will be by the linear foot of pipe installed between the tee or wye in the receiving Sewer and the inside face of the catch basin.

Measurement for "Pipe, Inlet Connection, (Material) (Class), (Size)" will be by the linear foot of pipe installed between the inside face of the inlet, and the inside face of the catch basin.

Measurement for "Drop Connection, Outside, (Size)" will be by the vertical foot from the invert of the bend connection at the maintenance hole, to the invert at the upstream end of the tee as shown on Standard Plan 233a.

Measurement for "Drop Connection, Inside, (Size)" will be by the vertical foot from surface grade to the crown elevation at the end of the pipe elbow in the maintenance hole as shown on Standard Plan 233b.

Measurement for "Vertical Connection, (Size)" will be from surface grade to the crown elevation of the connecting pipe.

Measurement for "Pipe, Detention Pipe Outlet Connection, (Material), (Class), (Size)" when the pipe is an outlet pipe from a flow control Structure will be measured from the inside wall of the flow control Structure to either the inside face of a maintenance hole or to tee.

Measurement for "Bridge Downspout, (Material), (Class), and (Size)" will be by the linear foot along the center line of the pipe through fittings.

7-08.5 PAYMENT

1. **"Pipe, Catch Basin Connection**, **(Material), (Class), (Size)"**, per linear foot
2. **"Pipe, Inlet Connection**, **(Material), (Class), (Size)"**, per linear foot

The Bid Item prices for "Pipe, Catch Basin Connection, (Material), (Class), (Size)" and for "Pipe, Inlet Connection, (Material), (Class), (Size)" include all costs for the work required to furnish and install the pipe, including connections to catch basins or inlets, excavation, haul, stockpile and or disposal of soil, backfill, and compaction.

3. **"Drop Connection**, **(Type), (Size)"**, per vertical foot

The Bid Item price for "Drop Connection, (Size)" includes all costs for the work required to furnish and install the complete inside or outside drop connection as shown on Standard Plan 233a and 233b.

4. **"Vertical Connection**, **(Size)"**, per vertical foot

The Bid Item price for "Vertical Connection, (Size)" includes all costs for the work necessary to furnish and install the vertical connection as shown on Standard Plan 234a or 234b.

5. **"Pipe, Detention Pipe Outlet Connection**, **(Material), (Class), (Size)"**, per linear foot

The Bid Item prices for "Pipe, Detention Pipe Outlet Connection, (Material), (Class), (Size)" include all costs for the work required to furnish and install the pipe, including connections to existing maintenance holes, pipe, and flow control Structures, excavation, haul, stockpile and or disposal of soil, backfill, and compaction.

6. **"Bridge Downspout**, **(Material), (Class), (Size)"**, per linear foot

The Bid Item price for "Bridge Downspout, (Material), (Class), (Size)" includes all costs for the work required to furnish and installing bridge downspouts, including field measurement and adjustment, galvanizing where required, and other items necessary to make a complete construction as specified.

7. **Other payment information**

The cost for furnishing and installing new outlet trap when installing catch basin connection pipe to existing catch basin will be included in the Bid Item price for "Pipe, Catch Basin Connection, (Material), (Class), (Size)".

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Payment for bedding will be as specified in Section 7-17.5.

Payment for television inspection will be as specified in Section 7-17.5.

Payment for protective systems, when applicable, will be as specified in Section 2-07.5.

Payment for CDF bedding will be as specified in Section 7-17.5.

All costs for the work required to furnish and install Polyethylene Foam between utilities must be included in the applicable bid item cost for pipe.

The cost for removal and disposal of existing pipe within trench neat line limits of new pipe to be installed is incidental to the new pipe installation and no separate payment will be made.

SECTION 7-09 RESERVED

SECTION 7-10 RESERVED

SECTION 7-11 PIPE INSTALLATION FOR WATER MAINS

7-11.1 DESCRIPTION

Section 7-11 describes Work consisting of installing Water Main pipe per the manufacturer's printed specifications and instructions and with the AWWA standards for installing the type of pipe proposed.

Join pipe sections so as not to damage the lining or coating. The method of pulling or jacking the pipe home must allow for both vertical and horizontal movement of the pipe for protection of the gasket.

Do not proceed with Water Main installation until line and grade hubs have been set and measurements for connection fittings have been made as specified in Section 7-11.3(4).

Maintain clearances between Water Mains and other utilities as specified in Section 1-07.17(2).

Install water distribution main, water transmission main, water services, and fire hydrant and connection pipe at least 5 feet clear of any tree measured horizontally from the edge of the vault/pipe to a vertical plane projected down from the tree's outer bark surface at ground level.

Provide and maintain clear access to fire hydrants, water valves, water meters, water vaults, and related water Structures at all times unless the Contract specifies otherwise.

This Work includes excavation, backfilling, and compaction as specified in Section 2-04, Section 2-10, and Section 2-11.

Work in excavations over 4 feet deep must comply with Section 2-07.

Work will also include assisting SPU Water Operations with the cut, cap, and blocking of existing Water Mains; temporary and permanent Water Main connections - including the furnishing of pipe materials, fittings, and valves for these connections; and temporary and permanent water services connection transfers.

7-11.2 MATERIALS

7-11.2(1) GENERAL

Materials must comply with the requirements of the following Sections:

Material	Section
Pipe and Pipe Coatings	Section 9-30.1
Fittings	Section 9-30.2
Valves, Valve Boxes, and Valve Chambers	Section 9-30.3
Hydrants	Section 9-30.4
Service Connections and Service Pipe or Tubing	Section 9-30.5
Bedding, Foundation Material and Gravel	Section 9-30.6
Joint Bond Cable	Section 9-30.7
Thermite Weld Materials	Section 9-30.8
Electrolysis Test Station	Section 9-30.9
Turbine Meters (sizes 2" – 12")	Section 9-30.10
Locating Wire	Section 9-30.11
Coating for Bolts and Shackle Rods	Section 9-30.12
Backflow Prevention Assemblies	Section 9-30.13
Mineral Aggregates	Section 9-03

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Materials listed are not considered equal or generally interchangeable for all applications. The Engineer will determine from the Materials listed, those that are suitable for the project and will so specify in the Contract.

The Engineer must have free access to all testing and records pertaining to Materials to be delivered to the site. The Engineer may elect to be present at any or all Material testing operations.

7-11.2(2) PRE-INSTALLATION TASTE AND ODOR RATING TEST

All Water Main manufactured of any material and all Water Main lining material must:

1. Satisfactorily pass an Engineer conducted SPU taste and odor rating test; or
2. Be a product of a Materialperson pre-approved by the Engineer per SPU's taste and odor rating test program.

The Contractor must allow for taste and odor rating testing as follows:

Material	Time for Testing and Reporting Results
Water Main	Up To 30 Working Days
Water Main Lining Material	Up to 30 Working Days

NOTE: This time can be reduced to as little as 10 Working Days if:

1. A test on a section of pipe, either with or without lining Material, can be done as a bench scale test and not by a full scale test with a pipe manifold; and
2. A retest is not required.

Time for testing and reporting results is based on the day the Material is received by the Engineer to the day the results are available to the Engineer.

Water Main pipe Material will be sampled for testing at the rate of 1 for each lot of 100 or fewer, for each diameter size pipe.

Water Main lining Material will be sampled for testing.

No taste and odor rating test will be required for service connection pipe.

A list of Materialpersons with taste and odor rating test Program pre-approved Water Main and Water Main lining material can be obtained by contacting (206) 684-7834.

Materialpersons can obtain cost information on the taste and odor rating test Program pre-approval process for Water Main and Water Main lining material by contacting (206) 684-7834.

7-11.2(3) POST INSTALLATION TASTE AND ODOR RATING TESTS

The Engineer may perform post installation taste and odor rating tests on any portion of the Work before or after connection to existing Water Main. Such retesting may be performed as part of bacteriological sampling and testing during flushing and testing specified in Sections 7-11.3(12)J and 7-11.3(12)K, and may include sampling and testing of mortar and lining materials. Post-installation taste and odor rating testing requires a minimum 48 hours contact time in the Water Main assembly under test. Depending on the extent of the testing required, results will be made available in 15 Working Days or fewer.

If results of additional taste and odor rating tests are determined unacceptable, make timely correction as determined by the Engineer.

Failure of the system or portion of the system to pass the taste and odor rating test will result in the rejection of all new Water Main under test.

7-11.3 CONSTRUCTION REQUIREMENTS

7-11.3(1) TRENCH DEWATERING, EMBANKMENT FILL AND PIPE BEDDING

7-11.3(1)A DEWATERING OF TRENCH

In addition to the requirements of Section 2-08, where water is encountered in the trench, remove the water during pipe installation operations and maintain trench dewatering until the ends of the pipe are sealed and provisions are made to prevent floating of the pipe. Trench water or other deleterious materials must not enter the pipe at any time.

7-11.3(1)B INSTALLING PIPE IN EMBANKMENT FILL

Where the Drawings show pipe is to be installed above existing ground surface, make and compact an embankment fill as shown on the Drawings, and excavate the Water Main trench therein. Compact that portion of the embankment below the bottom of the pipe with rollers or mechanical compactors under controlled moisture conditions as specified in Method B of Section 2-11.3(1).

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7-11.3(1)C BEDDING RIGID PIPE

7-11.3(1)C1 GENERAL

All distribution Water Main must have Class B bedding with either of Mineral Aggregates Type 6 or Type 7. All transmission Water Main must have Class B bedding with Mineral Aggregate Type 9. See Standard Plan 350.

All classes of bedding must provide uniform support along the entire pipe barrel, without load concentrations at pipe bells and fittings.

Prevent damage to the pipe, to any protective coating, and to any electrolysis monitoring system.

7-11.3(1)C2 BEDDING FOR POLYETHYLENE ENCASED, MULTI-LAYERED POLYETHYLENE TAPE COATING, THERMOPLASTIC POWDER COATED, OR SPECIAL COATED PIPE

Class B bedding Material for specially protected or coated pipe must be Mineral Aggregate either Type 6 or Type 7 as specified in Section 9-03. Class B bedding consisting of Mineral Aggregate Type 6 or Type 7 must be compacted by tamping.

Bedding of specially protected pipe must prevent damage to the protective coating or wrap.

Placing of Class B bedding around wrapped, coated, or specially protected pipe must prevent damage to the protective coating or wrap. The Contractor is solely responsible for repairing any damage to the special protection, coating, or wrap, including all costs of repair.

7-11.3(1)C3 SAND BEDDING AT TRENCH CROSSINGS

See Standard Plan 350 for protective sand bedding requirements. When trenching exposes the metal pipe, protect the pipe from exposure to cementitious materials placed in the trench by:

1. After excavation, wrapping the existing metal pipe in 8 mil polyethylene wrap.
2. Bedding the exposed pipe in 1 foot, bottom, sides and above, as specified in Section 7-11.3(1)C1. Bedding Material must be Mineral Aggregates Type 6 or Type 7, or sand approved by Seattle City Light for heat dispersion if required in the Contract.
3. Backfilling above as specified in the Contract.

7-11.3(1)D BEDDING FLEXIBLE PIPE

Bedding for flexible pipe, when flexible pipe is permitted for use, must be Class B with Mineral Aggregate Type 22 placed in lifts as shown on Standard Plan 350. Use care in installing flexible pipe to prevent vertical pipe deflection.

The first bedding lift thickness must be placed, spread, and compacted across the width and length of the trench bottom at the required grade to support the pipe, allowing for pipe bells and any other fitting. Install pipe and place and compact the next lift of bedding Material evenly along both sides of the pipe up to the crown. Do not displace the pipe from its set line and grade. Once the bedding is completed to the crown of the pipe, and the pipe shows no visible misalignment, place the final bedding lift over the pipe.

7-11.3(2) HANDLING OF PIPE

7-11.3(2)A GENERAL

Pipe ends must be sealed from the time the pipe is manufactured until the time it is installed to prevent dirt, water, or debris from entering the pipe segments. Protect threaded pipe ends using couplings or other means until the pipe is installed.

Inspect the pipe and fittings for defects upon delivery to the Project Site.

All types of pipe must be handled in a manner that prevents damage to the pipe and pipe lining or coating. Use heavy canvas or nylon slings of suitable strength to lift and support materials. Chains or cables must not be used to lift and support materials. Pipe and fittings must not be dropped, skidded, or rolled against other pipe. Damaged pipe will be rejected, and the Contractor must immediately place all damaged pipe apart from the undamaged pipe and remove the damaged pipe from the Project Site within 24 hours.

Stack pipe in a way that prevents damage to the pipe and prevents any movement of the pipe. Keep the bottom tiers of the stack off the ground on timbers, rails, or similar supports. Alternate pipe on succeeding tiers by bell and plain end. Place timbers 4” x 4” in size between tiers and place chocks at each end to prevent movement. Stack each size of pipe separately.

Ductile iron and cast iron pipe, while suspended above grade, must be rung with a light hammer to detect cracks. Prevent dirt or other foreign material from entering the pipe or pipe joint during installation. When pipe installation is not in progress, close the open ends of the pipe in the trench with a water tight plug or other approved means to ensure cleanliness inside the pipe. Any pipe or fitting installed with dirt or foreign material in it must be removed, cleaned, and reinstalled.

7-11.3(2)B HANDLING SPECIAL COATED PIPE

Handling and shipping of enameled or multilayered polyethylene tape coated or thermoplastic powder coated ductile iron pipe while being transported and in the field must be per AWWA C214, and as specified.

Always handle pipe with equipment such as stout wide canvas slings and wide padded skids designed to prevent damage to the coating. Bare cables, chains, hooks, metal bars, or narrow skids are not permitted to come in contact with pipe lining or coating. When shipped by rail, all pipe must be carefully loaded on properly padded saddles not less than 12 inches

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wide. Separate pipe sections so that they do not bear against each other and securely fasten the whole load together and to the cars to prevent movement in transit.

In truck shipments, support the pipe in wide cradles of suitable padded timbers hollowed out on the supporting surface to fit the curvature of pipe. All chains, cables, or other equipment used for fastening the load must be carefully padded.

The Engineer will inspect the pipe and coating after delivery to the Project Site before installation by the Contractor. Allow for inspection of the coating on the underside of the pipe while suspended from the sling before the pipe is lowered into the trench.

Support pipe stored along the trench side with padded wooden timbers placed under the pipe to hold the pipe off the ground, or by other acceptable means not damaging to the pipe and pipe coating.

Repair of multi layered polyethylene tape coating must be per AWWA C214 and Section 7-11.3(6)C. Repair of thermoplastic powder coated pipe must be per manufacturer's written instructions. The Contractor must submit the manufacturer's recommendations for thermoplastic coating repair at least 3 Working Days in advance of the scheduled repair.

7-11.3(2)C HANDLING HIGH-DENSITY POLYETHYLENE (HDPE) PIPE

HDPE pressure pipe must be handled in accordance with the manufacturer's recommendations and per AWWA M55, AWWA C906, and ASTM D2774. Cut out and remove sections of pipe with cuts or gouges in excess of 10 percent of the pipe wall thickness. Rejoin the undamaged portions of the pipe using heat fusion joining.

7-11.3(3) CUTTING PIPE

Whenever it becomes necessary to cut a length of pipe, make the cut using an abrasive saw or a special pipe cutter. All pipe ends must be square with the longitudinal axis of the pipe. The outside of slip joint pipes must be beveled and smoothed so that good connections can be made without damage to the gasket. Threads must be cleanly cut. Torch cutting of ductile iron pipe is not allowed.

Cut restrained joint pipe per the pipe manufacturer's recommendations. The Contractor must submit at least 3 Working Days in advance the pipe manufacturer's recommendation for cutting restrained joint pipe, including a manufacturer's certificate of compliance stating the cutting process does not adversely impact the pipe material or integrity of the joint.

Cut HDPE pipe per the pipe manufacturer's recommendations. The Contractor must submit method for cutting pipe at least 10 Working Days in advance of installation, including a manufacturer's certificate of compliance stating the cutting process does not adversely impact the pipe material or integrity of the joint.

7-11.3(4) GRADE AND ALIGNMENT

7-11.3(4)A GENERAL

Trenches for pipe must be opened per the lines and grades shown on the Drawings, and to a depth that maintains the minimum required depth of cover unless specified otherwise in the Contract.

The grade and alignment must be taken from points established by the Engineer.

7-11.3(4)B VERIFICATION OF LOCATION

After marking underground facilities as specified in Sections 1-07.17(1) and before any pavement cutting or removal or excavation for pipe installation, verify in the presence of the Engineer the locations of existing Water Mains. Arrange to establish Water Main depths at points where connections will be made. After excavation, verify the dimensions, type, condition, and roundness (16-inch diameter and larger) of the exposed Water Main. The excavation for pipes 16 inches and larger in diameter must provide access all around the pipe for measurement of the outside diameter by the Engineer. Should a condition be discovered that materially differs from that specified in the Contract, immediately notify the Engineer. When necessary, adjust the profile as directed to prevent abrupt changes in grade and alignment of Water Main and connection.

7-11.3(4)C MINIMUM DEPTH OF COVER

The depth of trenching for distribution Water Mains must provide a minimum depth of cover as indicated on Standard Plan 030. The depth of trenching for transmission Water Main must provide the minimum depth of cover as specified in the Contract. Where profile of Water Main and ground surface is shown on the Drawings, install the Water Main to the elevation shown on the Drawings, regardless of depth of cover for distribution Water Main indicated on Standard Plan 030. Deeper excavation may be required due to localized breaks in grade or due to installing the new distribution Water Main under existing underground facilities. Excavate to such depth that the cover over the valve operating nut is at least 1 foot.

7-11.3(4)D INSTALLING PIPE ON CURVES

On long radius curves, either horizontal or vertical, pipe may be installed with standard pipe by deflecting the joints. If the pipe is shown curved on the Drawings and no special fittings are shown, the Contractor can assume that the curves can be made by deflecting the joints with standard lengths of pipe. If shorter lengths are required, the Drawings will indicate maximum lengths that can be used. The amount of deflection at each pipe joint when pipe is installed on a horizontal or vertical curve must not exceed 50 percent of the manufacturer's printed recommended deflections. Submit to the Engineer the pipe manufacturer's joint deflection recommendations indicating deflections are within allowable AWWA specification tolerances before pipe installation.

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Where field conditions require deflection or curves not anticipated on the Drawings, the Engineer will determine the methods to be used.

When rubber gasketed pipe is installed on a curve, the pipe must be jointed in a straight alignment and then deflected to the curved alignment. Widen trenches on curves for this purpose.

Where pipe installation on curves requires the use of special fittings, use concrete blocking per Section 7-11.3(13).

Where restrained joint pipe is installed on a curve, submit the pipe manufacturer's recommendations to the Engineer for approval.

7-11.3(4)D1 INSTALLING HDPE PIPE ON CURVES

Install HDPE pipe as shown on the Drawings and per the Line Layout Plan as specified in Section 7-11.3(6)F1.

For HDPE pipe shown curved, either horizontal or vertical, on the Drawings and no special fittings are indicated, the Contractor may cold (field) bend the pipe if the following conditions are met:

1. Minimum long-term cold bending radius per AWWA M55, based on the pipe's dimension ratio and outside diameter, and pipe manufacturer's recommendations is achieved. Submit to the Engineer the pipe manufacturer's minimum bending radius recommendations indicating minimum bend radius is within allowable AWWA limits and for the ambient air temperatures anticipated during installation.
2. Minimum cover as specified in Section 7-11.3(4)C and utility vertical and horizontal separation requirements as specified in Section 1-07.17(2) are maintained.
3. Line and grade for all tangent sections are maintained.

If fittings, electrofusion couplings, or connections are present in the bend, then the minimum cold radius must be at a minimum 100 times the outside diameter of the pipe or per the pipe manufacturer's recommendations, whichever is greater. Cold temperatures increase the energy required to bend HDPE. Effective minimum radius of cold-bending may exceed 70 times the diameter during cold weather. Include the consideration of HDPE material property changes, due to cold or hot temperatures, in construction scheduling decisions and construction resource planning.

If the conditions for field bending cannot be met, or where indicated on the Drawings, fittings must be installed.

7-11.3(5) CLEANING AND ASSEMBLING JOINTS

All parts of the pipe ends, couplings, fittings, and appurtenances must be cleaned to remove oil, grit, or other foreign matter from the joint, taking care to keep the joint from contacting the ground.

Pipe not furnished with a depth mark must be marked before assembly to ensure visual observation of the Work.

7-11.3(6) INSTALLING AND JOINTING PIPE

7-11.3(6)A INSTALLING AND JOINTING DUCTILE IRON PIPE AND APPURTENANCES

The installation of ductile iron pipe and appurtenances must be per AWWA C600.

Except where restrained joint systems are required, mechanical or slip joints may be used.

7-11.3(6)B INSTALLING AND JOINTING POLYETHYLENE ENCASED (FILM WRAPPED) PIPE

Install pipe with polyethylene (film wrap) encasement per AWWA C105. The method used for encasing the pipe must be approved by the Engineer. The Contractor is solely responsible for repairing all damage to the polyethylene encasement, including all costs of repair. Bedding, backfill, and compaction is specified in Section 7-10.3(9), Section 2-10, and Section 2-11.

7-11.3(6)C INSTALLING AND JOINTING MULTI LAYERED POLYETHYLENE TAPE COATED PIPE

Hoist pipe from the trench side into the trench using a wide canvas or leather sling. Use of chains, cables, tongs, or other equipment likely to cause damage to the lining or to the coating of the pipe is not permitted. Dragging or skidding the pipe is not permitted. The Contractor must allow inspection of the coated pipe while suspended from the sling, and must repair any damage to the coating to the specified requirements before the pipe is lowered into the trench. Follow bedding, backfill and compaction as specified in Sections 7-11.3(1)C, Section 2-10, and Section 2-11.

At all times during construction of the Water Main, prevent damage to the protective coating on the pipe. Do not permit metal tools or heavy objects to come in contact with the finished coating. Workers are permitted to walk on the coating only when necessary, and must wear shoes with rubber or composition soles and heels when walking on the coating. This applies to all surfaces whether bare, primed, or coated. The Contractor is solely responsible for repairing any damage to the protective coating from any cause, before final acceptance of the Water Main, including all costs of repair.

Cutbacks on the spigot end must be 6 inches or less and made with a cutting device that is guided from the end of the pipe to ensure a straight, uniform cutback. Do not make cutbacks on the bell end of the pipe.

Following the application of the outerwrap, electrically test the coating for holidays using a pulse tape holiday detector. The detector voltage range for this coating is 7000 to 9800 volts. The testing must conform to NACE RP 02 74.

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All holidays detected in the field must be repaired by removing the outerwrap and primary coating from the damaged area, cleaning the exposed surfaces thoroughly and applying a suitable primer and tape to the exposed area as specified by the manufacturer. If required by the Engineer, the repaired area must be outerwrapped after patching.

If the outerwrap is damaged and a holiday is not found in this area, repair the damaged outerwrap area by applying a patch as recommended by the manufacturer and approved by the Engineer.

If the outerwrap is damaged and a holiday is found, remove the damaged outerwrap taking care not to damage the inner coating. Before new outerwrap is placed, apply a holiday detector to the exposed innerwrap to determine if it has been damaged during removal of the outerwrap. Install the outerwrap as recommended by the manufacturer and approved by the Engineer.

After electrical bonds are installed and tested, protect the entire pipe joint and electrical bond strap with a heat shrink joint sleeve as specified in Section 9-30.1(4)E.

7-11.3(6)D INSTALLING RESTRAINED JOINT PIPE

Install restrained joint Water Main as shown on the Drawings and the lay plan. Submit a Water Main lay plan and the manufacturer's recommendations to the Engineer at least 20 Working Days before pipe installation. This includes all equipment necessary to complete the Work.

Fully extend the restrained joint Water Main by pulling on the joint after the installation of the pipe segments as recommended by the manufacturer of the restrained joint pipe, unless stated otherwise in the Drawings or Specifications. When newly installed Water Main is pressurized, bending or buckling is not allowed.

Where adjustment of the Water Main line and grade is required to avoid existing or planned facilities, mechanically jointed fittings may be used with Wedge Restraint Glands to make the needed changes. All Wedge Restraint Glands must be wax tape encased as specified in Section 9-30.2(4). Submit change requests to the Engineer for approval before installation.

7-11.3(6)E INSULATED COUPLINGS AND FLANGE KITS

Install insulated couplings and flange kits to electrically isolate the Water Main from other Structures. Locate insulated joints as shown on the Drawings.

Carefully align and install insulating couplings and flange kits according to the manufacturer's recommendations to avoid damaging insulating Materials. Coat all exposed surfaces of insulating flange, including fasteners, with petroleum impregnated wax tape as specified in AWWA C217. Submit the manufacturer's installation recommendations to the Engineer for review at least 3 Working Days before use.

7-11.3(6)F INSTALLING AND JOINTING OF HDPE PIPE AND APPURTENANCES

Install HDPE pipe in accordance with the pipe and fitting manufacturer's recommendations, AWWA M55, ASTM D2774, and as specified herein. HDPE pipe joining methods used must be per the pipe and fitting manufacturer's recommendations.

1. Ensure kinking or bending of the pipe in excess of the minimum allowable bend radius of the pipe does not occur during the installation process.
2. Laterally support the pipe upon placement in the trench to meet dimensional requirements, as shown on Drawings, for placement of pipe bedding Material on both sides and under the haunches of the pipe.
3. Utilize sand bags (which may be left in the finished backfill), pre-placement of pipe bedding Material, or other approved separation methods to separate pipe from the trench wall around curves and to control snaking of the pipe prior to backfill.
4. Control pipe temperature prior to and during installation to avoid undesired pipe movement following backfill.

7-11.3(6)F1 PROJECT FIELD MANUAL FOR HDPE PIPE

Submit the Installer's Project Field Manual, which must include:

1. All equipment and O&M instructions for fusion technicians for all fusion operations required, including the following:
   a. Field Operating Instructions: Simplified, "need-to-know" information, organized step-wise, and customized for the project. Field operating instructions may be supplemented by, but not replaced with, industry or manufacturer reference documents;
   b. Butt fusion equipment O&M instructions;
   c. Electrofusion fitting or coupling equipment O&M instructions, where electrofusion fittings or couplings are proposed and approved by the Engineer;
   d. Flanged adapter equipment O&M instructions, where flanged adapters are proposed and approved by the Engineer; and
   e. O&M instructions for on-site McElroy (or approved equal) Guided Side Bend Tester equipment and procedures for performing the side bend test.
2. Methods for pipe delivery, storage, staging, and installation, including handling and support information, details, and descriptions. Such support information, details, and descriptions must indicate the type, number, and other pertinent

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details of the slings, strutting, and other methods proposed for pipe support and handling during transport and installation.

3. Methods for environmental controls (wind, dust, precipitation, heat, cold) for fusion operations, and pipe storage and installation.
4. Detailed layout of staging area for typical fusion equipment set-up and pipe layout.
5. Methods for pipe defect identification and measurement, including methods and equipment for removal and repair per the pipe manufacturer's recommendation.
6. Identification of equipment to be used for welding. Equipment used for welding must include a continuous data logger that records the plate temperature, pressure applied, and a graphic representation of the fusion cycle.
7. Welding procedure specifications, adapted for each fusion machine utilized, including the following information:
    a. Clarify distinction between interfacial pressure, drag pressure, heat pressure, fusion pressure, and gauge pressure;
    b. Measure of actual drag pressure in-situ;
    c. Pipe mounting and clamping;
    d. Pipe and equipment cleaning;
    e. Joint facing;
    f. Alignment tolerances, angular and horizontal;
    g. Setup and use of Continuous Data Logger;
    h. Heating element temperature;
    i. Shifting sequence for fusion machine;
    j. Identification of initial bead-up;
    k. Proper heating pressure following bead-up (drag pressure);
    l. Minimum heat soak time;
    m. Special procedures for fusing non-equal thickness pipe ends;
    n. Acceptable appearance of heated ends;
    o. Maximum lag time between heating and fusion;
    p. Calculated fusion gauge pressure for each wall thickness;
    q. Graphic and dimensional descriptions of acceptable joint beads;
    r. Joint identification stamp (initials and joint number) and large marking with metallic pen for visibility;
    s. Cooling time and handling instructions following joining;
    t. Procedure for removing defective joints; and
    u. Download, processing, and analysis instructions of Data Logger records.
8. Forms for field quality control records, including:
    a. Equipment maintenance check lists. Equipment must be maintained and calibrated per manufacturer's requirements and recommendations. Submit manufacturer's recommendations for equipment maintenance;
    b. Butt Joint Acceptance Checklist for Engineer to complete;
    c. Electrofusion Joint Acceptance Checklist, where proposed and approved by the Engineer, for Engineer to complete;
    d. Flanged Joint Acceptance Checklist, where proposed and approved by the Engineer, for Engineer to complete. Submit flanged adapter and gasket manufacturer's recommendations for flange bolting and installation Procedures, including the maximum allowable torque that can be applied and the anticipated compressive loads from the flange assembly that are needed to hold gaskets in place. Indicate the procedures for "retorque" if applicable;
    e. Data Logger Records for each installed joint; and
    f. Joint map, station location of each installed joint.

7-11.3(6)F2 HDPE PIPE LINE LAYOUT DRAWINGS

Submit a HDPE Pipe Line Layout Plan to the Engineer at least 20 Working Days before pipe installation. The Pipe Line Layout Plan must include the following:

1. Designation or serial number of pipe section and fitting, and manufacturer's recommended joining methods. Include unique piece number for each molded or fabricated fitting, special, outlet, or any joint except standard in-line butt fusion joints between straight pipe segments;
    a. Product details of molded or fabricated fittings must include its designation or serial number information for easy comparison between the Line Layout Plan and the product detail.

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2. Drawings indicating the location and details of temporary bulkheads for hydrostatic leakage testing of the pipeline, and details for the removal of the test bulkheads and closure of the finished pipeline;
3. Pipe station and elevation of each pipe section laid. Elevation must be indicated at invert elevation for pipe;
4. Invert elevations of pipeline crossings, including diameters;
5. Invert elevations of connections to existing Water Main;
6. Elements of curves and bends, both in horizontal and vertical alignment, including elements of the resultant true angular deflections in cases of combined curvature. Include information that verifies minimum requirements as specified per this Section for cold (field) bending are met;
7. Details and locations of closures for length adjustment and for construction convenience; and
8. Temporary restraint system for pipe to perform field bending, if proposed by the Contractor.

7-11.3(6)F3 HDPE JOINTS

Unless otherwise indicated, butt fusion connections are the only joining method for all HDPE pipe and fittings.

Electrofusion is acceptable only if specifically approved in writing by the Engineer. Flanged connections are acceptable joining methods for HDPE fittings to other pipe materials. Each fusion joint must be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine that must register and/or record the parameters required by the manufacturer and these specifications.

1. Butt Fusion:
   a. Use procedures outlined in ASTM F2620 and perform in accordance with the pipe manufacturer's recommendations. Inspect and test butt fusion joints in accordance with joint field inspection and quality control requirements as specified in Section 7-11.3(6)F4.
   b. The pipe manufacturer must be consulted to obtain machinery and expertise for the joining by butt fusion of HDPE pipe and fittings.
   c. Personnel joining HDPE pipe or fittings by butt fusion must meet the qualification requirements as specified in Section 7-11.3(6)F5 for hands on training of fusion procedures per ASTM F2620.
   d. Perform butt fusion between pipe ends, or pipe ends and fittings that have the same outside diameter and are not different in wall thickness by more than one standard dimension ratio (SDR) step. Make transitions between unlike wall thickness greater than one SDR step with a fabricated transition where the inside pipe diameter has been machined to match the thinner pipe end.
2. Electrofusion, where approved by the Engineer:
   a. Use procedures outlined in ASTM F1290 and perform in accordance with the pipe and coupling manufacturer's recommendations. Inspect and test joints in accordance with joint field inspection and quality control requirements as specified in Section 7-11.3(6)F4.
   b. Electrofusion fittings and joints must be manufactured and tested in accordance with ASTM F1055 and AWWA C906.
   c. The pipe and coupling manufacturer must be consulted to obtain machinery and expertise for the joining by electrofusion and HDPE pipe and fittings.
   d. Personnel joining HDPE pipe or fittings by electrofusion must meet the qualification requirements as specified in Section 7-11.3(6)F5 for hands-on training of electrofusion procedures per ASTM F1290.
3. Flanges, where approved by the Engineer:
   a. Use procedures in accordance with the flange adapter and gasket manufacturer's recommendations and PPI-TN38. Inspect and test joints in accordance with joint field inspection and quality control requirements as specified in Section 7-11.3(6)F4.
   b. The pipe manufacturer must be consulted to obtain machinery and expertise for the joining of HDPE pipe and fittings by flanges.

7-11.3(6)F4 HDPE PIPE JOINT FIELD INSPECTION AND QUALITY CONTROL

Provide a minimum of 24-hour notice to Engineer prior to commencing in-field fusion or joining operations and provide a minimum 4-hour notice to Engineer of fusion joints ready for inspection. Do not install fused HDPE pipe in trench prior to review by Engineer.

The Engineer may request up to 5 percent of all joints welded in the field be subject to a side bend test per ASTM F3183. Remove and replace disqualified joints at Contractor's expense. For every failed test, the Engineer may request the replacement joint and nearby joints on each side of the failing test be removed for destructive testing.

Have at all times onsite a McElroy (or approved equal) Guided Side Bend Tester and supporting equipment with which to perform joint bending tests to qualify joints.

The Engineer may disqualify any joint where the fusion procedure deviates from the Contractor's submitted plans, with or without visual or data logger evidence of a defect. The Contractor is responsible for removing and replacing disqualified joints at the Contractor's sole expense.

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The critical parameters of each fusion joint, as required by the manufacturer and these specifications, must be recorded by an electronic data logging device. All fusion data must be included in a Fusion Technician's Joint Report per ASTM F3124, which shall be prepared and submitted by the Contractor within 2 days after joining. The Fusion Technician's Joint Report shall include the following:

1. Fusion Technician identification;
2. Fusion equipment size and identification;
3. Identify the type of joint made for each joint ID (butt fusion, electrofusion, or flanged);
4. Each joint shall be assigned a specific ID and shall be correlated to the data logger of the machine. The joint ID shall be noted on the As-Builts at the joint's final location;
5. The critical parameters of each fusion joint (butt fusion or electrofusion), as required by the manufacturer and this Section, shall be recorded; and
6. Data Logger records.

7-11.3(6)F5 HDPE PIPE QUALIFICATIONS

See Section 7-11.3(6)F2 for submittal requirements.

In addition to requirements listed elsewhere in the Contract, only qualified personnel, whether by the Contractor or Subcontractor, must be responsible for and perform the proposed joining and installation procedures for HDPE pipe. The Contractor must identify the qualified personnel who will be responsible for performing each joining procedure proposed, and submit the following for each qualified person indicated by the Contractor:

1. A record or certificate of training that verifies qualifications for being able to make each type of fusion joint per ASTM F3190, including proof of:
   a. Current and formal training on all fusion equipment utilized on the project. Contractor's personnel joining HDPE pipe by pipe or fitting manufacturer's recommended joining method(s) must be trained and qualified or re-qualified in the pipe or fitting manufacturer's recommended procedures within the last 12 months before commencing construction. Training more than two years prior to operation with no evidence of activity within the past 6 months must not be considered current;
   b. Classroom and hands-on training of fusion procedures per ASTM F2620 and PPI TN-42 for butt fusion and per ASTM F1290 for electrofusion; and
   c. Minimum 4-hour equipment-specific field training by fusion equipment manufacturer's authorized training specialist.

7-11.3(7) INSTALLING STEEL PIPE

7-11.3(7)A THREADED STEEL PIPE LESS THAN 4 INCHES IN DIAMETER

Connect steel pipe in sizes up to and including 3-1/2 inches with malleable iron screwed couplings. Couplings must be galvanized. Use unions or flanges at all equipment and valves. Cut ends must be reamed and threads cleanly cut. Brush coat exposed threads, after jointing, with an asphalt varnish, Royston Roskote Mastic R28 or approved equal. In wet conditions, use 3-component wax tape wrap consisting of primer, wax tape, and fiberglass overwrap per Section 7-11.3(8)A.

7-11.3(7)B COUPLED PIPE 4 INCHES IN DIAMETER AND LARGER

Steel pipe 4 inches and larger for use in underground services must be coupled as specified in the Contract.

Any welding of steel pipe must be per AWWA C206.

Before assembly, thoroughly clean bell and spigot joints and brush a lubricant suitable for potable water meeting the approval of NSF on the inside of the bell.

7-11.3(7)C STEEL CASING PIPE

7-11.3(7)C1 GENERAL

Where shown on the Drawings, install steel casing pipe for the Water Main. Where trenchless construction is shown on the Drawings, see Section 7-17.3(2)H for installation Specifications, and if by directional drilling, see Section 2-16.

All joints must be welded by operators who are qualified by testing as prescribed by the AWS in Standard Qualifications Procedure and are certified to perform the type of work required. The quality of welding must conform to the current edition AWS D1.1 Structural Welding Code, Section 3, Workmanship.

7-11.3(7)C2 SEALS AND SPACERS BETWEEN CASING AND WATER MAIN

Casing end seals must comply with the requirements of Section 9-30.2(12)A, completely seal the annular space at each end of the casing pipe, and be installed per the manufacturer's instruction.

Casing spacers must electrically isolate the outer casing pipe from the inserted Water Main. The spacers (also known as casing insulators, crossing insulators, and casing isolators) must comply with the requirements of Section 9-30.2(12)B. There must be a minimum of 2 spacers per length of pipe, and the spacing between any 2 spacers must not exceed 10 feet. For 4 inch through 12 inch diameter pipe, each spacer must have at least 4 runners. For 14 inch through 36 inch diameter pipe,

each spacer must have at least 6 runners. At least 2 runners must be located on the upper half of the spacer for all diameter Water Main. At least 2 runners must be located on the lower half of the spacer for 4 inch through 12 inch diameter Water Main, and at least 4 runners must be located on the lower half of the spacer for 14 inch through 36 inch diameter Water Main. Actual locations of runners on the spacer per the manufacturer's recommendations. Casing spacers must be installed first on the Water Main and then the Water Main inserted in the casing pipe must be per the manufacturer's instructions.

Submit the spacer and end seal manufacturer's catalog cuts and installation instruction to the Engineer at least 5 Working Days in advance of this work.

7-11.3(8) FIELD APPLIED COATINGS

7-11.3(8)A WAX TAPE COATING

When specified in the Contract, wax tape coating must be field applied to Water Main including pipe, fittings, valves, couplings, bolts, flanges, shackle rods, or other appurtenances, see Section 9-30.1(4)F.

Preparation for wax tape coating:

1. On Water Main without a coating, clean the surfaces with wire brush, cleaning products, duct tape dust and particle pickers, and similar means and Supplies to remove all rust, dirt, oil, and other deleterious material. Use sandblasting methods if necessary for stubborn rust and other deleterious coating removal. The surface must be dry, have no loose particles of any kind, and be in a prepared condition as recommended by the wax tape Supplier.
2. On Water Main with a coating, clean the surfaces with Supplies and means that do not injure or harm the existing coating and produce a prepared surface as recommended by the wax tape Supplier. Water Main with existing coating and type of coating will be identified in the Contract.

Coverage by wax tape coating must have full contact with all Water Main Material and no voids. Where voids, or gaps, or irregular surfaces and transitions in the Water Main exist, apply joint filler compatible with the wax tape coating product as recommended by the wax tape Supplier. Wax tape coating must be complete before outerwrapping.

Extend coverage to a minimum 1 pipe diameter length beyond the wax tape limits specified in the Contract, up to 18 inches.

Coverage thickness must be a minimum 70 mil. Spiral wraps must overlap by 1 inch and the ends of the wax tape circumferential segments overlap 6 inches.

Wax tape application on prepared surfaces includes:

a. Initial coating with a petroleum primer,
b. Wrapping with wax tape, and
c. Outer wrapping with fiberglass mesh.

All products in the wax tape application must be compatible with each other and with the Water Main prepared surfaces. The Supplier may recommend an alternate component to provide an acceptable protective coating.

The Contractor must submit to the Engineer for approval at least 10 Working Days in advance, the Supplies and method proposed for preparing the Water Main, the wax tape coating system and how it is applied, any alternate component and the reason for use, Supplier recommendations with sufficient detail indicating an acceptable finished product, and Supplier contact information.

7-11.3(9) WORK ON EXISTING WATER MAINS

7-11.3(9)A GENERAL

Do not operate any valve on an existing Water Main.

SPU Water Operations will make all connections to charged Water Mains and will operate all valves to accomplish shutdowns and subsequent reactivation. The Contractor must contact the Engineer at least 10 Working Days in advance to schedule Work requiring SPU Water Operations per Section 1-07.28. However, the Contractor is encouraged to communicate and coordinate with the Engineer as early in the project as possible regarding the scheduling of these connections as SPU Water Operations' shutting down and starting up portions of the water system will take into consideration:

1. Size of Water Main and total system impacts.
2. Coordination with Fire Department.
3. End user Customer needs and coordination.
4. SPU Water Operation's workforce availability.
5. Contractor's workforce availability.
6. Notifications of the scheduled shutdown will be made by SPU Customer Service / Inspection Services personnel to the affected consumers a minimum of 5 Working Days in advance of the shutdown.

Also see Section 7-15 Water Service Connections.

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7-11.3(9)B CONNECTIONS TO EXISTING WATER MAINS

Newly installed Water Main must be pressure tested and must be acceptable as specified in Sections 7-11.3(11) and 7-11.3(12) before making any connection. When required, newly installed Water Main must pass the taste and odor rating test as specified in Sections 7-11.2(2) and 7-11.2(3) before and/or after making any connection.

After all tests, flushing, and disinfection have been completed and the installed Water Main has been approved by the Engineer, the Contractor may submit a request to the Engineer to schedule the shutdown and connection with SPU Water Operations. Connections must be made within 14 Calendar Days after the date of written notice that flushing and disinfection sample analysis indicated acceptable results per Section 7-11.3(12)A.

Provide the Engineer 2 Working Days advance notice for scheduling inspections for approval of Water Main installations for connection. Within 2 Working Days after the inspection, the Contractor will be provided with written approval or with a list of items to be corrected. Items to be corrected will be reinspected. The notification requirement and reinspection response times are the same as the initial inspection. Approval is contingent on the Water Main and appurtenances being completely installed and tested per Contract.

The Contractor's scheduling of connections requires the Engineer's approval on the following items:

1. Verification of existing Water Main grade and alignment per Section 7-11.3(4)B. The Contractor must match the grade and alignment of the new Water Main to the existing Water Main.
2. Contractor's written list of materials being supplied.
3. Verification and inspection of Contractor's supplied materials.

All connections to existing Water Main will be performed by SPU Water Operations. Contractor must assist SPU Water Operations with connections and the Contractor is responsible for the following elements of work:

a. Protection of the Water Main and services during construction.

b. Coordination with Engineer and SPU Water Operations staff including scheduling per Section 7-11.3(9)A.

c. Preparation of the Project Site prior to arrival of SPU Water Operations, including excavation, dewatering, support and safety systems, and traffic control.

d. The Contractor must furnish all materials and equipment required to complete the connection not specifically called out in the Contract as being furnished by SPU Water Operations. The Contractor must furnish and install the connection fitting on new Water Mains (see Standard Plan 300a, 300b, and 300c). SPU will furnish connection fittings to existing Water Mains, unless otherwise specified. All required materials and equipment supplied by the Contractor must be available on the Project Site during the shutdown.

e. Provide equipment and operators required for trench excavation and to move and lower the component parts of the connection into position. A dedicated crew must be provided for the duration of the Work and must be solely dedicated to assist SPU Water Operations. Additional equipment and operators must be provided as necessary for multiple connections during the same shutdown.

f. Removal of abandoned pipes, appurtenances, and blocking.

g. Coat, wrap, and joint bond the connection to conform with the requirements of the new Water Main.

h. Provide pipe bedding per Standard Plan 350, backfill, compaction, and temporary pavement patch.

In addition to those connections shown on the Drawings, segments of a new Water Main may be placed in service before completion of the entire Water Main. All connections between the charged and uncharged segments of the new Water Main will be done by SPU Water Operations. Locations of connections between segments of new Water Main are dependent on Contractor's operations and are not shown. The Contractor must furnish all Materials for such connections.

7-11.3(9)C CUT, CAP, AND BLOCKING FOR EXISTING WATER MAIN

Where indicated in the Drawings or as directed by the Engineer, a cut, cap, and blocking to isolate existing Water Main will be performed by SPU Water Operations. The Contractor must verify the existing Water Main grade and alignment per Section 7-11.3(4)B prior to scheduling the cut and cap.

The Contractor must assist SPU Water Operations with the cut, cap, and blocking, and is responsible for the following elements of work:

1. Protection of the Water Main and services during construction.
2. Coordination with Engineer and SPU Water Operations staff including scheduling per Section 7-11.3(9)A.
3. Preparation of the Project Site prior to arrival of SPU Water Operations, including excavation, dewatering, support and safety systems, and traffic control.
4. Provide equipment and operators required for trench excavation and to move component parts of the cut and cap into position. A dedicated crew must be provided for the duration of the work and must be solely dedicated to assist SPU Water Operations. Additional equipment and operators must be provided as necessary for multiple cut and caps during the same shutdown.
5. Furnish and install precast Ecology Block or Dailey Block as indicated in the Contract or as directed by the Engineer.
6. Removal of abandoned pipes and appurtenances.

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7. Backfill, compaction, and placement of temporary pavement patch

7-11.3(9)D TEMPORARY WATER MAINS AND SERVICES

The Contractor's critical path schedule must allow adequate time for installation and connection of these temporary Water Mains and services. Provide the Engineer a minimum of 10 Working Days advance written notice for scheduling of the temporary Water Main and service work. Temporary Water Mains and Services must be maintained by the Contractor in such a manner as to provide constant, adequate water supply to customers and to avoid impeding traffic and access to abutting properties.

Temporary Water Mains and Services must be furnished and installed by the Contractor unless otherwise noted on the Drawings or Project Manual. If work is identified to be completed by SPU Water Operations, the Contractor must support SPU by furnishing pipe and performing all required excavation, backfill, and compaction.

All temporary Water Mains must be disinfected, flushed, and sampled for bacteriological testing by the SPU Customer Service / Inspection Services. When found acceptable, the temporary Water Mains will be placed in service per Section 7-11.3(9)B. Transfer existing Water Services to the Temporary Water Main or Service per Section 7-15.3.

The Contractor is solely responsible for maintaining private water service laterals in service. When it is necessary to provide temporary water supply, the Contractor is responsible for providing temporary services on the private side of the water service. Should construction activity damage or disrupt private water service laterals or appurtenances, immediately notify the Engineer of any such damage or disruption. The Contractor must start repairs immediately as directed by the Engineer, and work continuously until the water service lateral is restored.

7-11.3(10) LOCATING WIRE AND TRENCH MARKER TAPE

7-11.3(10)A LOCATING WIRE

Install locating wire 6 inches directly above the centerline of all nonmetallic and non-HDPE pipe, except that the locating wire must be bonded by exothermic welds to all metallic fittings, valves and valve boxes to form an electrically continuous system.

For HDPE pipe, the locating wire must be centered on the pipe as shown on the Drawings. Locating wire must be secured to the crown of the HDPE pipe with 7 mil plastic tape every 5 feet, except the locating wire must be bonded by exothermic welds to all ductile iron fittings and valves to form an electrically continuous system per Standard Plan 362.

After all the trench backfill operations are successfully completed and prior to the final paving, the Contractor must perform continuity and trace tests on all tracer wire in the presence of the Engineer. If the tracer wire is found to be not continuous after testing, the Contractor must repair or replace the failed segment of wire.

7-11.3(10)B TRENCH MARKER TAPE

Install continuous marker tape centered above the pipe just below the sub-base of the roadway or sidewalk, or, if pipe located in landscaped areas 12 inches below finished grade, during backfilling operations.

For wall anchor blocks, the marker tape must be placed on top of the wall anchor blocks in grid pattern with one-foot spacing between tapes and extending out a minimum of 2 feet beyond the perimeter of the wall anchor block.

7-11.3(11) HYDROSTATIC PRESSURE TEST

All Water Mains and appurtenances must be hydrostatically pressure tested. Once the new Water Main has passed the hydrostatic pressure test, the Water Main must be flushed, disinfected, and bacteriologically sampled as specified in Section 7-11.3(12), and may be required to pass additional post-installation taste and odor rating test as specified in Section 7-11.2(3).

The Contractor will furnish and/or operate all labor, equipment, pumps, gauges, plugs, saddles, corporation stops, miscellaneous hose and piping, a 1/4-inch F.I.P.T. connection for pressure recorder, and as necessary for performing the test.

Pressure recorders and charts used to record the tests will be furnished and operated only by the Engineer.

Before notifying the Engineer to witness and record the pressure test, the Contractor must have set up and performed the pressure test to make certain that the pipe is in acceptable condition. The Contractor must then notify the Engineer at least 2 Working Days before recording and conducting the test.

Furnish and install temporary blocking as required for pressure testing. Upon successful testing, remove temporary blocking.

To protect existing Water Mains from contamination by backflow of test water during filling operations, temporarily install a Washington State Department of Health approved reduced pressure principle backflow prevention assembly between the test and supply Water Main. See Section 1-07.28 item 8D for notification requirements regarding BPA inspection. Provide a current BPA performance test report, which must be on the Project Site for the assembly being used. Install the temporary backflow protection and isolate the Water Main under test from the supply Water Main before hydrostatic testing.

7-11.3(11)A TEST PRESSURE FOR FIELD TESTING WATER MAIN PIPE

Field hydrostatic testing of various diameter ductile iron Water Main pipes and appurtenances must be per the following table:

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Diameter Pipe (inches)	Test Pressure (psi)
4	300
6	300
8	300
10	300
12	300
16 and larger	250

Test pressure for pipe except ductile iron is specified in the Contract.

The indicated test pressure must be taken at the lowest elevation of the section of Water Main being tested. All air in the pipe must be vented before test.

Maintain the hydrostatic test pressure until the Engineer determines that the section of pipe, valves, and fittings are water tight. If there are no visible leaks and the test pressure is maintained without pumping for 15 minutes with a pressure drop of less than 15 psi, the Water Main will be accepted as a water tight installation. When testing lengths of Water Main pipe less than 18 feet long, or when testing hydrant pipe, maintaining the test pressure without pumping for 5 minutes with less than 5 psi drop in pressure will be considered evidence of an acceptable test.

Sections to be tested are limited to 1,500 feet or less. The Engineer may require that the first section of pipe, not less than 1,000 feet in length, installed by each of the Contractor's crews, be tested to qualify the crew and the Material. Do not continue pipe installation more than an additional 1,000 feet until the first section has been tested.

Perform hydrostatic tests on every completed section of Water Main between valves. The pressure differential across closed valves must not exceed the rated operating pressure of the valve.

All tests must be made with the hydrant auxiliary gate valves closed. After the test has been completed, test gate valves by closing each one in turn and relieving the pressure beyond. This test of the gate valve will be acceptable if no immediate loss of pressure is registered on the gauge when the valve is being checked. Verify that the pressure differential across the valve does not exceed the rated test pressure of the valve.

Correct any visible leakage detected regardless of the allowable leakage specified above. Should the tested section fail to meet the pressure test as specified, the Contractor is solely responsible for locating and repairing the defects and retesting the Water Main.

The Contractor must replace and remedy defective Materials or workmanship discovered as a result of a hydrostatic field test as specified in Section 1-05.7. Whenever it is necessary to replace defective Material or correct the workmanship, the hydrostatic test will be rerun until an acceptable test is obtained.

7-11.3(11)B TESTING EXTENSIONS FROM EXISTING WATER MAINS

When an existing Water Main is extended over 18 feet, the section of new pipe installed to the existing Water Main will be made by SPU Water Operations with pretested, pre-disinfected pipe, and no hydrostatic test is required. Notify SPU Customer Service for approval at least 3 Working Days in advance if pre-disinfected pipe is proposed for installation. When the required hydrostatic tests are conducted in the new Water Main section beyond the installed new valve in the closed position, the normal pressure of the existing Water Main may be present against the other side of the new valve.

Where the distance between the end of an existing Water Main pipe extension to the new valve is more than 18 feet, do not connect the new pipe to existing pipe until after hydrostatic tests have been made to the required pressure in both directions against the new valve. Use a temporary cap or plug installed on the end of the new pipe, beyond the new valve, within the tolerances shown on Standard Plan 300b from the existing pipe. Where a new valve is not part of the Work, notify the Engineer at least 10 Working Days in advance to coordinate other arrangements for hydrostatic testing.

Apply the required test pressure to the short length of pipe between the temporary cap or plug end with the new valve in the closed position, with no hydrostatic pressure active on the opposite side of the valve. Conduct the same test against the other side of the new valve when that section of pipe is tested with no hydrostatic pressure active in the short section of pipe toward the existing Water Main pipe. The final connection to the existing Water Main will be made by the SPU Water Operations with pretested, prechlorinated pipe, and no hydrostatic test is required.

7-11.3(11)C TESTING SECTION WITH HYDRANTS INSTALLED

When hydrants are included with the section of Water Main pipe to be tested, the testing must be conducted in 3 separate tests:

Test	Process
Test 1	Water Main gate valves and hydrant auxiliary gate valves closed, with the hydrant operating stem valves and hose ports wide open.

Test	Process
Test 2	Water Main gate valves and the hydrant operating the stem valves tightly closed but the hydrant auxiliary gate valves and hose ports wide open.
Test 3	Each hydrant tested to 200 psi with the hydrant auxiliary gate valve and hose ports closed and the hydrant operating stem valve wide open. 25 pounds per square inch in the supply Water Main beyond the hydrant auxiliary gate valve when testing a hydrant singly.

7-11.3(11)D TESTING HYDRANTS INSTALLED ON EXISTING WATER MAINS

For hydrants installed and connected to an existing Water Main, the hydrant connection including hydrant tee, connection pipe, and auxiliary gate valves must be installed with pretested Materials.

Before the hydrant connection is made to the existing Water Main, subject the hydrant installation to the hydrostatic Test 3 as specified in Section 7-11.3(11)C. Following an acceptable hydrostatic test, hydrants installed and connected to an existing Water Main must have a bacteriological sample obtained and tested for acceptable results before connection the Water Main.

7-11.3(12) FLUSHING AND DISINFECTION OF WATER MAINS

7-11.3(12)A GENERAL

Before being placed in service, all newly installed pipe, valves, hydrants, and appurtenances must be flushed, disinfected, kept clean, and sampled for acceptable bacteriological analysis. Additional taste and odor rating testing may be required, see Section 7-11.2(3).

Newly installed Water Main will have 2 samples taken from every 500-foot interval, and at each end. The first set of samples will be taken a minimum of 16 hours following completion of the final flushing, see Section 7-11.3(12)J. While allowing the sample tap to continue running between samples, the second set of samples will be taken at least 15 minutes after the first set. Alternatively, if approved by the Engineer, the first set of samples may be taken immediately after final flushing and the second set after a minimum of 16 hours after flushing. For each hydrant lateral over 18 feet in length, samples will be taken at the hydrant end. Hoses for sampling are not allowed. On new Water Main without hydrant, temporary sampling taps must be provided and then removed and plugged after the Engineer notifies the Contractor of acceptable bacteriological results. Fit the hydrant used for sampling with a sampling tap acceptable to the Engineer.

Coordinate with the Engineer for the location of sampling taps. All bacteriological analysis will be performed by the SPU Water Quality Laboratory. Written notice of the results of sample analysis will be returned to the Contractor 2 Working Days after the sampling. Analysis of any sample indicating unacceptable results requires the remedy specified in Section 7-11.3(12)K. Analysis of samples indicating acceptable results requires the new Water Main be connected to existing Water Main within 14 Calendar Days of the Date of written notice from the Engineer to the Contractor. Failure to make the connection within this time frame requires additional disinfection, flushing, and additional sampling and testing for acceptable results. The Engineer may perform additional bacteriological sampling and testing at any time.

7-11.3(12)B PREDISINFECTION FLUSHING

Sections of pipe smaller than 24-inch diameter to be disinfected by methods except those found in Section 7-11.3(12)D, Method 1, must first be flushed to remove any solid or Contaminated Material. If Method 1 is used, the 2-1/2 fps flushing must be done after disinfection is complete, see Section 7-11.3(12)J. If no hydrant is installed at the end of the new pipe, provide a tap large enough to develop a velocity of at least 2-1/2 fps in the pipe. Flushing period must be at least 5 minutes for every 150 feet of new pipe but in no case less than 30 minutes. One 2-1/2-inch hydrant opening will, under normal pressure of 40 psi, provide this velocity in pipe sizes up to and including 12 inches. For pipe sizes exceeding 12-inch diameter, flushing taps size requirements are:

REQUIRED FLOW AND OPENING TO FLUSH WATER MAINS

Pipe Diameter (inches)	Flow Required to Produce 2-1/2 feet per second (fps) Velocity in Water Main (gpm)	Number - Size (inch) of Taps Required for a 2-1/2 fps Flush
14	1200	3 – 2”, or 1 – 3”
16	1600	4 - 2”, or 1 - 4”
20	2500	6 - 2”, or 3 - 3”, or 2 - 4”
24	3600	4 - 3”, or 2 - 4”, or 1 - 6”
30	5625	4 - 4”, or 2 - 6”, or 1 - 8”
36	8100	2 - 6”, or 1 - 8”

Pipe Diameter (inches)	Flow Required to Produce 2-1/2 feet per second (fps) Velocity in Water Main (gpm)	Number - Size (inch) of Taps Required for a 2-1/2 fps Flush
42	11025	3 - 6", or 1 - 10"
48	14400	4 - 6", or 1 - 12"

The Contractor must furnish and install taps required for chlorination, flushing, or temporary or permanent release of air , which are incidental to the construction of Water Mains. When a hose bib faucet is installed for bacteriological sampling, locate it upstream from the flushing point. Taps on existing Water Mains required for chlorination or flushing will be furnished and installed by SPU's Water Operations Division.

As an alternative to 2-1/2 fps flushing, sections of pipe 24 inches or larger diameter may be prepared for disinfection by mechanical cleaning methods approved by the Engineer.

The Contractor is responsible for disposing of treated water flushed from the Water Mains as acceptable to State and local authorities. Neutralize water to 0.1 parts per million chlorine, or less, before disposal into any natural drainage channel. Maintain an air gap equal to twice the discharge pipe/hose diameter (but not less than 12 inches) between the discharge outlet and the overflow rim of the receiving waters.

7-11.3(12)C REQUIRED CONTACT TIME

Before placing into service, disinfect all newly installed pipe so that a chlorine residual of not less than 10 mg/L remains in the water after the retention period. Keep treated water in the pipe at least 24 hours. If the water temperature is less than 41 °F (5 °C), the water must remain in the pipe for at least 48 hours. After the retention period, test chlorine residual at all extremities of the pipe. The measured chlorine residual must be at least 10 mg/L. If a measurement of less than 10 mg/L is obtained repeat disinfection is required.

7-11.3(12)D FORM OF APPLIED CHLORINE

Apply chlorine by one of 2 methods to provide a dosage of at least 25 mg/L of available chlorine:

Method 1: Dry Calcium Hypochlorite

As each length of pipe is installed, place sufficient high test calcium hypochlorite (65 to 70 percent chlorine) in the pipe to yield a dosage of not less than 25 mg/l available chlorine, calculated on the volume of the water to be contained in the pipe and appurtenances. This method may only be used if the pipes and appurtenances are kept clean and dry during construction.

The number of ounces of 65 percent test calcium hypochlorite required for a 20-foot length of pipe equals $0.004216d^2$ in which "d" is the pipe diameter in inches.

Method: 2 Sodium Hypochlorite

Sodium Hypochlorite, commercial grade (12.5 percent Cl_2) or in the form of liquid household bleach (5 to 6 percent Cl_2), must be applied by means of a solution-feed chlorinating device. This liquid chlorine compound may be used full strength or diluted with water and injected into the Water Main with fill water in correct proportion to produce a mixture of at least 25 mg/l Cl_2.

7-11.3(12)E CHLORINE DOSAGE

The amounts of chlorine required to provide 25 mg/l for 100-foot lengths of various diameters of pipe are:

AMOUNTS OF CHLORINE REQUIRED FOR 25 MG/L DOSAGE

Pipe Size (inch)	**Volume of Water per 100 ft. Length** (gallons)	**Household Bleach 5-1/4% Cl_2** (gallons)	**Commercial Bleach 12-1/2% Cl_2** (gallons)
4	65.3	.03	.013
6	146.5	.07	.03
8	261.0	.13	.053
10	408.0	.2	.08
12	588.7	.3	.12
14	799.6	.4	.16
16	1044.4	.5	.21
20	1631.9	.8	.33
24	2349.9	1.1	.47
30	3671.7	1.8	.75
36	5287.3	2.5	1.1

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Pipe Size (inch)	**Volume of Water per 100 ft. Length** (gallons)	**Household Bleach 5-1/4% Cl_2** (gallons)	**Commercial Bleach 12-1/2% Cl_2** (gallons)
42	7196.6	3.5	1.44
48	9399.0	4.6	1.6

7-11.3(12)F POINT OF APPLICATION FOR LIQUID DISINFECTION

The preferred point of application of the chlorinating agent is at the start of the Water Main extension or any valved section of it and through a corporation stop inserted in the horizontal axis of the pipe. The water injector for delivering the chlorine bearing water into the pipe must be supplied from a tap on the pressure side of the gate valve controlling the flow into the Water Main extension. Alternate points of application may be used when approved by the Engineer.

7-11.3(12)G BACKFLOW PREVENTION REQUIREMENT

To prevent contaminated water from the new Water Main from entering the existing distribution system, use a disinfected Washington State Department of Health approved reduced pressure backflow assembly on the line supplying the water. An approved reduced pressure backflow assembly is sufficient backflow protection only for filling and flushing of the new Water Main. During the hydrostatic pressure test, remove the temporary connection between the new Water Main and the existing distribution system. See Section 1-07.28 item 8D for backflow prevention assembly notification and testing requirements.

7-11.3(12)H RATE OF APPLICATION

Water from the existing distribution system, or other approved supply source, must be controlled for very slow flow into the newly installed Water Main during chlorine application. The rate of sodium hypochlorite application must be in such proportion to the rate of water entering the newly installed pipe that the dosage applied to the water is at least 25 mg/l.

7-11.3(12)I DISINFECTION OF CONNECTIONS TO EXISTING WATER SYSTEMS

All connections must be disinfected per the requirements of AWWA C651 section titled Disinfection Procedures When Cutting into or Repairing Existing Main. Swab or spray all pipe and fittings with a chlorine solution at least as strong as liquid household bleach (5-6 percent Cl_2).

7-11.3(12)J FINAL FLUSHING AND TESTING

Following chlorination, flush all treated water from the pipe until the replacement water treated throughout its lengths shows an absence of chlorine. If chlorine is normally used in the source of supply, tests must show a residual not in excess of that carried in the system.

Where dry calcium hypochlorite has been used for disinfection, flushing velocity must be at least 2-1/2 feet per second in the Water Main. Flushing period must be at least 5 minutes for every 150 feet of new Water Main but in no case less than 30 minutes.

See Section 7-11.3(12)A for bacteriological sampling and testing, and see Section 7-11.2(3) for post installation taste and odor rating testing when required by the Engineer.

All hydrants on the new Water Main must be flushed to remove excess chlorine from the hydrant and hydrant branch.

7-11.3(12)K REPETITION OF FLUSHING AND TESTING

Based on any unacceptable bacteriological sample results, as specified in Section 7-11.3(12)A, the new Water Main or hydrant connection over 18 feet must be either flushed and resampled, or re-disinfected, flushed, and resampled. The Contractor must repeat these procedures until acceptable bacteriological sample results are obtained.

7-11.3(12)L PREFLUSHING AND DISINFECTION OF WATER MAINS BY SPU (SPECIAL CASE)

SPU may determine that installation of pre-flushed pipe is in the best interest of the City and its customers. This will be a case-by-case determination by the Engineer. When pre-flushing, follow this flushing and disinfection of pipe for Water Main connection procedure:

1. Deliver to SPU the required pipe, of proper diameter and material for connection, at least 5 Working Days before the installation date.
2. SPU will flush, disinfect, re-flush, and obtain bacteriological sampling and testing of pipe.
3. SPU will bag the ends of the pipe as it is removed from the cleaning and testing rack and will deliver it to site.
4. SPU will install pipe connection.

7-11.3(13) CONCRETE THRUST BLOCKING

Place concrete thrust blocking as shown on Standard Plans 330a - 331b at bends, tees, dead ends, and crosses as shown on the Drawings. Blocking must be Class 3000, as specified in Section 6-02, concrete mix poured in place or the Engineer may approve the use of ecology blocks as a substitute.

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Concrete blocking must bear against solid undisturbed earth at the sides and bottom of the trench excavation and be shaped so as not to obstruct access to the joints of the pipe or fittings. If ecology blocks are used for thrust blocking on tees, the Contractor must place metal spacers/shims between the ecology blocks and the body of the tee to transfer load to the body of the tee between the bells. Thrust blocking that transfers the load to the bells of the tee will be rejected.

Provide the Engineer at least 1 Working Day advance notice before pouring concrete thrust blocking or placing ecology blocks and 1 Working Day advance notice for inspection and approval of all concrete blocking or placement of ecology blocks before backfilling. Protect all metallic components of thrust blocks from corrosion by a wax tape system or another method approved by the Engineer.

Unacceptable concrete blocking and corrosion protection must be replaced at the Contractor's expense.

7-11.3(13)A WALL ANCHOR BLOCK

Place wall anchor blocks as shown on the Drawings. Wall anchor blocks must be Class 3000, as specified in Section 6-02, concrete mix poured in place.

Wall anchor blocks must bear against solid, undisturbed earth at the sides and bottom of the trench excavation and be shaped so as not to obstruct access to the joints of the pipe or fittings.

Provide the Engineer at least 1 Working Day advance notice before pouring concrete wall anchor blocks and 1 Working Day advance notice for inspection and approval of all wall anchor blocks before backfilling. Protect all metallic components of wall anchor blocks from corrosion by a wax tape system or another method approved by the Engineer. Unacceptable wall anchor blocking and corrosion protection must be replaced at the Contractor's expense.

7-11.3(14) BLOWOFF ASSEMBLIES

Construct Water Main blowoff assemblies as shown on the Drawings or Standard Plans 340a and 340b. Install a standard meter box in non-traffic bearing areas and use a Type 361 frame and cover for all other installations subject to vehicular traffic. Take care in locating the meter box or frame and cover such that it is not in any water course or in any other location subject to drainage or sewerage contamination. Set tops to conform to finished grade. Backfill and compact as specified in Section 2-10 and Section 2-11.

The Contractor must install the blowoff assemblies complete, including the tee at the Water Main as shown on Standard Plan 340a and 340b, except for making the connection to the Water Main. For 4-inch or 6-inch Water Mains, the Contractor must install a 2-inch plug at the tee to prepare for pressure testing, as specified in Section 7-11.3(11). For 8-inch and larger Water Mains, the Contractor must install a 2-inch IPT plug into the 2-inch IPT threaded hole to prepare for pressure testing, as specified in Section 7-11.3(11).

Once the new Water Main has passed the hydrostatic pressure test, the Contractor must remove plugs and connect the corp stop to the Water Main.

7-11.3(15) ELECTROLYSIS MONITORING SYSTEM

7-11.3(15)A GENERAL

Where called out on the Drawings, the Water Main Contractor furnishing the pipe must:

1. Install electrical continuity bonds. Furnish and install electrical joint bonds, as specified, at all mechanical coupling non-insulated flange joints and all rubber gasket joints. Take special precautions to avoid disturbing existing bonds, electrical cables, and wires for test stations and other cathodic protection equipment connected to, or installed near the Water Main.
2. Install electrolysis test stations. Where shown on the drawings, the Contractor must furnish and install the Electrolysis Test Stations.

7-11.3(15)B ELECTRICAL JOINTS FOR PIPE AND FITTINGS

7-11.3(15)B1 GENERAL

Where shown on the Drawings, each length of pipe in the Water Main and each hydrant run must be electrically bonded together, and each mechanical joint must be bonded to the pipe as shown on Standard Plan 362.Perform adhesion tests of all bonds and bonded joints in the presence of the Engineer. Any bonded joint that fails to meet the adhesion test must be re-bonded until an acceptable test is obtained. Bonding cable is specified in Section 9-30.7.

7-11.3(15)B2 JOINT BOND CABLE CONNECTIONS FOR PIPE

Before making any bond connection to metal, remove a 2" x 2" section of coating materials from the pipe surface to make the connection. Remove paint, primer, and coating material from the pipe surface with clean rags and solvent before preparing the metal surface. Clean the metal surface to white metal by sandblasting, grinding, or filing before welding the conductor. Do not use resin base grinding disks. Ceramic base disks are acceptable. Weld joint bonding cable to the pipe or fitting by the exothermic process with a copper sleeve fitted over the exposed conductor. Remove only sufficient insulation from the bonding cable to allow placing of the welding mold. After the weld is completed it must be tested and capped as specified in Section 7-11.3(15)D.

Remove and replace defective welds.

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Cover exposed metal surfaces around the exothermic weld, including the end of the copper conductor and the weld itself, with coating material as shown on the Drawing or as specified in Section 9-30.8(3).

Provide the Engineer 3 Working Days notice so that all connections to pipe obtain inspection and approval before covering. Bond connections not receiving Engineer approval before cover or backfill will be rejected.

7-11.3(15)B3 TESTING ELECTROLYSIS TEST STATION

Provide the Engineer written notice 3 Working Days in advance, to perform a functional test of the electrolysis test station before backfilling.

7-11.3(15)C ELECTROLYSIS TEST STATION

7-11.3(15)C1 GENERAL

Install Electrolysis Test Stations as shown on Standard Plan 360 and 365.

7-11.3(15)C2 ZINC REFERENCE ELECTRODES

Place reference electrode within the Water Main trench excavation 6” horizontally from the Water Main at or just below the springline. An exception is where Water Main crosses any other metallic pipe in which the electrode is to be placed between the Water Main and the other pipe. Backfill reference electrodes with suitable Material. Terminate wires in the test stations.

7-11.3(15)C3 TEST STATION

The test station must consist of a molded test station box installed inside a conventional cast iron water meter box for non-traffic areas or inside a Type 230 frame and cover for traffic areas. The cover must have the letters “WATER” cast into it.

7-11.3(15)C4 TEST WIRES

Wire location, connections to pipe, size, insulation color, and crimp-on wire connectors must be as shown on Standard Plan 363 and 365.

7-11.3(15)D TESTING AND CAPPING EXOTHERMIC WELD CONNECTIONS

7-11.3(15)D1 GENERAL

Two methods of testing, a manual test using a hammer blow, or an electronic method that measures bond resistance, may be required. Also, when required in the Contract, identify a cathodic protection specialist to oversee installation of joint bonds and testing for electrical continuity. The Contractor’s cathodic protection specialist must prepare a Shop Drawing and procedures for testing the pipe and maintaining records. The procedure must, at a minimum, require the cathodic protection specialist to monitor testing of bonded joints for the first 2 days of testing. The Contractor must complete testing of the remaining joint bonds and prepare records of the testing results on a test form that includes:

1. Description and location of the pipeline tested.
2. Starting location and direction of test.
3. Date of test.
4. Joint type.
5. Test current and voltage drop across each joint and calculated bond resistance (calculated resistance method as described in Section 7-11.3(15)D3 .
6. Measured joint bond resistance (digital low-resistance ohmmeter method).
7. Review of test records by the Contractor’s cathodic protection specialist.

7-11.3(15)D2 CAPPING EXOTHERMIC WELD CONNECTIONS

Insulate each bond connection thoroughly with a Royston Handy Cap or approved equal. The cap must completely cover the cleaned area and provide insulation of the bond connection from the soil environment. Attach the cap with a bonding cement or primer. The cap must contain an elastomeric Material under a plastic dome. The elastomeric Material must mold completely around the bond wire and weld area. The cap must be a minimum of 4” x 4” x 125 mils thick. Caps are not required when the connection is covered by heat shrink joint wrapping.

7-11.3(15)D3 GLANCING BLOW TEST FOR EXOTHERMIC WELD CONNECTIONS

After the exothermic weld has cooled, remove slag and test the weld with a glancing blow from a 16-ounce hammer to assure proper metallurgical bond.

7-11.3(15)D4 RESISTANCE TEST FOR EXOTHERMIC WELD CONNECTIONS

Where shown on the Drawings, or when specified in the Project Manual, test each joint bond connection for resistance using a digital low resistance ohmmeter. Exothermic welds to wedge restraint glands on mechanical joints are exempt from the resistance test specified in this Section. Before backfilling, test each bond in the presence of the Engineer and record the testing results. Any joint bond that exceeds the maximum allowable resistance must be replaced by the Contractor and

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retested. Any defective joint bond discovered during energizing and testing must be located, uncovered and repaired at the Contractor's sole expense.

The following electrical continuity test equipment or approved equal must be stored at the Project Site, maintained in accurate working condition, and be available to the Engineer for testing:

1. One Biddle Model No. 247001 digital low-resistance ohmmeter.
2. One set of duplex helical current and potential hand spikes, Biddle Model No. 241001, cable length as required.;
3. One calibration shunt rated at 0.001 ohms, 100 amperes, Biddle Model No. 249004.

File or grind the contact area to bright metal without surface rusting or oxidation. The testing method to measure the resistance of joint bonds must comply with the low-resistance ohmmeter manufacturer's written instructions. The helical hand spikes must contact the prepared bare contact area of pipe on each side of the joint without touching the exothermic weld, cap, or bond wire.

Single joint bond continuity for #2 AWG wire will be acceptable if the tested resistance values are less than the proportional total resistance as calculated below:

$$Rp = (0.000216 \text{ ohm/foot}) \times L + (0.0000275 \text{ ohm}) \times Nbw$$

Where:

Rp = Proportional Total Resistance

L = Length of one Bond Wire in test (in feet)

Nbw = Total number of cad welds in test

For a typical 18-inch length of #2 AWG wire with 1 bond per joint, the joint bond continuity will be acceptable if tested resistance values are less than: 0.000380 ohm. If #2 AWG wire length exceeds 18-inches, or if more than one bond per joint is used, the Contractor must contact the Engineer and request verification of the allowable resistance values prior to exothermic welding.

7-11.3(15)E SACRIFICIAL ANODE BONDED TO PIPE INSTALLATION DETAILS

Sacrificial anode bonded to pipe must be installed as shown on Standard Plan 364.

7-11.3(16) ELECTRICAL INSULATION OF WATER MAIN

7-11.3(16)A GENERAL

Install the Water Main to maintain electrical insulation from dissimilar pipe material, other water Structures, and other underground installations.

7-11.3(16)B TESTING OF INSULATING COUPLINGS OR INSULATING FLANGE KITS

Insulating couplings or insulating flange kits must be located and installed as shown on the Drawings. Install an electrolysis test station at each insulating device. Notify the Engineer at least 72 hours in advance for the SPU corrosion engineer to perform a functional test of the insulating couplings and flange kits. All damaged or defective insulating devices will be replaced at the Contractor's sole expense.

7-11.4 MEASUREMENT

Measurement for "Bedding, (Class), (Size) Pipe" for Water Main will be as specified in Section 7-17.4.

Measurement for "Pipe, Water Main, (Material), (Class), (Size), including Fittings" and "Pipe, Water Main, (Material), (Class), (Size), including Fittings, (Trenchless Construction Method)", will be per linear foot based on the distance from point to point. The point of starting or ending of measurement in any particular run of pipe will be either with the vertical intersection of the center line of the intersecting pipe, or with the starting or ending of any new pipe installed. No deductions will be made for the linear length of fittings, valves, or couplings contained within the measured length. At changes in pipe size connected by a reducer, the point of measurement will be taken as the midpoint of the reducer.

Measurement for "Blocking, Cement Concrete" will be by the cubic yard of concrete placed as computed by the Engineer.

Measurement for "Blocking, Ecology Block" will be per each.

Measurement for "Blowoff Assembly, (Size)" will be per each complete blowoff assembly installed, including up to 10 feet of blowoff connection pipe in excess of what is shown on the Drawings.

Measurement for "Steel Casing Pipe, (Class), (Size), (Construction Method)" will be as specified in Section 7-17.4. Measurement for "Station, Electrolysis Test" will be per each installed complete.

Measurement for "Sacrificial Anode Bonded to Pipe" will be per each.

7-11.5 PAYMENT

1. **"Pipe, Water Main, (Material), (Class), (Size), (Coating), including Fittings"**, per linear foot

The Bid Item price for "Pipe, Water Main, (Material), (Class), (Size), (Coating), including Fittings" includes all costs for the work required as follows:

a. Costs required for excavating, installing and joining pipe, backfilling and compacting native material, and disposing of and/or placing excess native material elsewhere.

b. Cost of Materials, including but not limited to, the pipe, fittings and pipe supports, locating wire, special coatings, and other items called for in the Contract. Where required, the costs of sand or foam cushioning between the Water Main and other pipes are also included.

c. Costs for the work required to furnish and install mechanical joint sleeves and pipe supports, including pipe hanger rods with nuts, single pipe rolls, steel angles, reinforcing bars, nuts, bolts, washers, mastic, and galvanizing.

d. Costs required to perform the taste and odor rating test procedures, procedures for hydrostatic pressure testing, and procedures for flushing, disinfection and bacteriological sampling of new Water Mains.

e. Costs necessary for installing pipe on curves as shown on the Drawings, including field changes involving standard lengths of pipe deflected at the joints.

f. Costs of all Material, labor and equipment associated with making pipe connections unless otherwise specified.

g. Costs of all Material, labor and equipment associated with making a cut, cap and blocking to isolate existing water main unless otherwise specified. and

h. Costs of furnishing and installing service connecting tees 4 inches and larger.

i. Costs required for removal and disposal of existing pipe and fittings within trench neat line limits when pipe replacement is called for in the Contract.

Special fittings used but not called for on the Drawings will be paid for at the Supplier's invoice cost plus 15 percent for overhead and profit. Special fittings called for on the Drawings but not used will be deducted from the Contractor's final estimate based on the current cost to the Supplier of fittings used on the improvement.

If the pipe, its lining, or its coating is damaged, the Contractor will be required, at the Contractor's sole expense, to repair the damage to an acceptable condition before installation.

Payment for protective systems will be as specified in Section 2-07.5.

Defective Material or workmanship discovered as a result of tests will be addressed as specified in Section 1-05.7.

2. **"Blocking**, **Cement Concrete"**, per cubic yard

The Bid Item price for "Blocking, Cement Concrete" includes all costs for the work required as follows:

a. Costs of placing concrete blocking including: excavation, turnbuckles, shackle rods, steel plates, corrosion protection of all metallic components, concrete form work, finishing, removal and disposal of material not required for backfill.

b. Other work that may be necessary for constructing the blocking in place as specified.

3. **"Blocking**, **Ecology Block"**, per each

The Bid Item price for "Blocking, Ecology Block" includes all costs for the work required as follows:

a. Costs of furnishing and installing the Ecology Block including: excavation, turnbuckles, shackle rods, steel plates, corrosion protection of all metallic components, and removal and disposal of material not required for backfill.

b. Other work that may be necessary for constructing the blocking in place as specified.

4. **"Blowoff Assembly, (Size)"**, per each

The Bid Item price for "Blowoff Assembly, (Size)" includes all costs for the work required as follows:

a. Costs for furnishing and installing the complete assembly including corporation, fittings, pipes, valve, meter box or ring and cover, excavation, backfill with native material, and compaction;

b. Costs to furnish and install the pipe between the corporation and the blowoff assembly including fittings.

c. If the location of the blowoff assembly differs from that shown on the Drawings and requires an increase of more than 10 feet of connection pipe, the excess of pipe over 10 feet will be paid for as specified in Section 1-09.4.

5. **"Steel Casing Pipe**, **(Class), (Size), (Construction Method)"**, per linear foot

Payment for "Steel Casing Pipe, (Class), (Size), (Construction Method)" is specified in Section 7-17.5.

Payment for directional drilling installation is specified in Section 2-16.5.

6. **"Pipe**, **Water Main, (Material), (Class), (Size), (Coating), including fittings, (Trenchless Construction Method)"**, per linear foot

The Bid Item price for "Pipe, Water Main, (Material), (Class), (Size), (Coating), including fittings, (Trenchless Construction Method)" includes all costs for the work required to furnish and install the pipe, including spacers, end seals, and placing the designated fill in the annular space when applicable.

Payment for directional drilling installation will be as specified in Section 2-16.5.

7. **"Station**, **Electrolysis Test"**, per each

The Bid Item price for "Station, Electrolysis Test" includes all costs for the work required as follows:

a. Cost of furnishing and installing water meter box, test box, terminal blocks, wires to pipes and zinc reference electrodes, zinc reference electrodes, removal and restoration of sidewalks.

b. All other Materials and labor required to complete this construction.

8. **"Bedding**, **Water Main, (Class), (Size) Pipe"**, per linear foot

Payment for "Bedding, Water Main, (Class), (Size), Pipe" is specified in Section 7-17.5.

9. **"Sacrificial Anode Bonded to Pipe"**, per each.

The Bid item price for "Sacrificial Anode Bonded to Pipe" includes all costs for the work required as follows:

a. Costs of furnishing and installing sacrificial anode, wire connection to pipe or electrolysis test station, anode backfill, conduit, native backfill, thermite weld, and red "Caution" or "Danger" tape; and

b. All other materials, labor, and incidentals required to complete this construction.

10. **Other payment information**

No separate payment will be made for electrical joint bonds, capping, testing and recording test results. Costs for labor, material and equipment required to acceptably bond and test across mechanical couplings and across rubber gasket joints, and all incidentals required to provide acceptable and complete bonding will be included in the Bid Item price for "Pipe, Water Main, (Material), (Class), (Size), including Fittings" or the Bid Item price for "Pipe, Water Main, (Material), (Class), (Size), including Fittings, (Trenchless Construction Method)".

Joint bonding Material includes all required cables, bolts, molds, cold applied tape coatings and heat shrink sleeves.

SECTION 7-12 VALVES FOR WATER MAINS

7-12.1 DESCRIPTION

Section 7-12 describes Work consisting of furnishing and installing Water Main valves and valve accessories as specified in the Contract, and supplying materials, tools, and appurtenances needed to complete the installation.

7-12.2 MATERIALS

Materials must comply with the requirements of Section 9-30.3.

Valves for Water Mains must be suitable for ordinary waterworks service and are intended to be installed in a normal position on buried Water Mains for water distribution and water transmission systems.

7-12.3 CONSTRUCTION REQUIREMENTS

7-12.3(1) GENERAL

Do not operate any valve on an existing Water Main.

Inspect all valves upon delivery in the field to ensure proper working condition before installation and to verify they are free of rust and dirt. Set and join the valves to the pipe per the AWWA Standards, unless indicated otherwise in the Contract, for the type of connecting ends furnished. Carefully inspect the valves for damage to the outer protective coating and verify the valves are damage free before installation.

Furnish and install an operating nut extension when the ground surface is more than 30 inches above the valve operating nut. In standard valve boxes, which contain valves 12-inch and smaller, the operating nut extension must extend into the top section of the standard valve box as shown on Standard Plans 315a and 315b. In vaults that contain valves greater than 12 inch, the operating nut extension must extend into the upper section of the vault and clear the bottom of the lid within a range of 24 to 30 inches.

Upon delivery at the Project Site, all valves must be opened to prevent the collection of water in the valve. Clean valve interiors of all foreign matter and inspect in both open and closed position before installation. Set valves perpendicular to the Water Main. Place valve boxes over the 12-inch and smaller valve or valve operator and any extension in a manner that the valve box makes no contact with the valve assembly or extensions and does not transmit shock or stress to the valve assembly or Water Main, see Section 7-12.3(4). Install the lower casting of the valve box first, so as to be supported by backfill and a polyethylene foam collar not less than 2 inches in thickness. The casting must not rest directly on the body of the valve or on the Water Main. Carefully tamp backfill around the valve box to a distance of 3 feet on all sides or to the undisturbed face of the trench if it is closer. Set the cast iron valve box cover flush to finished grade.

Install the combination air release/air vacuum valves as shown on the Drawings. All piping must be sloped to allow escape of any entrapped air. Backfilling and compaction is specified in Section 2-10 and Section 2-11.

After installation, test and disinfect all valves as specified in Sections 7-11.3(11) and 7-11.3(12). The Contractor is responsible for correcting any defects in design, Materials installation, or workmanship that appear during these tests to an acceptable condition.

7-12.3(2) VALVE CHAMBERS

7-12.3(2)A GENERAL

Where shown on the Drawings, valve must be enclosed in a valve chamber.

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Valve chambers must be either precast or cast in place. The use of solid concrete blocks or concrete brick is allowed only when specified in the Contract.

Valve chambers and the casting assembly for valves larger than 12-inch must not make contact with the valve assembly or extension where surface shock or stress can be transmitted to the valve assembly or Water Main.

7-12.3(2)B PRECAST VALVE CHAMBERS

The concrete base must be poured in place or precast. Poured in place base must be allowed to attain sufficient strength to support the chamber, usually 2 or 3 Days, as approved by the Engineer. Set precast chambers on the concrete base in cement mortar. The vault chamber must have adequately sized and located openings for chamber installation adequately clear of the Water Main.

Wrap the Water Main with 2-inch thick plastic foam Material at those areas where the Water Main intersects the chamber walls. The plastic foam Material must cover the Water Main the full width of the chamber wall. Fill any remaining space between the chamber wall and the plastic foam Material with cement mortar, and when the opening is large enough, brick and mortar. Do not allow the Water Main to rest on the chamber wall.

7-12.3(2)C CHAMBERS MADE WITH PRECAST CONCRETE BLOCKS

Circular or rectangular chambers may be made with solid precast concrete blocks. First, pour the base in place. After the base has reached sufficient strength (usually 2 or 3 Days), the walls may be constructed of concrete blocks with water tight cement mortar joints.

Construct circular chambers with curved maintenance hole blocks. Taper the chamber top as shown on the Standard Plans, unless the Contract specifies otherwise.

Chambers must have a cast in place or precast concrete top slab suitable for H20 traffic loading unless greater loading is required by the Contract.

7-12.3(2)D CAST IN PLACE CHAMBERS

Cast in place chambers may be constructed by using forms and poured concrete. Finishing of walls is not required except the patching of porous spots, rock pockets, and bolt holes. Forms must be removed for inspection of concrete.

7-12.3(3) SETTING FRAME AND COVER

Set the cast iron frame and cover (see Standard Plan 361) to grades furnished by the Engineer. Provide for future adjustment of frame to changes in grade by constructing a minimum of 2 courses of brick with mortar joints between the top of the chamber and the bottom of the casting. Brick for this purpose must be standard concrete brick 2-1/4 inches thick. When the casting is in concrete pavement or in rigid concrete base, reinforcement within the concrete pavement slab is specified in Section 5-05.3(9).

7-12.3(4) SETTING VALVE BOX

Position cast iron valve boxes during backfilling operations to be in vertical alignment with the gate valve operating stem. Support the lower casting of the unit with a plastic foam collar not less than 2 inches thick, held in place by carefully compacted backfill. The casting must not rest directly on the body of the gate valve, operating nut extension, or on the Water Main. The upper casting of the valve box must be placed in the plane of and flush with the finished grade, and when installed on slopes may both need to be tilt adjusted and adequately offset to provide valve and extension clearances meeting the requirements of Section 7-12.3(1) and allow straight and direct access to the operating stem.

Backfill and compaction is specified in Section 2-10 and Section 2-11.

7-12.3(5) VALVES INSTALLED ON SPECIALLY COATED PIPE

Valves installed on Water Mains that are polyethylene encased, tape coated, or special coated, must be polyethylene encased, epoxy coated, or special coated the same as the Water Main.

7-12.3(6) LADDERS

See Section 7-05.3(1)M.

7-12.3(7) PAINTING OF VALVES

7-12.3(7)A PAINTING AT FACTORY

After the factory test and inspection, all ferrous parts of the valves except finished or bearing surfaces must be painted inside and out with 2 coats of asphalt varnish, Federal Specification TT V 51A or approved equal.

7-12.3(7)B PAINTING IN THE FIELD

Carefully inspect the valve for injury to the outer protective coatings. At all places where the coating has been ruptured or scraped off, thoroughly clean the damaged area to expose the iron base, and then recoat the cleaned area with the manufacturer's recommended primer and 2 or more coats of Royston Roskote R28, or approved equal, per the manufacturer's instructions. In wet conditions, use 3-component wax tape wrap consisting of primer, wax tape, and fiberglass overwrap per Section 7-11.3(8)A.

7-12.3(8) THERMOPLASTIC POWDER COATING

Valves and attachments to be installed on Water Mains where the Contract specifies thermoplastic powder coating for the Water Main, must also have an equivalent coating such as fusion bonded epoxy, polyurethane, or approved equal.

All bolts, nuts, followers, and similar must be wax tape coated, see Section 9-30.1(4)F.

Substitute Material requires the Contractor to submit sufficient information and a manufacturer's certificate of compliance stating that the proposed substitute Material will perform at least as well as that specified.

7-12.4 MEASUREMENT

Bid Items of Work completed under the Contract will be measured as provided in Section 1-09.1 unless otherwise provided for by individual measurement paragraphs in this Section.

7-12.5 PAYMENT

1. **"Valve**, **Gate, (Size)"**, per each
2. **"Valve**, **Butterfly, (Size)"**, per each

The Bid Item price for "Valve, (Type), (Size)" includes all costs for the work required to furnish and install the valve, including painting, jointing, disinfecting, hydrostatic testing, operating nut and extensions.

When the valve is to be polyethylene encased or coated as specified in the Contract, the cost for furnishing and installing the coating as specified in Section 7-12 will be included in the Bid Item price for "Valve, (Type), (Size)".

3. **"Valve Chamber**, **(Type), (Size)"**, per each

The Bid Item price for "Valve Chamber, (Type), (Size)" includes all costs for the work required to furnish and install the precast concrete, brick and block, or cast in place chamber, including foundation, adjustment brick, castings and lid, ethafoam cushion, mortar plastering, valves, support piers, water proofing Materials and steps or ladders.

4. **"Valve Box**, **Cast Iron"**, per each

The Bid Item price for "Valve Box, Cast Iron" includes all costs for the work required to furnish and install the valve box, including plastic foam cushion.

SECTION 7-13 RESERVED

SECTION 7-14 HYDRANTS

7-14.1 DESCRIPTION

See Section 2-12 regarding hydrant use.

These Specifications are to be used in conjunction with the AWWA Standard C502 for dry barrel hydrants for ordinary water works service.

Section 7-14 describes work consisting of furnishing, installing, and setting the hydrant, hydrant tee, auxiliary valve, restraint system and shackles, gravel drain, concrete blocks, shear block, bleeder, hydrant connection, connection pipe, marker posts, retaining wall and rock facing, coating, painting, excavation, backfilling, furnishing and installing hydrant markers and quick connect adapters when required, flushing, hydrostatic pressure testing, disinfection, and other pertinent Work as specified in other Sections of this Specification.

7-14.2 MATERIAL

Materials must comply with the requirements of Section 9-30.

7-14.3 CONSTRUCTION REQUIREMENTS

7-14.3(1) SETTING HYDRANTS

Check and tighten any loose bolts on the hydrant before installation.

Where shown on the Drawings, install hydrants per the detail shown on Standard Plans 310a - 314. Do not install hydrants within 3 feet of a traveled roadway. In addition, provide a minimum 4-foot radius unobstructed working area around all hydrants. The bottom surface of the breakaway flange must be set 2 inches minimum and 7 inches maximum above the concrete shear block finished grade.

For each new hydrant requiring vertical adjustment, see Section 7-14.3(5).

All barrel adjustment risers are to be positioned between the hydrant foot assembly and the barrel section provided with the hydrant. The companion extension for the hydrant main stem must be positioned on the valve stem immediately below the stem section contained within the hydrant curb stand or discharge section.

After installation, hydrants must be subjected to a hydrostatic test as specified in Section 7-11.3(11).

The hydrant excavation must be backfilled and compacted when installation and testing are complete and accepted by the Engineer.

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Construct a concrete shear block with rebar, as shown by the hydrant details on Standard Plan 310a through 311b, for all hydrants. Construction, Materials, and finishing of the concrete shear block must conform to Section 8-14. The shear block must be set flush with the immediately surrounding finish grade.

Flush, test, and disinfect hydrant assemblies as specified in Section 7-11.3. After all installation and testing is completed, paint the hydrants as specified in Section 7-14.3(8).

Identify any hydrants not in service by covering with a burlap or plastic bag.

7-14.3(2) HYDRANT CONNECTIONS

7-14.3(2)A GENERAL

Hydrant laterals must consist of a section of 6-inch ductile iron pipe from the Water Main to the hydrant and must include an auxiliary gate valve set vertically and placed in the line as shown on the Standard Plans.

7-14.3(2)B HYDRANT RESTRAINT

Hydrant assemblies constructed with ductile iron pipe must be restrained with mechanical joint restraint gland such as EBAA Iron Megalug Series 1100 or approved equal.

Hydrant assemblies that change existing cast iron hydrant branch pipe must be restrained with two 3/4-inch diameter steel shackle rods as shown on Standard Plans 310a and 311a.

Cut threads at the ends or where rod couplers are needed. Slip joint pipe and fittings are not allowed.

Completely coat shackle rods, nuts, washers, and couplers as specified in Section 9-30.12.

7-14.3(2)C AUXILIARY GATE VALVE AND VALVE BOX

Install auxiliary gate valves and boxes as specified in Section 7-12. When an auxiliary valve per Standard Plan 311b is to be installed within an area subject to lawful vehicle parking, use a second auxiliary valve in place of the mechanical joint by flange adapter at the inlet of the hydrant. See Standard Plan 310b and 311b for additional hydrant valve requirements.

7-14.3(3) RESETTING EXISTING HYDRANTS

Resetting hydrants, or moving an existing hydrant closer to or farther away from a Water Main on an existing hydrant connection, will be performed by SPU Water Operations.

When the Contract specifies the resetting of an existing hydrant, reset the hydrant without disturbing the location of the hydrant lateral tee at the Water Main.

Shackle the hydrant as specified in Section 7-14.3(2)B.

This work is specified in Section 7-14.3(1).

Unless otherwise noted, the Contractor must assist SPU Water Operations with resetting the hydrant, and is responsible for the following elements of work:

1. Protection of the Water Main and services during construction
2. Coordination with the Engineer and SPU Water Operations, including excavation, dewatering, support and safety systems, and traffic control.
3. Establishing staking points. Do not install hydrants within 3 feet of a traveled roadway. In addition, provide a minimum 4-foot radius unobstructed working area around all hydrants.
4. Providing equipment and operators required for trench excavation and to move component parts of the hydrant and connection pipe into position.
5. Furnishing and installing concrete shear block with rebar, as shown by the hydrant details on Standard Plan 310a through 311b, as indicated in the Contractor or as directed by the Engineer. Construction, Materials, and finishing of the concrete shear block must conform to Section 8-14. The shear block must be set flush with the immediately surrounding finish grade.
6. Removal of abandoned pipes and appurtenances
7. Placement of bedding and backfill, compaction, and placement of temporary pavement patch.
8. Furnishing and installing hydrant markers.

7-14.3(4) RELOCATING EXISTING HYDRANTS

Relocating hydrants, or moving an existing hydrant and connection pipe to a new location, will be done by SPU Water Operations crews. Unless otherwise noted, the Contractor must assist SPU Water Operations with the hydrant and hydrant connection pipe relocation, and is responsible for the following elements of work:

1. Protection of the Water Main and services during construction
2. Coordination with the Engineer and SPU Water Operations, including excavation, dewatering, support and safety systems, and traffic control.
3. Establishing staking points. Do not install hydrants within 3 feet of a traveled roadway. In addition, provide a minimum 4-foot radius unobstructed working area around all hydrants.

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4. Providing equipment and operators required for trench excavation and to move component parts of the hydrant and connection pipe into position.
5. Furnishing and install concrete shear block with rebar, as shown by the hydrant details on Standard Plan 310a through 311b, as indicated in the Contractor or as directed by the Engineer. Construction, Materials, and finishing of the concrete shear block must conform to Section 8-14. The shear block must be set flush with the immediately surrounding finish grade.
6. Removal of abandoned pipes and appurtenances
7. Placement of bedding and backfill, compaction, and placement of temporary pavement patch.
8. Furnishing and installing hydrant markers.

7-14.3(5) HYDRANT BARREL EXTENSIONS

The minimum requirements for hydrant barrel extensions, operating stems, and flanged adapters must conform to AWWA C502 in design, Material, and workmanship. The drilling of the flanges on the extensions must match the drilling of the flange that joins the hydrant foot section to the factory-supplied barrel section on the hydrant. All bolts used with barrel connection flanges must engage the flanges through drilled bolt holes. Use slotted bolt holes only on above-grade breakaway flange connections when the function of the breakaway feature requires their use.

7-14.3(6) RETAINING WALLS FOR HYDRANTS

Where indicated on the Drawings, the Contractor must furnish and place a rock facing wall around hydrants per Standard Plan 313 and Standard Plan 141.

7-14.3(7) HYDRANTS ON WATER MAINS THAT ARE POLYETHYLENE ENCASED, MULTI-LAYERED POLYETHYLENE ENCASED, OR SPECIALLY COATED

Unless the Contract specifies otherwise, hydrants installed on special coated Water Mains, such as polyethylene encased, multi-layered polyethylene encased, thermoplastic coated, or other special pipe coating per Contract, require:

1. Hydrant connections up to and not including the hydrant, see Section 7-14.3(2), must have the same coating as the Water Mains to which they are connected, and have Class B bedding as specified in Section 7-10.3(9).
2. Hydrant barrels below ground must have the same special coating as the Water Main to which they are connected with the exception of thermoplastic coating.
3. Hydrants connected to thermoplastic coated Water Mains must have the hydrant barrel below ground polyethylene encased. Thermoplastic coating of the hydrant is not allowed.
4. Hydrant connection must be installed as specified in Section 7-11.3(6).

7-14.3(8) HYDRANT FIELD PAINTING

7-14.3(8)A BELOW GROUND COATING

Following hydrant installation and before backfill, any damaged coating on the below ground portion of the hydrant must be repaired with the same coating as recommended by the coating manufacturer and approved by the Engineer.

7-14.3(8)B ABOVE GROUND COATING

After construction of the concrete shear block, the hydrant curb stand section including all exposed surfaces of the sidewalk flange must receive 2 coats of Kelly Moore Luxlite, or approved equal, in Caterpillar yellow. Based on the elevation of the hydrant within the surrounding pressure zone, if the maximum static pressure at the hydrant is less than 60 psi, the engine port cap on the hydrant must be painted with 2 coats of Kelly Moore Luxlite, or approved equal, as indicated by the notes on Standard Plans 310a and 311a.

7-14.3(9) HYDRANT PAVEMENT MARKING

See Section 8-08.1 for installation of pavement markings associated with fire hydrants.

7-14.4 MEASUREMENT

Measurement for rock facing walls will be as specified in Section 2-13.4 as for the Bid Item "Rock Facing".

Measurement for hydrant and hydrant connection will be per each.

Measurement for Assisting SPU with hydrant reset will be per each.

Measurement for Assisting SPU with hydrant and hydrant connection pipe relocation will be per each.

Measurement for Mineral Aggregate for hydrant walls will be by the ton.

7-14.5 PAYMENT

1. **"Hydrant**, **6 Inch Connection (Type)"**, per each

The Bid item price for "Hydrant, 6-Inch Connection (Type)" includes all costs for the work required to furnish and install on new Water Main (or existing Water Main with existing tee) a complete Type 310 or Type 311 hydrant assembly including

but not limited to hydrant, hydrant tee, auxiliary valve, valve box, restraint system and shackles, barrel extension, gravel drain, concrete blocks, shear block, bleeder, hydrant connection, connection pipe, marker posts, retaining wall and rock facing, coating, painting, excavation, backfilling and compaction, disposal of material, furnishing and installing hydrant markers and quick connect adapters when required, flushing, hydrostatic pressure testing, and disinfection.

2. "**Assist SPU with Resetting Existing Hydrant**", per each

The Bid Item price for "Assist SPU with Resetting Existing Hydrant" includes all costs for labor, material, and equipment to assist SPU with resetting of an existing hydrant, including but not limited to the concrete shear block, excavation, safety systems, backfilling and compaction, disposal of material, and hydrant markers.

3. "**Assist SPU with Relocating Existing Hydrant**", per each

The Bid Item price for "Assist SPU with Relocating Existing Hydrant" includes all costs for labor, material, and equipment to assist SPU with the hydrant and hydrant connection pipe relocation, including but not limited to installation of the concrete shear block, excavation, safety systems, backfilling and compaction, and hydrant markers.

4. **Other payment information**

Payment for rock facing will be as specified in Section 2-13.5.

Payment for Mineral Aggregate will be as specified in Section 4-01.5. All costs related to furnishing and installing coatings and field painting as specified in Section 7-14 will be included in the hydrant Bid Item price.

Payment for bedding for polyethylene encased, multi layered polyethylene encased, or special tape coated hydrant connection pipe will be as specified in Section 7-11.5.

All costs associated with installing and removing temporary blocking, and removing existing blocking when specified in the Contract are incidental to the various Bid Items and no separate or additional payment will be made.

SECTION 7-15 WATER SERVICE CONNECTION TRANSFERS

7-15.1 RESERVED

7-15.2 RESERVED

7-15.3 CONSTRUCTION REQUIREMENTS

Where existing services are transferred from old to new Water Mains, the Contractor must plan and coordinate the Work with SPU Water Operations to ensure service is resumed with the least possible inconvenience to customers.

Water service connections, number and type of connections, sequencing of work, operation and construction needs and related work will be addressed at the preconstruction conference. Service transfers must not be connected until the new Water Main has been tested and accepted by the Engineer.

Provide the Engineer at least 10 Working Days advance notice when transfer of existing water service is required per Section 1-07.28.

SPU will, at no cost to the Contractor, mark the exact field locations of service taps and tees on services 2 inches and smaller. Locations of services larger than 2 inches will be identified on the Drawings. The Contractor must assist SPU Water Operations and the Contractor is responsible for the following elements of work:

1. Protection of the Water Main and services during construction.
2. Excavation for the water service connections, including shoring and dewatering.
3. Furnish and install tees, valves, plugs, and valve boxes for 4-inch, 6-inch, or 8-inch service connections. A 3-inch water service is considered a 4-inch water service. The tees must be mechanical joint (MJ) x mechanical joint x flange (FLG). Valves must be MJ x FLG, and removable plugs must be MJ for the service connection. The MJ plugs will be returned to the Contractor after SPU Water Operations completes the service connections.
4. Furnish and install valve boxes for curb stops on 1.5-inch and 2-inch water services as shown on Standard Plan 316. SPU Water Operations will furnish the necessary equipment, pipe, and fittings for 2 inches diameter and smaller services, unless otherwise noted in the Contract.
5. Removal of abandoned pipes, appurtenances, and blocking.
6. B Backfill, compaction, and placement of temporary pavement patch. Maintain the temporary pavement patch until completion of all work by SPU Water Operations.
7. Upon completion of work by SPU Water Operations, make all final adjustments of valve boxes, water meter boxes, and rings and covers to final grade at no cost to the Owner, and then make the final surface restorations as specified in the Contract.

If existing water service material to be reconnected to the new or existing Water Main is considered substandard material, such as plastic, cast iron, or galvanized iron pipe, SPU Water Operations will replace it with copper, for 2-inch and smaller, or ductile iron for, 3-inch and larger, from the water service union to the new or existing Water Main.

To supply customers with water during the construction, where any section of pipe has passed the required hydrostatic and bacteriological tests, SPU Water Operations may tap corporation stops into a section of a new Water Main and install corporation stops and service connections at locations where SPU Water Operations deems necessary, at no expense to the

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Contractor. The attaching of any such service connections by SPU Water Operations does not constitute acceptance by the Engineer of any part of the Work required under the Contract.

The Contractor must not remove or abandon existing Water Main until all existing service connections have been transferred to the new Water Main or temporary service has been provided, and the Engineer has provided approval.

See also Section 7-11.3(9)B Work on existing Water Mains.

7-15.3(1) HDPE WATER SERVICE CONNECTIONS

Water service connections to HDPE pipe must be made using HDPE tee fittings or mechanical-type saddles as defined in Section 9-30.5(2).

HDPE tee fitting connections must be installed in accordance with Section 7-11.3(6).

Mechanical-type saddles must be installed in accordance with the connection manufacturer's recommendations.

7-15.4 RESERVED

7-15.5 PAYMENT

All costs associated with water service connection transfers will be included in the Bid Item prices for the applicable Bid Items and no separate or additional payment will be made.

SECTION 7-16 FLOW CONTROL STRUCTURE AND DETENTION PIPE

7-16.1 DESCRIPTION

Section 7-16 describes Work consisting of a flow control structure and detention pipe for storm water storage. The flow control structure consists of maintenance hole structure with a flow control device assembly.

7-16.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Material	Section
Flow Control Structure, Conduit, Fittings, and Related	Section 9-05
Maintenance Hole Components	Section 9-12
Non-Shrink Cement Sand Grout	Section 9-04.3(2)

Corrugated metal pipe (CMP) flow control systems and detention systems are not allowed in any landslide prone area as defined in SMC 25.05.908, or underneath buildings.

Corrugated metal detention pipe and flow control systems per Standard Plan 271a through 271d are for private ownership and maintenance as approved by SDCI. Corrugated metal detention pipe must be aluminized. Do not construct or place galvanized materials in the Storm Drain system.

Detention pipe to be owned, or to be maintained, by the City must be reinforced concrete, ductile iron, polypropylene, or steel reinforced polyethylene pipe.

7-16.3 CONSTRUCTION REQUIREMENTS

7-16.3(1) GENERAL

All work including bedding, pipe installing, and jointing for the construction of detention pipe and flow control Structure is specified in Section 7-05 and Section 7-17.

Excavation, backfill, and compaction is specified in Section 2-04, Section 2-10 and Section 2-11.

Work in trench excavations over 4 feet deep is subject to the provisions of Section 2-07.

7-16.3(2) FLOW CONTROL DEVICES

7-16.3(2)A FLOW CONTROL DEVICE ASSEMBLY

Flow control device assembly must be as shown on Standard Plans 272a and 272b. The flow control device assembly and all control elevations must be shown on the Drawings. The limit of variance at each orifice or weir elevation must not exceed ± 0.03 foot.

PVC pipe must be per ASTM D1785, Schedule 40.

The PVC orifice plate must be fusion welded to the PVC cross or tee and elbow with an orifice of the diameter indicated on the Drawings in its center.

The top of PVC pipe is the overflow weir and its elevation must be shown on the Drawings. The v-notch weir must be dimensioned per the Drawings.

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Shear gates must be as specified in Section 7-16.3(2)B.

7-16.3(2)B PVC SHEAR GATE

PVC shear gate per Standard Plan 272b must be constructed as part of the flow control device assembly within public flow control Structures within the Right of Way.

Locate the lift handle to allow operation of the shear gate by reaching from the surface without entering the flow control structure. Offset the orifice 2 elbow to provide clear operation of the lift handle and orient so it will not interfere with use of the ladder to enter the structure.

7-16.3(3) CORRUGATED METAL DETENTION PIPE

Seams in pipes and bands must be gasketed per AASHTO M 196.

The end plate must be welded to the end of the detention pipe with a water tight continuous weld.

The end of the detention pipe inside the flow control structure must be ground smooth of all burrs and sharp edges.

Aluminum that is to be in contact with a Portland cement product (CDF, concrete, grout, mortar, and other similar products) must be protected as specified in Section 9-05.7(1).

See Section 7-16.2 regarding limitations on uses of several Materials.

Bedding for the aluminized corrugated metal detention pipe must be Class B, using Mineral Aggregate Type 22 as indicated on the Drawings.

Coupling bands for steel detention pipes must comply with the Drawings, Specifications, or the WSDOT Standard Plans.

7-16.3(4) TEE CONNECTION TO CORRUGATED PIPE

Drainage pipes connected to corrugated detention pipe must be made through a shop fabricated tee as shown on the Drawings and installed as specified in Section 7-17.3(2)C2. Tee must be made to conform to the size of detention pipe and sized to accept only rubber joint pipe.

7-16.3(5) TESTING

Testing of flow control structure and detention pipe for leakage is specified in Section 7-17.3(3)B.

Test all detention systems as specified in Section 7-17.3(3)B. Approval will not be given unless the detention system passes this test. Notify the Engineer at least 5 Working Days in advance of testing.

7-16.3(5)A DEFLECTION TEST FOR FLEXIBLE PIPE

Detention facilities constructed of flexible pipe must be tested for vertical deflection. Detention facilities that also function as sewer or storm conveyance pipe during normal flow conditions must be tested as specified in Section 7-17.3(3)F. All other detention facilities must be tested as specified in this Section.

Prior to pipe placement, the Engineer will visually inspect flexible pipe to confirm no defects exist and no damage has resulted from Contractor handling. Do not install pipe until after it has been accepted by the Engineer.

After pipe is installed in place and backfill and compaction is complete, the Engineer will visually inspect the pipe. The Contractor must notify the Engineer when pipe is ready for inspection, and must provide access to the installed pipe. The pipe must have a round and straight alignment. If the Engineer deems the pipe to be over-deflected, the pipe will not be accepted.

No sooner than 10 Calendar Days after trench backfill and compaction have been completed, and before pavement restoration, flexible pipe must be tested for vertical deflection. Testing must be conducted on a maintenance hole to maintenance hole basis after the line has been thoroughly flushed with water. The allowable deflection and testing method must be as specified in Section 7-17.3(3)F for the size of pipe installed, except that allowable deflection for nominal diameter pipe 36 inches and greater is 5%. Deflection testing using a mandrel must be as specified in Section 7-17.3(3)F1. Deflection testing by direct measurement must be as specified in Section 7-17.3(3)F2.

If testing reveals an over-deflected pipe, the Contractor must remove and reinstall, repair, or replace the pipe as specified in Section 7-17.3(3)F3.

7-16.3(6) TEE CONNECTION TO STEEL REINFORCED POLYETHYLENE

Drainage pipes connected to steel reinforced polyethylene detention pipe must be made only at a prefabricated tee at locations shown on the Drawings. Installation must be in accordance to Section 7-17.3(2)C2 except that cut-in tees are not allowed.

7-16.4 MEASUREMENT

Measurement for “Flow Control Device Assembly” will be by each device complete in place.

Measurement for the “Pipe, Detention, (Material) (Size)” will be by linear foot for the actual length of pipe installed from inside face of flow control Structure to center of upstream maintenance hole.

Measurement for “Detention Pipe Outlet Connection” is as specified in Section 7-08.4.

Measurement for the Maintenance Holes required for the flow control structure or system is as specified in Section 7-05.4.

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Measurement for protective systems is as specified in Section 2-07.4.

7-16.5 PAYMENT

1. **"Flow Control Device Assembly"**, per each

The Bid Item price for "Flow Control Device" includes all costs for the work required to furnish and construct the flow control device, all orifice and weirs, shear gate and lift handle, making the connection with outlet pipe, and flexible adapter coupling.

2. **"Pipe, Detention, (Material), (Size)"**, per linear foot

The Bid Item price for "Pipe, Detention, (Material), (Size)" includes all costs for the work required to furnish, install, and test for leakage the detention pipe and all applicable work listed for the Bid Item "Pipe, (Use), (Material), (Class), (Size)" of Section 7-17.5.

3. **Other payment information**

The outlet pipe of the flow control device will be paid as "Pipe, Detention Pipe Outlet Connection (Material), (Class), (Size)" as specified in Section 7-08.5.

The maintenance hole required for the flow control structure or system will be paid as specified in Section 7-05.5.

Tees required outside the flow control structure will be paid as specified in Section 7-17.5.

Payment for protective systems will be as specified in Section 2-07.5.

SECTION 7-17 STORM DRAINS AND SANITARY SEWERS

7-17.1 DESCRIPTION

Section 7-17 describes Work consisting of foundation preparation, bedding, cut-in tees, pipe installing, jointing, and testing for the construction of Storm Drain, and sanitary and combined Sewer.

All reference to "Sewer" in Section 7-17 applies equally to construction of sanitary Sewer, combined Sewer, and Storm Drain. Side Sewer is addressed in Section 7-18.

This Work also includes excavation, backfilling and compaction as specified in Section 2-04, Section 2-10, and Section 2-11.

Work in excavations over 4 feet deep must comply with Section 2-07.

7-17.2 MATERIALS

7-17.2(1) GENERAL

Pipe Material used for sanitary Sewers, combined Sewers, and Storm Drains must be as shown on the Drawings and may be one or more of the following:

Flexible Pipe Material	Rigid Pipe Material
Polyvinyl Chloride (PVC)	All Concrete
Acrylonitrile butadiene styrene (ABS)	Ductile Iron
Corrugated Metal	Vitrified Clay
Spiral Rib	
Polyethylene (PE)	
Polypropylene (PP)	
Steel Reinforced Polyethylene	

It is not intended that Materials listed be considered equal or generally interchangeable for all applications. The Materials suitable for the project are specified in the Contract.

Pipe must have flexible gasketed joints unless otherwise specified in the Contract.

Materials must comply with the requirements of the following Sections:

Material	Section
Joint Materials and Non-Shrink Cement Sand Grout	Section 9-04
Pipe	Section 9-05
Pipe Bedding & Trench Backfill	Section 2-10

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All pipe must be clearly marked with the name of the manufacturer, class of pipe, date of manufacture, and location of manufacturing facility. Concrete pipe must also be marked with the wall thickness of the pipe. Lettering must be legible and permanent under normal conditions of handling and storage. Concrete pipe with elliptical reinforcement must be clearly marked on the inside and outside of the pipe along the minor axis to identify top and bottom.

After installation, test pipe as specified in Section 7-17.3(3).

7-17.2(2) PROOF TESTS (PREQUALIFICATION)

The intent of this requirement is to prequalify a joint system, components of which comply with the above requirements, as to the water tightness of that joint system. This proof test applies to all pipes that will be tested for water tightness before acceptance. Materials and test equipment for proof testing must be provided by the manufacturer. When approved by the Engineer, internal hydrostatic pressure may be applied by a suitable joint tester. See test requirements in Section 9-04.

7-17.2(3) MATERIAL CERTIFICATION

The manufacturer or fabricator must furnish a manufacturer's certificate of compliance based on manufacturer's routine quality control tests that confirms the pipe meets or exceeds the requirements of the pertinent ASTM or ANSI specification.

7-17.3 CONSTRUCTION REQUIREMENTS

7-17.3(1) PIPE BEDDING

Install bedding of the class or classes shown on the Drawings, including all Materials and work within the limits of the bedding zones, as shown on Standard Plan 285.

Unless otherwise specified in the Contract, bedding for ductile iron pipe must be Class D and bedding for all other rigid and flexible pipe must be Class B.

All classes of bedding must provide uniform support along the entire pipe barrel, without load concentration at joint collars or bells. Do not use blocking of any kind to adjust the pipe to grade except when used with embedment concrete. Excavate bell holes as required to ensure uniform support along the pipe barrel. Bedding disturbed by pipe movement, removal of shoring, or movement of a trench shield or box must be reconsolidated before backfill. Provide adequate bedding support at wye or tee connections and adjacent to maintenance holes or other Structures to avoid bending or shearing stresses at these critical points.

7-17.3(1)A BEDDING FOR CONCRETE PIPE

Bedding must be Class B or Class C. The requirements and limits for the various classes of bedding are as shown on Standard Plan 285 and are described as:

1. Class B bedding: Class B bedding of Type 9 Mineral Aggregate must be placed in at least 3 lifts. Place the first lift before the pipe is installed at a minimum of 4 to 6 inches in thickness, shown as dimension A on Standard Plan 285. Spread the Material smoothly so the pipe is uniformly supported along the barrel with bell holes provided at each joint. Subsequent lifts of not more than 6 inches must be brought up to a point 6 inches above the top of the pipe. Bring each lift up on both sides of the pipe equally and carefully work under the pipe haunches by slicing with a shovel, vibration, or other approved procedures. Compact bedding to 90 percent maximum dry density as determined by methods specified in Section 2-11.
2. Class C bedding: Class C bedding must be the same as for Class B except that the Type 9 Mineral Aggregate extends only to the springline of the pipe. From the springline, place selected native Material in 6-inch lifts to 6 inches above the pipe, using the same methods as those required for Class B bedding. Compact Mineral Aggregate Type 9 to 90 percent maximum dry density as determined by methods specified in Section 2-11. Compact native Material as specified in Section 2-11.

Where unauthorized excavation has been made below the established grade, the Contractor must provide, place, and compact suitable bedding Material to the proper grade and elevation at no cost to the Owner. If the Engineer substitutes imported Mineral Aggregate Type 9, instead of the selected native Material shown for Class C bedding on Standard Plan 285, the bedding will be measured and paid for as "Bedding, Class B, (Size) Pipe."

7-17.3(1)B BEDDING FOR FLEXIBLE PIPE

Bedding for flexible pipe is specified in Section 7-17.3(1)A except:

1. Bedding Material must be Mineral Aggregate Type 22.

7-17.3(1)C BEDDING FOR VITRIFIED CLAY PIPE

Bedding for vitrified clay pipe is specified in Section 7-17.3(1)A except:

1. Bedding Material must be Mineral Aggregate Type 22.
2. Class B bedding must have a load factor of 2.2.
3. Class C bedding must have a load factor of 1.9.

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7-17.3(1)D BEDDING FOR DUCTILE IRON PIPE

Bedding for ductile iron pipe is specified in Section 7-17.3(1)A except:

1. Class D Bedding: Class D bedding must be attained by carefully excavating the trench to proper grade, over-excavating at the bell sections, and placing and compacting selected native Material around the pipe. Class D bedding, backfill, and compaction must be as specified in Section 2-10 and Section 2-11.

If the Engineer substitutes imported Mineral Aggregate instead of the selected native Material shown for Class C and for Class D bedding on Standard Plan 285, the bedding will be measured and paid for as "Bedding, Class B, (Size) Pipe."

7-17.3(2) INSTALLING SEWER PIPE

7-17.3(2)A SURVEY LINE AND GRADE

Install pipe to the true line and grade specified in the Contract at the invert of the pipe. The variance at the invert must not exceed ± 0.03 feet from true line and grade when backfilling, and must not result in reverse flow or a sag. Checking of the invert elevation of the pipe may be made by calculations from measurements on the top of the pipe.

The Contractor may use any method, such as "laser beam," which would allow accurate transfer of the control points provided by the Engineer to installing the pipe to the designated alignment and grade.

When using a laser beam to set pipe alignment and grade, constantly check position of the laser beam from surface hubs provided by the Contractor to verify laser beam alignment and grade. In the event the laser beam is found out of position, stop work and make necessary corrections to the laser beam equipment and to pipe installed.

7-17.3(2)B PIPE INSTALLATION AND JOINTING

7-17.3(2)B1 PIPE INSTALLATION

After an accurate grade line has been established, install the pipe in the properly dewatered trench. Keep mud, silt, gravel, and other foreign Material out of the pipe. Keep pipe joints clean and protected at all times, and lubricated as recommended by the pipe manufacturer before joining.

Keep all pipe installed in the trench in longitudinal compression until the bedding has been placed and compacted around and over the pipe.

Exercise care in matching pipe joints for concentricity and compatibility. Do not join 2 pipes together with ends exceeding the maximum manufacturer's tolerance.

Install the pipe in the up-grade direction from the point of connection from either the existing pipe or the designated Structure as the starting point. Install the pipe with the bell end forward or upgrade.

When pipe installation is not in progress, any open end of the pipe must be sealed with an approved temporary water tight plug.

7-17.3(2)B2 JOINTS ON CURVES

Where pipelines will be installed on specified curves of sufficiently short radius to deflect the pipe joints in an amount greater than recommended by the pipe manufacturer, the curves must be achieved with a series of tangents and shop fabricated bends complying with the pipe manufacturer's recommendations as approved by the Engineer. Submit the pipe manufacturer's recommendations at least 5 Working Days in advance.

Hand mortared pipe joints are not allowed. All joints must be water tight and comply with the applicable test requirements specified in Section 7-17.3(3).

See Section 7-17.3(2)D for gasketed and compression sealed jointing.

7-17.3(2)C PLUGS AND CONNECTIONS

7-17.3(2)C1 GENERAL

Make connections to new and existing pipe with a tee, unless indicated otherwise in the Contract. Except for concrete pipe, all tees on new pipe less than 24-inch inside diameter must be prefabricated.

Connections to existing pipe must comply with SPU Core Tap Procedures for Storm and Sewer Mains, whether SPU or the Contractor is coring and installing a new tee. SPU will core and install tees on existing pipe when shown on the Drawings and the Contractor must schedule the work and provide all materials and support functions.

Fittings must be sized to maintain smooth transitions and inside diameter of the mainline pipe. If reducers are shown on the Drawings, coupling must maintain a smooth and continuous pipe invert.

All fittings must be capped or plugged with a plug of an approved Material gasketed with the same gasket Material as the pipe unit, or have an integrally cast knockout plug. If the Contractor wishes to substitute a mechanical stopper, the manufacturer's catalog cuts and installation recommendations must be submitted to the Engineer at least 5 Working Days in advance. The plug must be able to withstand all test pressures without leaking, and when later removed, must allow continuation of piping with jointing similar to joints in the installed line.

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7-17.3(2)C2 TEE FITTINGS

Unless otherwise specified in the Contract, provide tee fittings in the Sewer and Storm Drains for side Sewers, catch basin connections and service drains. Tees must be 8 inches inside diameter, except tees for side Sewers must be 6 inches inside diameter unless indicated otherwise in the Contract. All fittings must be of sufficient strength to withstand all handling and load stresses normally encountered. All fittings must be of the same Materials as the pipe, except when core drilling to insert a tee, which must be as specified in Section 7-17.3(2)C3. Material joining the fittings to the pipe must be free from cracks and adhere tightly to each joining surface. Fittings must make for a water tight connection meeting the requirements specified in Section 7-17.3(3).

Install the tee at locations and alignments shown on the Drawings. When tee alignment is not shown on the Drawings, position the tee no higher than a 45 degree angle above springline and no lower than a 30 degree angle above springline.

7-17.3(2)C3 CUT IN TEE ON EXISTING OR NEW PIPE

For information on SPU Core Tap Procedures for Storm and Sewer Mains, go to:

http://www.seattle.gov/utilities/construction-and-development/dso/drainage-and-wastewater/core-tap-procedures

Unless the Contract indicates otherwise, locate and cut a hole in the existing or new pipe centered at a 30 to 45 degree angle above the springline and sized for proper fit of the lateral tee material. Springline is defined as the widest cross-section of the host pipe measured horizontally. The cored out piece or other materials must not drop into the pipe. Notify the Engineer at least 2 Working Days in advance of cut in tee operation. For manufactured tee products, installation must be per the manufacturer's recommendations for the specific host pipe material and size for the specific lateral pipe material and size. For pipe connection types not specified in the Drawings, in this Section, or the SPU Core Tap Procedures for Storm and Sewer Mains, submit a proposed method of connection to the Engineer for review.

Cut-in tees must be installed per the following:

1. Concrete pipe tee to concrete pipe: A concrete tee may be installed on an existing concrete pipe 18 inches in diameter or larger by placing a short length of concrete pipe into the core drilled hole with its bell end against the outside face of the pipe and the barrel end inserted just to the inside face of the pipe. Thoroughly clean the bonding areas between the tee and the pipe so that the surfaces are free of dirt, dust, grease, oil or other contaminants that may reduce the bond between the grout and the pipe surfaces. First coat both surfaces with a concrete bonding agent submitted for review and accepted by the Engineer. Then tightly pack the annular space between the tee and the core drilled surfaces with non-shrink cement sand grout meeting the requirements of Section 9-04.3(2). The connection must be neatly finished inside and outside the existing concrete pipe.
2. Ductile iron tee to existing concrete pipe: Core drill the existing concrete pipe with a hole large enough to accommodate the barrel of the specified size of ductile iron pipe and provide a 1-inch space between ductile iron pipe and the existing concrete pipe for application of grout. Cut a length of ductile iron pipe so that it can be placed in the core drilled hole with its bell end against the outside face of the existing pipe without the barrel protruding beyond the inside face of the existing pipe. Clean the outside of the ductile iron pipe, removing loose particles, dust, dirt, oil, or film of any sort that may reduce the bond between the grout and the pipe. After core drilling, the exposed surface of the existing concrete pipe must be rough and clean. Coat both surfaces with a bonding agent submitted for review and approved by the Engineer. Tightly pack the annular space between the pipe and core drilled surfaces with non-shrink cement sand grout meeting the requirements of Section 9-04.3(2). The connection must be neatly finished inside and outside the existing concrete pipe.
3. Corrugated metal tee to corrugated metal pipe: In corrugated steel and aluminum pipes, sawcut a hole to match a shop fabricated tee as shown on Standard Plan 279.

   The flange plate of the fabricated tee must be corrugated to match corrugation of the pipe to which it is attached. Insert a neoprene gasket or approved equal between the outside face of the existing pipe and the flange plate of the tee and connect with self-tapping stainless steel screws.

   Connect the incoming pipe and the tee using a flexible gasketed coupling with stainless steel shielding as specified in Section 9-05.18. Provide corrosion protection for the pipe section of the tee by isolating the aluminum from the steel by extending the gasket 1 inch beyond the edge of the stainless steel coupling.
4. Compression seal inserted tee to clay, or concrete pipe: The Contractor must submit the method and type of tee recommended by the tee manufacturer to the Engineer for approval at least 5 Working Days in advance. Core drill a full size hole in 1 operation to accommodate an Engineer approved PVC tee insert with a coupling fitting.

All existing pipe, 24-inch and smaller diameter, must be fully exposed for inspection and securing the coring machine to the pipe.

Restore the bedding as specified in Section 7-17.3(1). Notify the Engineer at least 2 Working Days before starting cut-in operations. The Engineer will inspect existing pipe for defects before the drilling or cutting operation starts, again during drilling or cutting operations, and after installation of the tee is completed to make certain that no defective parts or work remain undetected and uncorrected. If the exposed pipe is found cracked or deformed, the Engineer will arrange for either roll in of a new pipe, or repair of the damage at no cost to the Contractor, provided the damage was not caused by the Contractor's operations. If the Engineer rolls in a new pipe with a tee already on it, no fitting will be required.

7-17.3(2)D GASKETED AND COMPRESSION SEALED JOINTS

Pipe handling after the gasket has been affixed must be carefully controlled to avoid disturbing the gasket and knocking it out of position, or contaminating it with dirt or other foreign Material. Any gaskets so disturbed must be removed, cleaned, replaced, and relubricated before joining the sections.

Pipe with bonded compression seals must be handled so that no damage occurs to the seal or its bond with the pipe. Store pipe such that the pipe does not rest on the compression seal. Pipe with bonded compression seals determined by the Engineer to be damaged in any way will be rejected and not incorporated in the Work.

Properly align the pipe before joints are entirely forced home. During insertion of the tongue or spigot, the pipe must be partially supported by hand, sling, or crane to minimize unequal lateral pressure on the gasket and to maintain concentricity until the gasket is properly positioned. Since most joints tend to creep apart when the end pipe is deflected and straightened, such movement must be held to a minimum once the joint is home.

Apply sufficient pressure in making the joint to ensure that it is home, as described in the standard installation instructions provided by the pipe manufacturer. Apply sufficient restraint to the line to ensure that joints, once home, are held so until fill Material under and alongside the pipe has been sufficiently compacted. At the end of the Working Day, block the last pipe in an effective way to prevent creep.

Where pipe must be deflected to accommodate required horizontal or vertical curvature, it must first be joined in straight alignment and then deflected as required. See Section 7-17.3(2)B2 for hand mortar joints and joints on curved pipe.

7-17.3(2)E JOINTING – BREAK-OUT AND RECONNECT AND MISMATCHED WALL THICKNESS

Where it is necessary to break out or connect to an existing pipe, use new pipe of the same inside diameter to reconnect the pipeline. Inverts, grade, and alignments must match.

Where joints must be made between pipes with a mismatched wall thickness, the Contractor must measure the outside diameter of both pipes to the hundredth of an inch, and install a coupling manufactured to the actual dimensions for each pipe to be connected. A record of the measurement of the pipes and the coupling Manufacturer's model number installed must be submitted to the Engineer as specified in Section 1-05.3.

Couplings must be flexible gasketed couplings with stainless steel shielding, adapters, or coupling-adapters, as specified in Section 9-05.18, to make a watertight joint that maintains the internal pipe alignment.

7-17.3(2)F STORM DRAIN AND SEWER CONNECTIONS

Catch basin installation must be as specified in Section 7-08. Service drain and side Sewer connections must be as specified in Section 7-18.

Catch basin, service drain, or side Sewer connections to Sewer and Storm Drain trunks, mains, or laterals, must be left uncovered until after the Engineer has inspected and approved the Work. Complete the bedding and trench backfill Work after approval of the connection.

7-17.3(2)G PROTECTION OF EXISTING SEWER FACILITIES

Keep all existing live Sewers including septic tanks and drain fields in service at all times. Provide for disposal of sewage flow if any existing Sewer is damaged.

Water accumulating during construction must be removed from the new pipeline but is not permitted to enter the existing system. The Contractor is responsible for flushing out and cleaning any existing pipeline into which gravel, rocks, or other debris has entered as a result of his/her operations, and must repair lift stations or other facilities damaged by his/her operations.

Do not make the physical connection to an existing maintenance hole or pipeline until authorized by the Engineer. Such authorization will not be given until all upstream lines have been completely cleaned, all debris removed and, where applicable, a pipe has been temporarily placed in the existing channel and sealed.

7-17.3(2)H TRENCHLESS CONSTRUCTION AND CASING PIPE

7-17.3(2)H1 GENERAL

Directional drilling must be as specified in Section 2-16. Trenchless construction except directional drilling, qualifications of the trenchless construction Contractor, casing pipe, and carrier pipe, spacers, and end seals must be as specified in the Contract.

7-17.3(2)H2 CASING PIPE, SPACERS AND END SEALING

When casing pipe is required, and the size and gauge of pipe has not been specified in the Contract, select the gauge and size of the casing pipe compatible with the construction operation and surrounding loading conditions. Prevent caving ahead or around the casing, which would create voids outside the casing pipe.

When the Contract does not specify spacers and end seal, the carrier pipe must be carefully skidded through the casing pipe and adjusted to the line and grade shown on the Drawing.

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When the Contract specifies using spacers and end seals, submit the spacer type and layout and method of adjustment to maintain the line and grade shown on the Drawing. Submit spacer and end seal manufacturer's catalog cuts and installation instructions to the Engineer at least 5 Working Days in advance of this work.

7-17.3(2)H3 TRENCHLESS CONSTRUCTION

Where indicated on the Drawings, install pipe by trenchless construction methods including jacking, auguring, tunneling, microtunneling, pipe bursting, or any other trenchless technology method or use of rapid excavation machine except directional drilling, including installing the pipe in a casing pipe, or by any combination of these methods.

Ground support in portal areas, shafts, and pits, whether launch, intermediate, or receiving, must be designed to support adjacent structures, support the sides of excavation, and withstand all forces from jacking and other operations.

Safety rules and standards must comply with Section 1-07.1(2). At least 1 assigned person must be on duty above ground whenever any employee is working underground. The Contractor must have in place communications, hoisting equipment, emergency provisions, air quality monitoring, and ventilation equipment as necessary.

Excluding directional drilling as specified in Section 2-16, at least 20 Working Days in advance of underground construction activities, submit 8 sets of a single Shop Drawing and all necessary calculations describing these activities:

1. Dimensions of shaft, pit, or portal.
2. Method of shaft excavation, shoring installation, maintenance and removal, and all supporting equipment.
3. Method of trenchless construction and all supporting equipment.
4. Control and monitoring equipment, including provisions to maintain line and grade, minimize over excavation and control the face of the excavation.
5. Staging and surface support, including waste disposal, including slurry handling and disposal, when applicable, as specified in Section 1-05.3.
6. Qualifications of trenchless construction Contractor. The submittal must include the name of the assigned person.

The material, procedure, and equipment used by the Contractor does not relieve the Contractor of responsibilities nor waive or change any provisions of the Contract.

7-17.3(2)I TEMPORARY SEWER BYPASS

Contractor must furnish, install, and maintain a temporary sewer bypass system to divert flows around the work area, as specified in this Section. The bypass system includes all pumps, generators, piping, valves, and other equipment needed to continuously move the effluent flow from an upstream connection point to a downstream reentry point.

7-17.3(2)I1 ACCESS

If the Contractor elects a bypass method requiring the use of property outside of the public Right of Way, the Contractor must arrange all necessary access and temporary construction agreements with all affected parties. All required written permissions must be submitted to the Engineer as specified in Section 7-17.3(2)I8. See Section 1-07.24 for real property rights requirements.

7-17.3(2)I2 SCHEDULING AND CONTINUOUS BYPASS OPERATION

The bypassing system must not be shut down between shifts, on holidays, on weekends, or during work stoppages without written approval from the Engineer. The Contractor must identify attendants responsible for maintaining the bypass system continuously until normal flow is restored.

If the Contractor elects to remotely monitor the bypass system, a submittal must be provided for approval by the Engineer. The remote system must include real time monitoring and notification functions.

7-17.3(2)I3 PUMPS, PIPING, AND EQUIPMENT

The Contractor must maintain the following equipment and materials on site:

1. If a pumping system is used, a system of pumps and piping that can maintain the anticipated low-flow specified in the Contract, and standby pump(s) fueled and operational at all times. Standby pumps must be capable of maintaining the low-flow rate.
2. A stock of valves, tees, elbows, connections, tools, sewer plugs, piping, hoses and other fittings and appurtenances sufficient to immediately repair or modify any part of the system as necessary.
3. Equipment or materials to accommodate high-flow conditions as specified in the Contract by bypassing, installing temporary pipe and restoring flow to the mainline, or by other means and methods, while maintaining the effluent level in the upstream bypass maintenance hole at no more than 1 foot above the crown of the incoming sewer pipe.
4. Other equipment and materials necessary to ensure continuous operation of the bypass system.

The Contractor must submit a high flow accommodation plan describing the work required to bypass the high-flow rates specified in the Contract while maintaining the effluent level in the upstream bypass maintenance hole at no more than 1 foot above the crown of the incoming sewer pipe.

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The Contractor must obtain written approval from the Engineer for the bypass system equipment and setup in the field prior to use.

7-17.3(2)I4 CRITERIA AND ESTIMATED FLOWS

The Owner will provide, at a minimum, the following information for each bypassing location:

1. Repair location
2. Upstream and downstream maintenance hole IDs
3. Bypassed pipe size
4. Basin type (sanitary, drainage, or combined flow)
5. Estimated low-flow and high-flow rates

Flows may exceed the amounts in the Owner's provided estimated flow range depending on weather and other upstream conditions. It is the Contractor's responsibility to account for deviations in flow quantity throughout the construction duration and provide continuous bypassing or restore flows to the existing system.

7-17.3(2)I5 LATERAL SEWER BYPASS

During bypass operation, the Contractor is responsible for all sanitary sewer back-ups and claims associated with the bypass operation or service interruption.

Laterals and sewer use must not be restricted for more than 8 hours per day. The Contractor must provide bypassing for side sewer connections with high anticipated discharge rates, as shown on the Drawings.

The Contractor must keep the construction trench free from sewage discharges from lateral connections. Temporary plugs must not be place in laterals to block flow unless a relief point is provided to prevent flooding of private property and sanitary sewer overflows.

7-17.3(2)I6 INSPECTION

The Contractor must inspect the entire bypass system for leaks hourly. The Contractor must keep an inspection log and record the time of the inspections, condition of the piping, depth of upstream flow and the name of the inspector into the log. The Contractor must submit the log to the Engineer upon request.

A leak in the bypass system is considered a sanitary sewer overflow. The Contractor must immediately repair leaks in the bypass system. Before operating the repaired bypass system, the Contractor must pressure test the system at the maximum operating pressure using clean water to demonstrate acceptable performance. All costs for the work to repair leaks and test the repaired bypass system must be borne by the Contractor as specified in Section 1-05.7.

7-17.3(2)I7 PROTECTION

The bypass system must not discharge to the ground surface, trench work area, receiving waters, or storm drains, and must not cause soil or groundwater contamination or health hazards. See Section 1-07.

The Contractor must immediately clean up any spill or leak, regardless of the size of the discharge. See 8-01.3(2)C.

7-17.3(2)I8 SUBMITTALS

The Contractor must submit a Bypass Plan and bypass submittals to the Engineer for approval at least 15 Working Days prior to operating the bypass. Bypass submittals must be prepared for each location where a bypass is required, including for any side sewers requiring bypassing. Bypass submittals must include the following:

1. Bypass Plan, including:
   a. Written proposal with a list of all equipment and a drawing showing bypass routing from upstream location to downstream reentry point
   b. Expected hours of operation
   c. Plan to provide uninterrupted power
   d. Staffing and emergency contacts
   e. Suction and discharge points with elevations on plan view
   f. High-flow accommodation plan
   g. Steps to address equipment failure
   h. Other equipment or measures to ensure continuous bypass operation
2. Manufacturer's catalog cuts showing the capacities of pumps and pipes.
3. Design calculations proving adequacy of the system and selected equipment, including:
   a. Pump performance curves
   b. System curve and operating point of the pump-conveyance system
   c. Ability of hoses, fittings, and appurtenances to meet the operating pressure

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4. Any real property agreements, permissions, or releases required to accommodate the Contractor's bypass plan, see Section 1-07.24, including:
   a. Written permission to enter or use private property
   b. Written release prior to vacating private property impacted by construction

The Engineer's approval does not relieve the Contractor of liability for sewage spills under this Contract.

7-17.3(3) CLEANING AND TESTING

7-17.3(3)A GENERAL

After backfilling, pipelines and appurtenances must be cleaned, television inspected, and tested using the low pressure air method. Infiltration testing is additionally required when the ground water elevation is in, or fluctuates through the pipe zone. Substitute exfiltration testing for the low pressure air method when the pipe or detention system is in or near, as specified in the Contract, Environmentally Critical Areas designated as geologically hazardous areas.

All required work involving cleaning and testing pipelines between maintenance holes or rodding inlets must be completed within 15 Working Days after backfilling of pipelines and Structures. Any delay must be submitted to the Engineer well in advance and requires the written consent of the Engineer. The Contractor must furnish all labor, Materials, tools, and equipment necessary to perform the test, clean the lines, and perform all related Work. The Contractor must perform the tests in the presence of the Engineer. All testing must be accepted by the Engineer, before final pavement restorations. Prevent joints from drawing apart during tests. The Contractor must repair any damage resulting from these tests. The manner and time of testing are subject to approval by the Engineer.

Plug all wyes, tees, and stubs using test tees, or acceptable alternate, securely fastened to withstand the internal test pressure. Such test tees must be readily removable, and their removal must provide a socket suitable for making a flexible jointed lateral connection or extension.

Flexible pipe must comply with the deflection testing requirements of Section 7-17.3(3)F.

Testing of side Sewers including runoff and downspout connections must comply with the requirements of Section 7-18.3(6).

Television inspection is specified in Section 7-17.3(3)G.

7-17.3(3)A1 PIPE NOT PASSING TESTING

If any pipeline installation fails to comply with the requirements of the test method used, or is indicated as defective by television inspection, determine the source or sources of leakage and replace all defective pipe. A new test method cannot be substituted to demonstrate passing, except with the written consent of the Engineer.

Should the Contractor believe the pipe which is damaged, or which failed the test, can be repaired by methods other than remove and replace, the Contractor must submit a repair method for approval by the Engineer at least 5 Working Days in advance. Do not replace or repair defective pipe until the method is approved. The replaced or repaired pipe must be reinspected and retested at no additional cost to the Owner.

All lateral or side Sewer branches included in the test section must be taken into account in computing allowable leakage.

Upon final acceptance of the Work, all Sewers, side Sewers and fittings must be open, clean, and free draining.

7-17.3(3)B EXFILTRATION TEST

Pipe with existing service connections are exempt from exfiltration testing.

Before making exfiltration leakage tests, the Contractor may fill the pipe with clear water to allow normal absorption into the pipe walls, provided that after filling the pipe the leakage test is completed within 24 hours. When under test, the allowable leakage is limited according to the provisions that follow. Specified allowances assume pre-wetted pipe.

Leakage must be less than 0.28 gph per inch inside diameter per 100 linear feet of pipe, with a hydrostatic head of 6 feet above the crown at the upper end of the test section, or above the natural groundwater table during test, whichever is higher. The length of pipe tested must be limited so the pressure at the lower end of the section tested does not exceed 16 feet of head above the invert, and in no case can the length be greater than 700 linear feet or the distance between maintenance holes when greater than 700 linear feet.

Where the test head is not 6 feet, the measured leakage must not exceed 0.28 gph per inch inside diameter per 100 linear feet times the ratio of the square root of the test head to the square root of 6.

$$\text{Leakage maximum} = 0.28 \times \sqrt{H} / \sqrt{6} = 0.114 \times \sqrt{H}$$

Where:

Leakage is in gph/inch inside diameter/100 linear feet.

When the test is made 1 joint at a time, the leakage per joint must not exceed the computed allowable leakage per length of pipe.

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An allowance of 0.2 gallons per hour per foot of head above invert must be made for each maintenance hole included in a test section.

7-17.3(3)C INFILTRATION TEST

Acceptance may be based on no visible leakage when the Engineer observes the pipe directly or through CCTV after groundwater pumping has been discontinued for a minimum of 24 hours and the Engineer determines the ground water elevation is at a suitable head above the crown of the pipe to represent the expected operational conditions.

When leakage is observed, the Contractor may select to measure the infiltration rate. Testing must be from maintenance hole to maintenance hole. For vitrified clay pipe, infiltration testing and acceptance must be per ASTM C1091. For concrete pipe, infiltration testing and acceptance must be per ASTM C969.

7-17.3(3)D AIR PRESSURE TEST

Conduct air pressure testing after the pipe has been backfilled and before paving. Pipe with existing service connections may be partially tested between the service connections.

Pipe with inside diameter of 42 inches and less may be tested from maintenance hole to maintenance hole or on shorter lengths at the Contractor's option. Pipe greater than 42 inches in diameter must be tested at all joints individually and in consecutive order along the entire line.

The Contractor must furnish the test equipment to be used, which must be inspected and approved by the Engineer before use. The Engineer may at any time require a calibration test of gauges, other instrumentation, and equipment used for this test.

Safety Provisions: Plugs used to close the Sewer pipe for the air test must be securely braced to prevent the unintentional release or loosening of a plug. Gauges, air piping manifolds, and valves must be at the ground surface. No person is permitted to enter a maintenance hole where a plugged pipe is pressurized. Four pounds per square inch gauge (psig) air pressure develops a force against the plug in a 12-inch diameter pipe of approximately 450 pounds, and over 5,000 pounds in a 42-inch diameter pipe. Plug failure may result in injury or death. Air testing apparatus must be equipped with a pressure release device designed to relieve pressure in the pipe at a pressure recommended by the pipe manufacturer. Submit the pipe manufacturer's recommendations to the Engineer including the safety precautions for pipe testing.

7-17.3(3)D1 TEST TIME

The table below shows the required test time, T, in minutes/100 feet of pipe for each nominal pipe size. Test times are for a 1.0-psi pressure drop from 3.5 to 2.5 psi. If a 1 psi drop does not occur within the test time, the line has passed. If the pressure drop is more than 1 psi during the test time, the line has failed the test.

Minimum Test Time for Pipe Sizes 4" to 42”

Nominal Pipe Size, in	T (time) min/100 ft.
4	0.3
6	0.7
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	3.6
27	4.2
30	4.8
33	5.4
36	6.0
39	6.6
42	7.3

To calculate test times or allowable air loss for nominal pipe sizes not in the minimum test time table, the Contractor has the option to calculate test times and allowable air loss, or to use the time associated with the next higher pipe size in the table.

Calculate the required test time at a given allowable air loss as follows:

$$T = K \times (D^2 L / Q)$$

Calculate air loss with a timed pressure drop as follows:

$$Q = K \times (D^2 L / T)$$

Where:

D = nominal size, inches

K = 0.371×10^{-3} for inch-pound units

L = length of line of 1 pipe size, ft

Q = air loss, ft^3/min

T = time for pressure to drop 1.0 psi, min

7-17.3(3)D2 GENERAL PROCEDURE FOR CONDUCTING ACCEPTANCE TEST BY PRESSURE DROP METHOD

1. Plug all pipe outlets with suitable test plugs. Brace each plug securely.
2. All gauge pressures in the test must be increased by the amount of groundwater pressure at the center of the pipe.
3. Add air slowly to the portion of the pipe installation under test until the internal air pressure is raised to 4.0 psig.
4. After an internal pressure of 4.0 psig is obtained allow at least 2 minutes for air temperature to stabilize, adding only the amount of air required to maintain pressure.
5. After the 2 minute period, disconnect air supply.
6. When pressure has decreased to 3.5 psig, start stop watch. Determine the time in seconds that is required for the internal air pressure to reach 2.5 psig. This time interval must then be compared with the time specified in Section 7-17.3(3)D1.
7. If the pressure has not dropped to 2.5 psig in the time specified in Section 7-17.3(3)D1, then the test may be terminated and the test section has passed the low pressure air test.

7-17.3(3)E HYDROSTATIC TEST FOR SEWER FORCE MAINS

7-17.3(3)E1 GENERAL

All force mains and appurtenances must be subjected to hydrostatic pressure testing as soon as possible after they are installed and backfilled.

7-17.3(3)E2 EQUIPMENT

The Contractor must furnish the following equipment for the hydrostatic tests:

Amount	Description
2	Approved graduated containers
2	Pressure gauges
1	Hydraulic force pump approved by the Engineer
--	Suitable hose and suction pipe as required

Pressure gauges must be calibrated within 6 months of hydrostatic testing. At least 2 Working Days before using the pressure gauge, provide a manufacturer's certificate of compliance stating the date of calibration.

7-17.3(3)E3 PROCEDURE

Use clean water or approved reclaimed water as the hydrostatic test fluid. All parts of the piping system must be subjected to a minimum test pressure of 50 psi plus pressure head required to overcome pumping height.

Where any section of pipe is provided with concrete thrust blocking, do not make the pressure test until at least 5 Days have elapsed after the thrust blocking is installed. If high early cement is used for thrust blocking, the time may be reduced to no less than 2 days.

The Contractor must provide all temporary plugs, caps, and thrust blocking and all closure sections and couplings required to test the pipeline in sections at the specified test pressure.

7-17.3(3)E4 DURATION

The duration of each pressure test must be a minimum of 1 hour. A leakage test of at least 2 hours duration must immediately follow the pressure test.

7-17.3(3)E5 EXPELLING AIR AND FILLING PIPE

Before applying the specified test pressure, expel all air from the pipe by slowly filling the pipe with water and allow to stand for 48 hours before testing.

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7-17.3(3)E6 PRESSURE TEST

Test pressures must be applied by a pump connected to the pipe. Apply the test pressure and operate the pump as necessary to maintain the test pressure at its full value for the entire duration of the pressure test.

7-17.3(3)E7 LEAKAGE TEST

For the leakage test, the pump suction must be in a barrel or similar device or metered so the quantity of water put into the pipeline can be accurately measured. Apply the test pressure and operate the pump as necessary to maintain the pressure in the pipeline at a minimum of 90 percent of the test pressure for the entire duration of the leakage test. At the end of the test period operate the pump until the test pressure is again attained. Leakage is defined as the quantity of makeup water required to maintain the pipeline pressure during the test and to restore the test pressure at the end of the test period. No pipe installation will be accepted if the leakage is greater than the number of gallons per hour as determined by the following formula:

$$L = N \times D \times (P)^{1/2} / 1850$$

Where:

L = Allowable leakage, in gallons per hour

N =Number of joints in the length of pipe tested.

D =Nominal diameter of pipe, in inches.

P =Average test pressure during the leakage test, in pounds per square inch gauge.

7-17.3(3)E8 CORRECTION OF EXCESSIVE LEAKAGE

Should any test of pipe indicate leakage greater than that allowed, locate and repair the defective joints or pipe until the leakage from subsequent testing is within the specified allowance. Submit the method of repair to the Engineer for approval at least 3 Working Days in advance.

7-17.3(3)F DEFLECTION TEST FOR FLEXIBLE PIPE

All Sewer and Storm Drain mainlines constructed of flexible pipe, including detention pipe that conveys sewage or stormwater during normal flow conditions, must be tested for vertical deflection no less than 30 Days after trench backfill and compaction have been completed, and before pavement restoration. Testing must be conducted on a maintenance hole to maintenance hole basis after the line has been thoroughly flushed with water. Pipe deflection is measured as the percent reduction in minimum interior diameter. Allowable deflection and deflection testing method are as follows:

Pipe Size, Nominal Diameter (inches)	Allowable Deflection	Deflection Testing Method
≤ 12	5%	Mandrel
15 to 34	3%	Mandrel
≥ 36	3%	Mandrel or Direct Measurement

7-17.3(3)F1 MANDREL DEFLECTION TEST

The Contractor must pull a mandrel through the pipe by hand to ensure the maximum allowable deflection has not been exceeded. Before use, the mandrel must be measured, inspected for roundness, and certified as being sound and accurate. A manufacturer's certificate of compliance stating the mandrel to be used meets these Specifications must be submitted to the Engineer at least 1 Working Day before the test. The use of an uncertified mandrel or a mandrel changed or modified after certification will invalidate the test, requiring a 2 Working Day advance notification to the Engineer of a retest with a certified mandrel. If the mandrel fails to pass through the pipe, the pipe will be deemed overdeflected and unacceptable.

The mandrel must:

1. Be a rigid, nonadjustable, odd numbering leg (9 legs minimum) mandrel having an effective length not less than its nominal diameter.
2. Have a minimum diameter at any point along the full length as follows:

   $$Dm = 0.95 \times Dp$$

   For nominal pipe sizes of 12 inches and less, or:

   $$Dm = 0.97 \times Dp$$

   For nominal pipe sizes greater than 12 inches, where Dm is the minimum mandrel diameter and Dp is the minimum interior diameter of the installed pipe per the pipe manufacturer.

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3. Be fabricated of steel, be fitted with pulling rings at each end, be stamped or engraved on some segment except a runner indicating the pipe material, material specification, nominal pipe size, and mandrel outside diameter, e.g. PVC, ASTM D 3034, 8 inch, 7.524 inch; and be furnished in a suitable carrying case labeled with the same data as stamped or engraved on the mandrel.

7-17.3(3)F2 DIRECT MEASUREMENT DEFLECTION TEST

Pipe large enough for a person to work inside it may be accepted on the basis of direct measurements. The Contractor must submit a method for making deflection measurements including the measurement device, how the measurement device is verified as providing reasonably repeatable results, how mark points will be placed on the pipe for the deflection measurements, and how the measurement data at each test location is presented to demonstrate that any indicated deflection is within the tolerances allowed.

Each test location must be measured in 3 equal angle projections, at 0 degrees, 60 degrees, and 120 degrees from a vertical orientation. Each section of pipe subject to testing must be tested in at least 2 locations. In addition, a minimum of 3 pipe sections must be tested per installation, and a minimum of 3 pipe sections must be tested for each 100 linear feet of pipe installed. The Engineer may require additional measurements, orientations of measurement, or test locations.

7-17.3(3)F3 OVER-DEFLECTED PIPE

If testing reveals an over-deflected pipe, it must be uncovered and, if not damaged from over-deflection or from excavation activities, the pipe may be corrected and reinstalled.

If the pipe requires repair, submit the proposed repair to the Engineer for approval at least 3 Working Days before making the repair. Before performing the repair, provide a manufacturer's certificate of compliance stating that the over-deflected pipe as repaired will perform specified in the Contract. If no repair is recommended, the Contractor must submit a written statement that includes the reason why the pipe requires no repair and provide a manufacturer's certificate of compliance stating that the pipe, without repair, will perform as specified in the Contract.

Any pipe damaged beyond reasonable repair, due to over-deflection or from any other cause, must be uncovered and removed from the Project Site and replaced with a new pipe at no cost to the Owner.

7-17.3(3)G TELEVISION INSPECTION

After repairs or improvements are completed and excavations are backfilled, and before pavement restoration, the Contractor must perform television inspection of the interior of all mainline Sewer and Storm Drain pipe larger than 6 inches in diameter and all catch basin connection pipe. Notify the Engineer at least 3 Days in advance of the television inspection. The Engineer must be present during each television inspection. Side Sewer and inlet connection pipe will not require television inspection.

7-17.3(3)G1 PERSONNEL QUALIFICATIONS

Personnel performing television inspection must be National Association of Sewer Service Companies (NASSCO) certified Pipeline Assessment and Certification Program (PACP) users. Submit proof of PACP certification to the Engineer at least 10 Working Days in advance of the first television inspection.

7-17.3(3)G2 RECORDING EQUIPMENT

At least 10 Working Days in advance of the first television inspection, the Contractor must submit to the Engineer for acceptance, a television inspection recording taken on the proposed recording equipment which demonstrates acceptable performance as specified in this Section.

The recording equipment must have a 360 degree radial view color television pan and tilt camera with a mechanical distance counter calibrated to show the distance traveled in the pipe, in feet, on the recorded video. The mechanical counter must record increasing or decreasing distance for forward or backward travel, respectively.

The recording equipment must have a light source providing adequate illumination to clearly identify pipe invert, crown, joints, sides, connections, infiltration, exfiltration, and record images 15 feet in front of the camera.

7-17.3(3)G3 TELEVISION INSPECTION RECORDING REQUIREMENTS

Each television inspection recording file must document a single run of pipe between 2 structures, including accessible or buried maintenance holes, vaults, catch basins, blind endpoints, or outfalls. A complete inspection must start at the centerline of the first structure, and end at the centerline of the second structure. If an impassible obstruction prevents the camera from completing the inspection, the Contractor must notify the Engineer. Inspections of the same pipe starting in a different structure must be recorded in a separate television inspection recording file.

If upstream flow was bypassed during construction, the television inspection must be recorded before removing the bypass. Bypass equipment must be installed to allow full visibility of pipe inverts. See Section 7-17.3(2)I.

Set the mechanical distance counter to zero feet at the centerline of the structure where the video starts. Position the camera lens head centrally within the pipe to minimize potential picture distortion.

Before starting each inspection, a data generator must display all PACP information standard fields, including structure depths, readable on the viewing monitor and the inspection recording. The data display must be sized and positioned such

that it does not obscure the pipe features being captured on the recording. The data display must be centered on the bottom of the viewing screen with white lettering on a black outline.

Begin recording the inspection from the centerline of the starting structure. The camera must travel along pipe invert at a speed no faster than 25 feet per minute.

During the inspection, the data display must continually show the following minimum information:

1. Distance traveled in the pipe in feet
2. Pipe dimensions in inches
3. Reference numbers for start and end point structures
4. Direction of survey, downstream (D) or upstream (U)
5. Date

The television inspection recording equipment must stop for a detailed inspection at all lateral connections; at locations where possible defects are discovered, including areas with apparent infiltration or exfiltration, open joints, pipe deflection, cracks, or other defects with a PAPC coding; and when requested by the Engineer. The detailed inspection must focus on the defect or structural feature for at least 5 seconds and must include slow travel backward and forward to capture multi-directional views.

At each point of detailed inspection, the recording must be coded with the following information:

a. PACP defect code (Group/Descriptor/Modifier) as applicable
b. The value on the distance counter where the defect is located, in feet
c. The corresponding time elapsed video readout
d. Circumferential Location, as applicable
e. For continuous defects, the value on the distance counter where the defect ends, in feet

The television inspection should end at the centerline of the second structure, such that the mechanical distance counter records the distance from the centerline to centerline of the 2 boundary structures.

7-17.3(3)G4 TELEVISION INSPECTION RECORD SUBMITTAL REQUIREMENTS

Within 5 Working Days of completion of each television inspection, the Contractor must submit the following records to the Engineer approval:

1. A hard copy report of the PACP Inspection Form complete with:
   a. Completed header section
   b. PACP coded conditions entered into the details section
   c. Follow up recommendations as applicable
2. Electronic inspection data, including all PACP coded inspection data in database format for direct entry into a database.
3. A complete video recording of the television inspection in MP4 format.

The electronic inspection data file and video recording file must be exported in PACP format to preserve coded data. Contact the manufacturer of the PAPC encoding software used for instructions on how to export in PACP format.

Each electronic inspection data file and video recording file must document a single run of pipe between 2 structures, as specified in Section 7-17.3(3)G3, and must be submitted together on a single DVD-R disc or flash drive. Corresponding data files and video recording files must be in a folder named to indicate the reference numbers of the start and end-point structures. Each DVD-R disc or flash drive may contain multiple television inspections, at the Contractor's option. All DVD-R discs or flash drives become the property of the Owner.

The DVD-R disc or flash drive and PACP Inspection Form must be delivered in an envelope with a transmittal letter defining the contents. Include the following information in the transmittal letter for each television inspection contained on the DVD-R disc or flash drive:

1) Date and time of day television inspection performed.
2) Names of television inspection crew members.
3) Project name, vault plan number listed on Drawings, and Drawing sheet number.
4) Location (ex: Broad Street, Fifth Ave W to mid-block)
5) Start and end-point structure reference numbers (ex: maintenance hole 024-319 to 025-319)
6) Camera travel direction
7) Size of pipe
8) Pipe material
9) A unique identification number, with these numbers being in consecutive sequence on all recordings of project pipe.

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7-17.3(3)G5 REPAIR OF DEFECTIVE WORK AND REINSPECTION

Defective Work discovered during television inspection must be addressed as specified in Section 1-05.7. After all defective Work has been addressed, the Contractor must perform a complete television inspection of the corrected pipe run including focus to verify the defective Work has been corrected. Video inspection of the entire pipe run must be as specified in this Section. Television inspection to verify the resolution of defective Work must be done at the Contractor's sole expense.

7-17.4 MEASUREMENT

Measurement for "Bedding, (Class), (Size) Pipe" and for Sewer, Culvert, and Storm Drain as shown on Standard Plan 285, and for Water Main as shown on Standard Plan 350, will be by the linear foot of pipe actually installed. For Sewer and Storm Drain, measurement will be from center to center of standard maintenance holes or to the inside face of other Structures. For Water Main, measurement will be to inside face of Structure, to end of pipe, or to centerline of connecting tee. Class D bedding will not be measured. Bedding beyond neat lines shown on the Standard Plans will not be measured.

Measurements for "Pipe, (Use), (Material), (Class), (Size)", and for "Pipe, (Use), (Material), (Class), (Size), (Trenchless Construction Method)" except directional drilling will be by the linear foot of pipe actually installed and tested, and must be along the centerline of the pipe through the tees or wyes with the exception of pipe ending at a tee or wye. Measurements will be to the center of new maintenance hole or rechanneled existing maintenance hole; or to the inside face of Structure or existing maintenance hole not rechanneled; or to the end of pipe where it meets a maintenance hole stub; or to a wye; or to a tee whether with stub or cut-in. Measurement will be to the nearest 0.1 foot. See Standard Plan 010.

Measurement for "Casing Pipe, (Class), (Size), (Construction Method)" will be by the linear foot of pipe actually installed.

Measurement for "Tee, (Material), (Size)" and for "Tee, (Size), Cut In Existing (Material) Pipe", will be per each where "size" applies to the size of the pipe fitting into the tee branching off the mainline pipe as shown on Standard Plan 010, and "Material" is the Material of the mainline pipe with the branching tee.

Measurement for "Temporary Sewer Bypass" will be by lump sum.

Measurement for "Television Inspection" will be for the linear feet of installed mainline Sewer and Storm Drain pipe larger than 6 inches in diameter and all catch basin connection pipe videotaped once during final inspection. Measurement will be made along the pipe centerline, through tees, starting and ending:

1. From center to center of new or rechanneled maintenance holes;
2. At the inside face of Structures or maintenance holes not channeled;
3. At the end of pipe where it dead ends beyond maintenance holes;
4. From the catch basin to the mainline pipe; or
5. From the flow control structure to the mainline pipe.

Measurement for "Extra Excavation" is specified in Section 2-04.

Measurement for foundation Material will be by the cubic yard of Mineral Aggregate required to fill the void made by extra excavation and will be based on neat line width of trench and depth and length as computed by the Engineer.

Measurement for protective system will be as specified in Section 2-07.4.

Measurement for "Mineral Aggregate, (Type)" will be by the cubic yard based on the neat line trench pay width as specified in Section 7-17.3(1) and the Standard Plans, or other neat line dimensions when designated by the Engineer. Imported Mineral Aggregate used beyond these neat line limits will be at the Contractor's sole expense.

Measurement for "Mineral Aggregate, (Type)" for trench backfill will be as specified in Section 4-01.5. Imported Mineral Aggregate used beyond these neat line limits will be at the Contractor's sole expense.

7-17.5 PAYMENT

1. **"Bedding, (Class), (Size) Pipe"**, per linear foot

The Bid Item price for "Bedding, (Class), (Size) Pipe" includes all costs for the work required to furnish and install bedding. Cost of Class D bedding is included in the Bid Item for the pipe Bid Item and no separate or additional payment will be made.

2. **"Pipe, (Use), (Material), (Class), (Size)"**, per linear foot

The Bid Item price for "Pipe, (Use), (Material), (Class), (Size)" includes all costs for the work required to furnish and install the pipe of the type and size specified, and the following:

a. Trench excavation, installing and joining pipe, and backfill and compaction of suitable native Material backfill;
b. Handling, hauling, storage, removal; and off-site disposal of excess suitable and unsuitable excavated native material; or hauling, storage, and placement of suitable excess excavated native material elsewhere on the Project Site except where designated for embankment construction;
c. Dewatering of the trench;
d. Cleaning and testing per Section 7-17.3(3), except separate payment will be made for Television Inspection per Section 7-17.3(3)G;
e. Class D bedding;

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f. Pipe coupling, measuring outside diameters of pipes to be connected; and

g. Removal and disposal of existing pipe within trench neat line limits when pipe replacement is called for in the Contract.

All costs in connection with excavating test pits and for standby time during field density tests for compaction is considered as included in the Bid Item prices for the applicable pipe Bid Items.

The Contractor is solely responsible for all costs of correcting any unauthorized excavation below the established trench grade by providing, placing and compacting suitable Material to the proper grade elevation as specified in Section 2-09.3(1).

Cost for the work of cleaning, testing, and furnishing and installing caps and plugs for the tests is included in the Bid Item prices of the pipe Bid Items.

Costs for the work required in proof testing the pipe are considered included in the Bid Item prices for the appropriate pipe Bid Items.

The Contractor is solely responsible for all costs of correcting any damage resulting from testing of the Sewers and appurtenances specified in Section 7-17.3(3)A.

All costs of determining the source or sources of leakage and the cost to repair or replace the Sewer found defective as specified in Section 7-17.3(3), will be borne by the Contractor as specified in Section 1-05.7

If the pipe fails the deflection test as specified in Section 7-17.3(3)F, all costs to locate and repair the failed sections and retest the pipe will be borne by the Contractor as specified in Section 1-05.7.

All costs for the work required to furnish and install joint coupling devices as specified in Section 7-17.3(2)E are considered as included in the Bid Item prices for the pipe Bid Items.

3. **"Casing Pipe**, **(Material), (Class), (Size), (Construction Method)"**, per linear foot

The Bid Item price for "Casing Pipe, (Material), (Class), (Size), (Construction Method)" except directional drilling includes all costs for the work required to furnish and install casing pipe as specified in Section 7-17.3(2)H, including installation and removal of shoring of any access pit.

Payment for directional drilling installation will be as specified in Section 2-16.5.

4. **"Pipe**, **(Use), (Material), (Class), (Size), (Trenchless Construction Method)"**, per linear foot

The Bid Item price for "Pipe, (Material), (Class), (Size), (Trenchless Construction Method)" except directional drilling includes all costs for the work required to furnish and install the pipe as specified in Section 7-17.3(2)H. Bid Item price also includes the cost for furnishing and installing pipe skids, casing spacers, and pipe end seals. All cost for filling the annular space, when required in the Contract, is incidental to this Bid Item and no separate or additional payment will be made.

Payment for directional drilling installation will be as specified in Section 2-16.5.

5. **"Tee**, **(Material), (Size)"**, each

The Bid Item price for "Tee, (Material), (Size)" includes all costs for the work required to furnish and install the tee including plug when required.

6. **"Tee**, **(Size), Cut In Existing (Material) Pipe"**, each

The Bid Item price for "Tee, (Size), Cut In Existing (Material) Pipe" includes all costs for the work required to furnish and install the tee as specified in Section 7-17.3(2)C3. If SPU installs a tee, no payment will be made.

7. **"Temporary Sewer Bypass"**, per lump sum

The Bid Item price for "Temporary Sewer Bypass" includes all work required to bypass Sewer flow around the construction work.

8. **"Television Inspection"**, per linear foot

The Bid Item price for "Television Inspection" includes all costs for the work required for television inspection of mainline Sewer and Storm Drain pipe larger than 6 inches in diameter, and all catch basin connection pipe, including the cost to furnish an acceptable DVD-R disc or flash drive to the Engineer. Costs for additional television inspections necessary to verify corrections or replacement of pipe or done solely for the Contractor's convenience will be borne by the Contractor.

The cost for the Owner's labor and equipment for the videotaping during the final acceptance process and the videotaping 6 to 11 months later to recheck the pipe condition will be borne by the Owner unless additional videotape inspection is necessary to verify corrections or replacement of deficient pipe. The cost of pre-television inspection cleaning, as specified in Section 7-17.3(3)A, or additional television inspections necessary to verify repairs or replaced pipe will be borne by the Contractor. The Contractor is also responsible for all costs incurred in any television inspection performed solely for the benefit of the Contractor.

9. **Other payment information**

See Section 2-07 for payment information on protective systems.

Where unauthorized excavation has been made which increases the established trench depth beyond 4 feet, the Contractor must comply with the requirements specified for Protective Systems in Section 2-07 at no additional cost to the Owner.

Payment for imported Material when ordered instead of native backfill Material by the Engineer will be paid as "Mineral Aggregate, (Type)", or other imported Material acceptable to the Engineer.

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Foundation Material when required will be paid as "Mineral Aggregate, (Type)" per cubic yard, as specified in Section 4-01.5.

Where the Engineer determines that the existing foundation is unsuitable, and foundation Material specified by the Engineer is not in the Contract and no Bid Item for "Mineral Aggregate, (Type)" is included in the Bid Form, payment will be made as specified in Section 1-04.1(2).

The Contractor must provide all necessary water for construction and testing purposes, as specified in Section 2-12.

No separate or additional payment will be made for submittals, or for Material used in the jacking operations or for the cost of the backfilling operations, including compaction.

Payment for plugging pipes will be as specified in Section 2-02.5.

Payment for "Selected Material" will be as specified in Section 2-10.5.

All costs for the work required to furnish and install Polyethylene Foam between utilities must be included in the applicable bid item cost for pipe.

The Contractor is solely responsible for all costs of providing pipe of increased strength classification or placing a class of bedding of higher load bearing capacity, as required by the Engineer, when the maximum trench width specified in Section 2-04 is exceeded without prior written approval of the Engineer. The Contractor must furnish and install any approved imported backfill Material required outside the trench neat line limits at no additional cost to the Owner.

SECTION 7-18 SIDE SEWERS

7-18.1 DESCRIPTION

Section 7-18 describes Work consisting of locating and placing a side Sewer, locating tees, and testing of side Sewers. This Section also accommodates private construction in the Right of Way under permit by SPU and SDOT Street Use.

A side Sewer is considered as pipe labeled as side Sewer, or combined side Sewer or service drain as addressed in Title 21 of the SMC and applicable Director's Rules. All privately owned and operated drainage control facilities or service drain facility, whether or not they discharge to a public facility are considered a side Sewer. A side Sewer does not include internal building piping or connecting appurtenances.

7-18.2 MATERIALS

Materials for a side Sewer must comply with the requirements of the following Sections:

Material	Section
Pipe	Section 9-05
Pipe Bedding & Trench Backfill	Section 2-10

A side Sewer in Right of Way must be at least 6 inches inside diameter unless otherwise specified in the Contract.

Clearly mark all pipe with type, class, date of manufacture, location of manufacturing facility, and/or thickness, as applicable. Marking must be legible and permanent on the outside surface of the pipe, and be able to withstand normal wear due to handling and storage.

Jointing must be flexible gasketing. Flexible gasketing includes rubber, synthetic rubberlike and plastic Materials specially manufactured for the joint, pipe size, and use intended and must be furnished by the manufacturer of the pipe to be used.

Mortared joints are not allowed.

Tees, wyes, couplers, and adapters must conform to the requirements of this Section.

Bends and transition sections are specified in the Contract.

Couplings to existing pipe and between dissimilar pipe must have stainless steel shielding to provide shear control.

Side Sewer that may be exposed to hot sewage, steam, or other extreme exposure must be of a Material and with joints as specified in the Contract, and comply with the clearance requirements specified in Section 1-07.17(2).

7-18.3 CONSTRUCTION REQUIREMENTS

7-18.3(1) SIDE SEWER CONSTRUCTION

7-18.3(1)A GENERAL

This Work also includes excavation, backfilling and compaction as specified in Section 2-04, Section 2-10, and Section 2-11.

Work in excavations over 4 feet deep must comply with Section 2-07.

Side Sewer installation must be as shown on Standard Plan 283.

Where Section 7-18 does not address specific construction requirements, the construction requirements for Sewer in Section 7-17 of these Specifications apply.

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Side Sewer locations shown on the Drawings are subject to relocation in the field after construction starts to accommodate Job Site specific conditions. Regardless of the Drawing location, place the tee or wye branch in the main Sewer or Storm Drain at the location designated by the Engineer.

When the Work requires, the Engineer will establish the depth for the invert elevation of side Sewer at the Right of Way margin.

Install side Sewer per the clearance requirements specified in Section 1-07.17(2) and other code, law, and regulation.

Where it is necessary to break out an existing side Sewer during construction due to grade conflict with a newly constructed pipeline, use only new pipe in reconnecting the side Sewer. Lay new pipe so as to minimize bends and as approved by the Engineer.

Separate side Sewer documentation of all new, re-laid, replaced, or repaired pipe and fittings must be per SMC 21 and applicable Director's Rules.

7-18.3(1)B SIDE SEWERS SHOWN ON THE DRAWINGS

7-18.3(1)B1 PROTECTION OF EXISTING SIDE SEWER

See Section 1-07.16.

7-18.3(1)B2 REMOVE AND REPLACE EXISTING SIDE SEWER

When the Drawings call for removal and replacement of existing side Sewer, use only new pipe to replace the removed pipe.

7-18.3(2) EXCAVATION, FOUNDATION PREPARATION, BEDDING, AND BACKFILL

Excavation, foundation preparation, bedding and backfill for side Sewer must conform to the requirements of Division 2, except that bedding must be limited to that required to hold the pipe in true alignment and to grade before backfill. Provide the Engineer at least 2 Working Days advance notice for inspection and testing per Section 7-18.3(6) before covering the side Sewer.

7-18.3(3) PIPE INSTALLATION AND JOINTING

7-18.3(3)A GENERAL

Pipe installation and jointing, except as specified in this Section, must conform to the requirements of Section 7-17 and Chapter 21.16 of the SMC.

7-18.3(3)B LINE AND GRADE

Install side Sewer to a line and grade between the main Sewer or Storm Drain tee branch or wye branch and the Right of Way margin, to best serve the property relative to these conditions:

1. Where a vacant property is level with or lower than the street grade, the invert elevation of the proposed side Sewer at the Right of Way margin must be 1 foot higher than the elevation of the crown of the main Sewer or Storm Drain at the location of its tee or wye branch connection. See Standard Plan 283 for additional requirements.
2. Where an occupied property is situated at higher elevation than the street grade and where the slope of the proposed side Sewer is steeper than 50 percent, the maximum elevation of the side Sewer at the Right of Way margin will be established by the Engineer with due consideration for placing the side Sewer below the invert of any proposed Storm Drain pipe, unless conditions require otherwise. The clearance between the invert of an existing Storm Drain or Sewer and the crown of a side Sewer below it must be at least 6 inches. In either of these conditions, place the end of the side Sewer at the Right of Way margin deep enough to accommodate at least 2-1/2 vertical feet of compacted backfill between the crown of the pipe and finished grade at that point.
3. Side Sewer Pipe must be installed on a grade of at least 2 percent.

7-18.3(3)C PIPE INSTALLATION

Install bell and spigot pipe with the bell end facing up grade. All pipe installation must start and proceed up grade from the point of connection at the Sewer or Storm Drain or other starting point.

Between fittings, install pipe in a straight line at a uniform grade.

7-18.3(3)D JOINTING – NEW PIPE TO EXISTING PIPE

Where joints cannot be made due to dissimilar pipe Material or mismatched wall thickness, use a coupling as specified in Section 9-05.18 to make a water tight joint.

7-18.3(4) FITTINGS

All fittings must be factory produced and be designed for installation on the pipe to be used.

The maximum deflection permissible at any 1 fitting or joint must not exceed the pipe manufacturer's recommendation, and must never exceed 2 inches per foot at any joint or fitting. The maximum deflection of any combination of 2 adjacent fittings or joints must not exceed 45 degrees (1/8 bend). Should greater than 45 degree deflection be needed between

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adjacent joints or fittings, install a straight pipe of not less than 2-1/2 feet in length between such adjacent fittings or joints, unless either one of such fittings is a wye branch with a cleanout provided on the straight leg or such a wye branch fitting is substituted for a joint.

Connect side Sewer to the tee or wye provided at the main Sewer or Storm Drain where such is available, using approved fittings or couplings. Where no tee or wye is provided or available, connect by core drilling and installing a connection as specified in Section 7-17.3(2)C3.

When the side Sewer Material is ductile iron pipe and is connecting to a mainline by core drilling and an inserted tee, connection includes a 1 foot long plain end by plain end section of ductile iron pipe inserted into the bell end of the tee manufactured to accept ductile iron pipe. Connect the 1 foot section to the upstream pipe using a flexible gasketed coupling with stainless steel shielding as specified in Section 9-05.18.

The installation of side Sewer to a vertical connection at the main Sewer or Storm Drain is shown on Standard Plan 234a or 234b.

7-18.3(5) CLEANOUTS

Refer to Section 7-19.

7-18.3(6) INSPECTION AND TESTING

7-18.3(6)A INSPECTION

As specified in Section 7-18.3(2), side Sewer covered without Engineer inspection must be uncovered for inspection.

7-18.3(6)B TESTING

All newly installed side Sewer must be tested after backfill. Side Sewer that is reconstructed or repaired to a length of 10 feet or more must be tested for water tightness as specified in Section 7-17.3(3)B. No testing is required if:

1. A new reconstruction of side Sewer consisting of a single length of pipe.
2. An existing side Sewer reconnected to the Sewer or Storm Drain.

Testing must be performed in the presence of the Engineer as specified in Section 7-17.3(3).

All side Sewer constructed in conjunction with main Sewer or Storm Drain construction, for purposes of testing as specified in Section 7-17.3(3), must have a 6-inch tee fitting placed at the point where the side Sewer crosses the Right of Way margin as shown on Standard Plan 283. Position the tee opening perpendicular to the side Sewer slope.

When the new side Sewer is connected to a new main Sewer or Storm Drain installed under the same Contract, and the side Sewer is not tested simultaneously with the test of the main Sewer or Storm Drain, furnish and place an additional 6-inch tee in the first length of pipe out of the tee on the main Sewer or Storm Drain so that an inflatable rubber ball can be inserted for sealing off the side Sewer and thus allow separate side Sewer and mainline tests.

When the new side Sewer is connected to an existing main Sewer or Storm Drain, furnish and place 2 test tees as shown on Standard Plan 283 and as follows:

a. One immediately adjacent to the main Sewer or Storm Drain.
b. A second at the Right of Way margin.

The ends of side Sewer and test tee openings must be plugged water tight with Materials and by method acceptable to the Engineer.

Side Sewer installed with pipe extending beyond the Right of Way margin that includes other connection, such as runoff or downspout, and is associated with private construction under the inspection of SPU, is not part of the Contract, and may require testing of the entire side Sewer system including pipe in the Right of Way.

7-18.3(7) MISCELLANEOUS REQUIREMENTS

7-18.3(7)A PIPE AND CONNECTIONS – PRIVATE PROPERTY

Side Sewer in utility easement must be at least 6 inches inside diameter. Side Sewer and/or service drain on private property must be at least 4 inches inside diameter. Do not connect any roof drain, area drain, or subsurface drain to a side Sewer that is connected to a separate main line sanitary only Sewer.

Private property roof drains or service drains in areas of mainline combined Sewer must be run in a separate pipe, not combined with sewage, to the property line before connecting into the side Sewer.

7-18.3(7)B PROXIMITY TO OTHER UNDERGROUND FACILITIES

In private property, clearance between side Sewer and/or service drain and water supply lines must comply with Washington State Department of Health requirements and other applicable code and regulation.

In the Right of Way, side Sewer clearances are specified in Section 1-07.17(2).

7-18.3(7)C PLUGS

In the Right of Way, securely seal unused side Sewer openings with a water tight plug fastened in place. The only exception is private construction under permit from SPU and SDOT Street Use where unused side Sewer openings in private

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property and side Sewer openings in the Right of Way, must be closed with a water tight plug fastened in place as approved by SPU.

7-18.3(7)D SEPTIC TANKS AND CESSPOOLS – PRIVATE PROPERTY

Do not construct side Sewer through or adjacent to an existing cesspool or septic tank. If Job Site conditions prohibit any other location, abate the cesspool or septic tank by such means as the SPU inspector may direct.

7-18.3(8) RESTORATION, FINISHING, AND CLEANUP – PRIVATE CONSTRUCTION

Restoration, finishing, and cleanup due to private construction in Seattle's street Right of Way under Street Use permit and SPU permit, must comply with the Right-of-Way Opening and Restoration Rule.

7-18.3(9) EXTENDING SIDE SEWER INTO PRIVATE PROPERTY

Extending side Sewer into private property is not part of the Contract and will not be allowed. Unless authorized by Title 21 of the SMC, private property owners who wish to extend side Sewer into the Right of Way or connect with Sewer or Storm Drain, must do so under permit with SPU and SDOT Street Use.

7-18.3(10) END PIPE MARKER

At the Right of Way margin, bury a 4-foot long, 2" x 4 "stake to a 3-foot depth directly over the side Sewer. Paint the exposed 1 foot of stake traffic white, and paint the depth to the invert of the side Sewer from finish grade legibly and with black permanent ink (or other durable marking agent) on the exposed white portion of stake. Securely nail a 2" x 4 "cleat to the bottom of the stake to prevent withdrawal of the buried stake. In addition, attach a 12-gauge galvanized wire to the tee on the side Sewer, or to the plugged end of the side Sewer if no tee, and extending to 6 inches above finished grade at the stake. Do not attached the wire to the stake.

7-18.4 MEASUREMENT

Measurement for "Pipe, (Use), (Material), (Class), (Size)" will be to the nearest 0.10 feet along the pipe from the tee or wye of the main Sewer or Storm Drain through tees, wyes and other fittings to the Right of Way margin as shown on Standard Plan 010, or to the end of pipe when the Contract or Engineer requires.

Measurement for "Tee, Test, (Material), (Size)" will be per each.

Measurement for protective systems will be as specified in Section 2-07.4.

7-18.5 PAYMENT

1. **"Pipe**, **(Use), (Material), (Class), (Size)"**, per linear foot

The Bid Item price for "Pipe, (Use), (Material), (Class), (Size)", includes all costs for the Work required to furnish all Material and Supplies necessary to install the side Sewer pipe of the type specified, including, but not limited to, the following:

a. Trench excavation, haul, stockpiling, backfill, and compaction of suitable native Material
b. Removal and disposal of excess and/or unsuitable excavated native Material
c. Dewatering of the trench
d. Removal and disposal of existing side Sewer pipe encountered in required trench excavation and backfill
e. Temporary bypass of sewage, including pumping
f. Cleaning and testing
g. End pipe marker, plug, and balloon
h. Class D Bedding
i. Separate documentation per SMC 21 and applicable Director's Rules.

2. **"Tee**, **Test, (Material), (Size)"**, per each

The Bid Item price for "Tee, Test, (Material), (Size)" includes all costs for the work required to furnish, install, and remove as necessary the test tee.

3. **Other payment information**

Payment for protective systems will be as specified in Section 2-07.5.

Payment for "Tee, (Material), (Size)", for "Bedding, CDF, (Size) Pipe", and for "Bedding, (Class), (Size) Pipe" will be as specified in Section 7-17.5.

All cost associated with uncovering a side Sewer without Engineer inspection and all cost associated with re-constructing any portion of completed Work associated with the uncovering will be at the Contractor's sole expense and no separate or additional payment will be made.

Remove and reinstall side Sewer will be paid as "Pipe, (Use), (Material), (Class), (Size)".

No payment will be made for any expense associated with the Contractor installing an additional tee on the side Sewer and requiring separate tests for purposes of testing as specified in Section 7-18.3(6)B.

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All costs relating to construction in private property, and to private construction in Seattle's Right of Way under the jurisdiction of SPU and SDOT Street Use, is not part of the Contract and no separate or additional payment will be made.

SECTION 7-19 SEWER CLEANOUT

7-19.1 DESCRIPTION

Section 7-19 describes Work consisting of the construction of sanitary Sewer cleanouts per Standard Plan 280 and as specified in the Contract.

7-19.2 MATERIALS

All Materials incorporated into the total cleanout structure must comply with the requirements of the various applicable Sections of these Standard Specifications.

7-19.3 CONSTRUCTION REQUIREMENTS

Provide a clean out at locations shown on the Drawings. All cleanouts located in the Right of Way must be locking and must extend to finish grade.

Provide a cleanout on side Sewers for each total change of 90 degrees in grade or alignment. The spacing of cleanouts must not exceed 100 feet. No cleanout is required at the connection of the side Sewer to a riser on the public Sewer. A suitably located cleanout in the house piping or plumbing may be considered as a cleanout for the side Sewer. Cleanouts consist of a wye branch in the side Sewer.

7-19.4 MEASUREMENT

Measurement for "Sewer Cleanout, (Size)" will start at the wye branch and extend through the casting, as shown on Standard Plan 280.

7-19.5 PAYMENT

1. **"Sewer Cleanout, (Size)"**, per each

The Bid Item price per each for "Sewer Cleanout, (Size)" includes all costs for the work required for furnishing and installing the wye, Sewer pipe, pipe bands, pipe plug, casting, and concrete collar.

SECTION 7-20 ADJUSTMENT OF NEW AND EXISTING UTILITY STRUCTURES TO FINISH GRADE

7-20.1 DESCRIPTION

Section 7-20 describes Work consisting of adjusting new and existing maintenance holes, catch basins, inlets, valve chambers, water meter boxes, handholes, and similar utility Structures encountered during the Work to a new grade elevation. The Work includes adjustment by removing and installing adjustment brick, by removing or adding a vertical riser section to the utility Structure, by removing and rebuilding a portion of the existing Structure, or by any combination of the preceding methods.

The Contractor must adjust publicly owned utility Structures to finished grade. Privately owned utility agencies are responsible for all adjustments and relocations of their own facilities. Schedule the Work so utility adjustments by others can be accomplished without undue delay.

The requirements of Section 7-20 apply to utility Structures constructed from precast concrete sections, masonry brick or blocks, and cast in place concrete.

Reinforce concrete pavement around castings per Standard Plan 406 and Section 5-05.3(9).

7-20.2 MATERIALS

Material used in the adjustment of existing utility Structures must comply with the requirements for new construction specified in the Specification Section applicable to the item being adjusted.

7-20.3 CONSTRUCTION REQUIREMENTS

7-20.3(1) ADJUSTMENT OF MAINTENANCE HOLES, CATCH BASINS, AND SIMILAR STRUCTURES

7-20.3(1)A GENERAL

The Contractor must establish approximate grade elevation for the tops of existing utility Structures requiring adjustment as specified in Sections 1-05.4 and 1-05.5. Establish the final alignment and grade elevation from adjacent roadway surfaces, forms, or such offset hubs as may be provided by the Contractor as specified in Sections 1-05.4 and 1-05.5.

To meet the new grade elevation, remove the pavement around the casting; remove the casting and install or remove leveling or adjustment brick or block; or excavate around the utility Structure, remove a portion of it as necessary and rebuild the Structure. Minimize pavement removal to the amount required to facilitate the adjustment. Adjustment of drainage Structure to finished grade elevation, by whatever method, must result in a finished Structure meeting the requirements for new construction as specified in Sections 7-05.3(1)L, 7-05.3(2)C, or 7-05.3(2)D corresponding to Structure type. The overall distance between the top of the casting to the bottom of the adjustment brick must not exceed 26 inches.

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Where a publicly owned casting adjustment is required and a new casting is shown on the Drawings, the Contractor must furnish and install a new casting. When a new publicly-owned casting is not shown on the Drawings, the utility must have the opportunity to furnish a new casting for Contractor installation. The Contractor must schedule the Work so the public utility has a minimum 2 Days notice to provide castings. Fit the new casting to the existing frame and ground to rest evenly and without rocking. When adjustment is made by adding or removing leveling bricks, fill all joints in the bricks with mortar and seat the casting in mortar on the top brick course. When bricks are added, installation must be as shown on Standard Plan 220, running bond pattern.

After the utility Structure has been adjusted to grade, and the Structure made water tight by plastering with mortar cement, backfill and compact all voids around the Structure with imported Mineral Aggregate Type 17. Secure the casting in place with a tapered layer of concrete or asphalt, as applicable.

Adjust water meter boxes encountered in the planting strip and sidewalk area to finish grade.

Should adjustment to a water meter box require adjustment or relocation of the water meter, notify the Engineer at least 10 Working Days in advance and the water meter will be adjusted or relocated by SPU Water Operations. Then make final adjustment of the meter box.

Maintenance holes, catch basins, and similar Structures must be raised or lowered to match the finished roadway grade. Structures flush with to no more than 3/8 inch below the finished roadway grade will be accepted by the Engineer. All Structures in sidewalks, walkways and trails must be flush. Utility adjustments not within these tolerances as determined by the Engineer will be considered defective work as specified in Section 1-05.7.

7-20.3(1)B CEMENT CONCRETE PAVING PROJECTS

Maintenance holes, catch basins and similar Structures must be constructed or adjusted as specified in Section 7-20.3(1)A except that the final adjustment must be made and the cast iron frame set after the forms have been placed and checked. In placing the concrete pavement, do not change the position of the casting in any way.

All Standard Plan 230 and 361 castings for maintenance holes and valve chambers installed in and requiring new concrete pavement or rigid concrete base pavement must comply with the reinforcing requirements of Standard Plan 406 and Section 5-05.3(9).

See Section 7-20.3(1)C for temporary transition tapers around exposed castings.

7-20.3(1)C ASPHALT CONCRETE PAVING PROJECTS

Utility Structures requiring adjustment of frames to match finish grade must be adjusted before the start of the final paving operation.

The tops of existing utility Structure frames must be raised or lowered to match the finish grade. Immediately after adjustment of the frame to finish grade in lanes that are to remain open to traffic, install temporary asphalt or temporary pavement patch transition tapers around the Structure frame to prevent a nuisance to traffic. Maintain the asphalt tapers and furnish, install, and maintain warning signs and barricades as specified in Section 1-07.23 and Section 1-10. Remove the asphalt tapers immediately before the start of paving operations.

Inside surfaces of adjusted Structure frame and bricks or rings which are disturbed or damaged by the adjustment, as well as the new adjustment area, must be mortared to provide a smooth, water tight surface.

7-20.3(1)D ASPHALT RESURFACING PROJECTS

Adjustment of maintenance holes, catch basins, and similar Structures on asphalt resurfacing projects must comply with the requirements of Section 7-20.3(1)C.

7-20.3(2) ADJUSTMENT OF INLETS

Establish the final alignment and grade of frames for new and old inlets to be adjusted to grade from the forms or from adjacent pavement surfaces. Perform the final adjustment of the inlet frame as specified in Section 7-20.3(1)A and the adjacent roadway surface must have the Drainage Transition Zone per Standard Plan 260a.

On asphalt concrete paving projects using curbs and gutters, that portion of the frame not embedded in the gutter section must be solidly embedded in concrete. Extend the concrete a minimum of 6 inches beyond the edge of the frame and leave 1-1/2 inches below the top of the frame so the wearing course of asphalt concrete pavement butts against the frame. Paint the existing concrete pavement and edge of the casting with hot asphalt cement.

Make adjustments in the inlet structure frame and frame extension in the same manner and of the same Material as that required for new inlets. The inside of the inlet frame and frame extension must be plastered smooth.

7-20.3(3) ADJUSTMENT OF MONUMENTS, AND FRAME AND COVER

Adjust monuments and monument castings to grade as specified in Section 7-20.3(1)A.

7-20.3(4) ADJUSTMENT OF VALVE BOX CASTINGS

If an existing water valve box requires adjustment, it must be done by excavating the casting and vertically adjusting the top section of the valve box. The flange must be cast into surrounding pavement as shown on Standard Plan 315. Do not use ring extensions.

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7-20.3(5) FURNISHING CASTINGS

Where adjustment of existing utility Structures is required and the Drawings indicate that the existing castings be replaced, furnish new castings of the type specified on the Drawings. Casting includes frame and grate, or ring and cover unless the Contract specifies otherwise. Clean and deliver salvaged castings as specified in Section 2-02.3(7).

7-20.3(6) REPLACEMENT OF INLET GRATE

Furnish and install new grates where the Drawings show existing inlet grate replacement. Do not replace the inlet frame.

7-20.4 MEASUREMENT

Bid Items of Work completed under the Contract will be measured as specified in Section 1-09.1, unless otherwise provided for in this Section.

7-20.5 PAYMENT

1. **"Adjust Existing Maintenance Hole, Catch Basin or Valve Chamber"**, per each
2. **"Adjust Existing Inlet"**, per each
3. **"Adjust Existing Monument Frame and Cover"**, per each
4. **"Adjust Existing Valve Box"**, per each
5. **"Adjust Existing Handhole"**, per each

The Bid Item price for "Adjust Existing (Item)" includes all costs for the work required to adjust the existing utility casting from original grade elevation to finished grade elevation with or without removing or adding adjustment bricks.

6. **"Utility Casting, (Type)"**, per each

The Bid Item price for "Utility Casting, (Type)" includes the costs for all work required to furnish and install new castings of the type specified in the Contract when existing castings are to be replaced.

When a maintenance hole is required to be rebuilt to accommodate a new casting, the cost of the utility casting will be included in the price Bid for the Bid Item "Rebuild (Item)" per Section 7-05.5 where "item" is "maintenance hole".

7. **"Install Casting**, **Utility Furnished"**, per each

The Bid Item price for "Install Casting, Utility Furnished," includes all costs for the Work required to install and adjust to finished grade a casting provided by the utility owner.

8. **"Utility Casting**, **(Type), Grate"**, per each

The Bid Item price for "Utility Casting, (Type), Grate" includes all costs for the Work required to replace the inlet grate with specified grate. Costs do not include replacing the frame. If the Engineer determines that the existing frame must be replaced, the cost to replace the frame and grate will be paid as "Utility Casting, (Type)".

9. **"Utility Casting**, **(Type), Cover"**, per each

The Bid Item price for "Utility Casting, (Type), Cover" includes all costs for the Work required to replace the utility cover with specified cover. Costs do not include replacing the frame. If the Engineer determines that the existing frame must be replaced, the cost to replace the frame and cover will be paid as "Utility Casting, (Type)".

10. **"Install Grate/Cover**, **Utility Furnished"**, per each

The Bid Item price for "Grate/Cover, Utility Furnished," includes all costs for the Work required to replace the utility grate or cover provided by the utility owner.

11. **Other Payment Information**

Costs for adjustment to finish grade of water meter boxes except adjustment of the water meter itself; small castings except inlet, catch basin, maintenance hole, valve chamber, handhole, monument, and water valve box; hydrant valve castings; and private and other public utility castings requiring coordination with the private or public casting owner, will be included in the Bid Item prices for the applicable Bid Items and no separate payment will be made.

Mineral Aggregate ordered as backfill instead of native Material will be paid as "Mineral Aggregate, (Type)".

Restoration of the roadway surface is per the applicable Section covering the Work involved.

The costs for placement and removal of asphalt or cement concrete used to secure castings before paving are considered incidental to the Work and no separate payment will be made.

All Work required to adjust castings of all newly installed or rebuilt utility Structures to finished street grade is considered included in the Bid Item prices of the Bid Items for the appropriate type of utility Structure.

In asphalt resurfacing projects, as specified in Section 7-20.3(1)D, all costs to remove the asphalt concrete and/or concrete base will be considered included in the Bid Item price of the Bid Items of work for adjusting the specified Structures.

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SECTION 7-21 BIORETENTION

7-21.1 DESCRIPTION

Section 7-21 describes Work consisting of the installation of bioretention soil in bioretention cells intended to receive surface water runoff for infiltration.

7-21.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Material	Section
Bioretention Soil (Type)	Section 9-14.1(4)
Bioretention Polishing Layer Media	Section 9-14.1(8)
Impermeable Liner for Bioretention	Section 2-15
Mineral Aggregate	Section 9-03
Geotextile	Section 9-37
Arborist Wood Chip Mulch	Section 9-14.4(4)
Compost	Section 9-14.4(8)

Unless otherwise specified, geotextile must be nonwoven construction geotextile for separation.

Unless otherwise specified or shown on the Drawings, aggregates for the discharge subbase gravel must comply with the requirements of Mineral Aggregate Type 26.

Unless otherwise specified or shown on the Drawings, bioretention soil refers to bioretention soil, type 7030.

7-21.3 CONSTRUCTION REQUIREMENTS

7-21.3(1) GENERAL

For the construction of bioretention cells, wet weather, in addition to weather days as specified in Section 1-08.8(3)A, is defined as a precipitation event that may adversely impact green stormwater infrastructure installation work and quality. Generally, such events produce visible runoff from the proposed work surface and the adjacent area. Wet weather events as specified in this Section are specific to bioretention soil installation work and do not include work on other activities or locations. The Engineer will make the determination of wet weather days. If wet weather days impact the critical path, weather delays may be granted.

In addition to the requirements in Sections 1-07.15, Section 2-08, Section 2-09, and Section 8-01, water must not be allowed to enter the bioretention cell until all civil and landscaping work is completed and stabilized, as determined by the Engineer.

Bioretention soil must be protected from rainfall, surface runoff, and other sources of added moisture while stored off-site, in transit, and at the Project Site until incorporated into the Work. The requirements for bioretention soil in this Section also apply to bioretention polishing layer media.

Do not operate heavy equipment within the cell perimeter once bioretention cell excavation has begun, including during excavation, backfilling, tree pit preparation, mulching, or planting.

Do not dump Materials or substances except the bioretention soil within the cell area.

Relocation and/or adjustments of water meters is specified in Section 7-15 Water Service Connection Transfers.

When the Contract specifies testing by a Contractor provided testing laboratory, the laboratory must be a STA, AASHTO, ASTM or other standards organization, as designated in the Contract, accredited laboratory with current and maintained certification. The testing laboratory must be Capable of performing all tests to the standards specified, and must provide test results with an accompanying manufacturer's certificate of compliance.

7-21.3(1)A BIORETENTION FACILITY INSTALLATION PLAN

The Contractor must submit a Bioretention Facility Installation Plan in accordance with Section 1-05.3. The submittal must be approved by the Engineer prior to any ground disturbing work on Bioretention facilities. At a minimum, the plan must include the following:

1. Protection of facility subgrade and installed materials from weather, runoff into cell, erosion, siltation, and deleterious materials.
2. Detail of how materials will be placed and consolidated in the bioretention cell.
3. All major work activities will be identified and installation procedures described. Description of final grade preparation.
4. The sequence of work activities required to build a given cell or facility.

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7-21.3(2) BIORETENTION CELL CONSTRUCTION

Do not start bioretention cell grading or placement until all areas of the Project Site draining to the bioretention area have been stabilized and authorization is provided by Engineer.

Survey elevations of grading check points as shown on the Drawings. If surveyed elevations vary by more than 0.05 feet from the provided elevations, the Contractor must notify the Engineer.

7-21.3(2)A EXCAVATION

At the locations shown on the Drawings, excavate bioretention cells to the depth necessary to accommodate the placement of bioretention soil and, if applicable, bioretention polishing layer media and Mineral Aggregate, Type 26.

Excavation within 6 inches of final native soil grade is not permitted if the Project Site soil is frozen, has standing water, or has been subjected to more than 1/2 inch of precipitation within 48 hours.

Where shown on the Drawings, place construction geotextile for separation and impermeable liner for bioretention as specified in Section 2-15.

Provide the Engineer the opportunity to inspect the excavation at least 1 Working Day before placement of any Materials or subgrade soil scarification.

After excavation to subgrade, if any sediment laden runoff has entered the cell before placement of bioretention soil, bioretention polishing layer media, or Mineral Aggregate, Type 26, remove the sediment deposition by over-excavating the cell by 3-inch minimum, and place an additional 3 inches of bioretention soil, at no expense to the Owner.

7-21.3(2)B SUBGRADE

The Contractor must scarify the surfaces of the subgrade of bioretention cells prior to placement of any materials. For bioretention cells with a slope of 10 percent or less, scarify by ripping the soil to a depth of 4 inches with excavator teeth or other method approved by the Engineer. The scarification process must result in 90 percent or more of the subgrade surface being loosened.

For bioretention cells with a slope greater than 10 percent, scarify by ripping the soil to a depth of 2 inches with the excavator teeth or other method as approved by the Engineer. The scarification process must result in 70 percent or more of the subgrade surface being loosened.

The scarification requirements of Section 8-02 do not apply to engineered bioretention cells.

Where shown on the Drawings, place Mineral Aggregate for discharge subbase gravel in loose lifts and hand rake Mineral Aggregate to final grade.

If applicable, after placement of Mineral Aggregate for discharge subbase gravel, if any sediment laden runoff has entered the cell before placement of bioretention soil, remove the sediment deposition by excavating Mineral Aggregate in the cell by a 3-inch minimum and replace it with clean Mineral Aggregate at no expense to the Owner.

The requirements for bioretention soil in this Section also apply to bioretention polishing layer media.

Where shown on the Drawings, bioretention polishing layer media must be placed in loose lifts, hand raked and tamped to final grade. Should sediment laden runoff enter the cell before placement of bioretention soil, the Contractor must remove and replace all contaminated bioretention polishing layer media (3 inches minimum) and replace with clean bioretention polishing layer media at no expense to the Owner.

7-21.3(2)C PLACEMENT OF BIORETENTION SOIL

The bioretention soil used in each bioretention cell must be as specified in Section 9-14.

Do not place bioretention soil until the following conditions are met:

1. There is no standing water in the excavation.
2. No wet weather conditions exist, as determined by the Engineer.
3. Temporary grading or other barriers are in place to prevent surface runoff into the bioretention cell.

The requirements for bioretention soil in this Section also apply to bioretention polishing layer media.

7-21.3(2)C1 ACCEPTANCE OF MIX PRIOR TO PLACEMENT

The Contractor must submit the bioretention soil mix, including material test results as specified in Section 9-14.1(1)A, to the Engineer for approval before delivering the bioretention soil to the Project Site.

Do not place bioretention soil until the Engineer has inspected and approved the material, and confirmed that the delivery tickets show the full delivered amount of bioretention soil, matching the product type, volume, and manufacturer named in the submittals. The Owner may perform quality assurance testing on the delivered bioretention soil. Materials that do not conform to the requirements of the Contract must be removed and replaced as specified in Section 1-05.7.

One 2-gallon sample will be gathered by Engineer from the first 100 cubic yards delivered. One additional 2-gallon sample will be gathered from each subsequent 200 cubic yards delivered. The Engineer may arrange to gather additional samples at any interval. Each 2-gallon sample must be a composite of 6 subsamples gathered from all sides around the perimeter of the load. The Engineer may select any load for sampling. Samples must be packaged in sealed plastic bags, labeled with project name, date and time of delivery, source, and delivery ticket number.

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7-21.3(2)C2 MIX MOISTURE

If the Engineer determines that visible free water is present in the material, placement and consolidation is not allowed until visible free water is no longer present in the bioretention soil, or the moisture content of the material is tested and shown to be less than 25 percent per ASTM D2974, method A. Moisture content testing must be performed by the Contractor's provided test laboratory, as specified in Section 7-21.3(1). Cost for moisture content testing must be borne by the Contractor, at no expense to the Owner.

7-21.3(2)C3 CONDITIONS

Placing bioretention soil is not allowed if the area receiving bioretention soil is frozen, has standing water, is excessively wet or saturated, or has been subjected to more than 1/2 inch of precipitation within 48 hours before placement, unless approved otherwise by the Engineer.

7-21.3(2)C4 PLACEMENT

Place bioretention soil and bioretention polishing layer media loosely in even lifts no deeper than 6 inches on the underlying material in conformity with the lines, grades, depth, and typical cross-section shown on the Drawings or as established by the Engineer.Place the soil in lifts that are half the depth of the total bioretention soil depth. After each lift, rake the surface to a uniform grade, consolidate as specified in Section 7-21.3(2)C5, and rake again to scarify before placing subsequent lifts or planting.

7-21.3(2)C5 CONSOLIDATION

Final soil depth will be measured and verified only after the soil has been water consolidated per the approved installation plan. Consolidate the entire surface area of each lift by boot compaction, or using a method approved by Engineer. Final soil depth will be measured and verified only after the soil has been consolidated per the approved installation plan. Final soil depth must be 1 inch above the specified grade for each 1 foot of mix placed. After consolidation, if the soil is not at final grade, add additional soil to bring it up to final grade and rake.

7-21.3(2)C6 PLACEMENT AND CONSOLIDATION IN GRASS AREAS

Place bioretention soil specified for grass areas outside of cells in loose lifts. Compact bioretention soil to a relative compaction of 85 to 90 percent of modified maximum dry density, per ASTM D 1557, where slopes allow, as determined by the Engineer. Where bioretention soil is placed in the 2-foot road pavement shoulder or shoulder within 1 foot of the sidewalk, compact to a minimum relative compaction of 90 percent of modified maximum dry density, per ASTM D 1557. Final soil depth will be measured and verified only after the soil has been compacted.

7-21.3(2)C7 INSPECTION PRIOR TO MULCHING AND PLANTING

After placement of bioretention soil, notify the Engineer at least 1 Working Day in advance of planned mulching or planting. The Engineer will reject any lot, sub-lot, or representative area that is not as specified in Section 9-14.1(4). No payment will be made for the rejected materials and the Contractor must remove and replace the material at no cost to the Owner.

7-21.3(2)C8 HIGH PERFORMANCE BIORETENTION SOIL MEDIA (HPBSM) FLUSHING

All bioretention cells with high performance bioretention soil media (HPBSM) discharging to an underground injection control (UIC) well, including those called "drilled drains", must be flushed prior to receiving stormwater as follows:

1. If UIC wells downstream of HPBSM cell(s) are constructed with an offline bypass such as a valve or temporarily installed pipe plug, keep cell(s) in an offline state until the upstream HPBSM cell(s) has been flushed with potable water.
2. Contact the Engineer 72 hours prior to potable water flushing and provide the time, date and location of flushing so they may observe.
3. To flush the bioretention cells apply 50 gallons of clean potable water per square foot of cell bottom area uniformly across the cell and wait for all water to drain from the cells.
4. Water from potable water flushing that accumulates in the underdrains must be removed by a pump or other means so it does not enter the UIC well. Prepare any necessary pumps such that all water which exits the underdrain of the bioretention cell(s) is pumped around the downstream UIC well and discharged to the public storm drain system.
5. When directed by the Engineer, put the UIC well(s) online by either removing the pump or pipe plug or opening the valve.

7-21.3(2)D BIORETENTION CELL PROTECTION DURING WET WEATHER

If the bioretention soil placement is interrupted by wet weather, or when the bioretention soil is placed but the bioretention cells are not stabilized, the Contractor must cover the entire excavated area, including native soil and bioretention soil, with a temporary geotextile fabric as specified in Section 2-15. Geotextile must be appropriately ballasted to prevent the migration of fines in or into the excavation.

Any locations not temporarily stabilized require evaluation by the Engineer. Any construction activities compromised by the wet weather must be modified or replaced at no cost to the Owner.

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Failure to comply with these requirements may be grounds for complete removal of the constructed bioretention cell or bioretention cell components and replacement at no cost to the Owner.

7-21.3(2)E MULCHING AND PLANTING CONSTRUCTION REQUIREMENTS

The mulches within each bioretention cell must be as specified in Section 9-14.

Placement for the mulches and planting is not allowed until the following conditions are met:

1. The cell is dry and has not been subjected to more than 1/2 inch of precipitation within 48 hours.
2. Temporary grading or other barrier is in place to prevent surface runoff into the cell.

If the mulch placement is interrupted by wet weather or when the mulch is placed but the bioretention cells are not stabilized, the Contractor must cover the entire excavated area, including native soil and bioretention soil, with a temporary erosion control material to prevent the migration of fines in or into the cell.

Any locations not temporarily stabilized require evaluation by the Engineer. Any construction activities compromised by the wet weather must be modified or replaced at no cost to the Owner.

The cell must be planted and mulched as shown on the Drawings.

At least 1 Working Day before placement of compost or arborist wood chip mulch in each cell, as specified in the Drawing, notify the Engineer to inspect the bioretention cell. If any sediment laden runoff has entered the cell, remove the top 3 inches of bioretention soil and replace with bioretention soil per design, at no expense to the Owner.

The finished elevation must be 1 inch below walks, curbs, pavements and driveways, unless adjacent to a bermed area. Upon completion of finish grading Work, remove all excess Material from the Project Site and dispose of it accordingly.

7-21.4 MEASUREMENT

Measurement for “Bioretention Soil” will be by the ton or cubic yard

Measurement for “Mineral Aggregate (type)” for discharge subbase gravel will be by the ton or cubic yard.

7-21.5 PAYMENT

1. **"Bioretention Soil "**, per ton or cubic yard

The Bid Item price for "Bioretention Soil" includes all costs for the work necessary to furnish, place, compact, grade, shape, and mix bioretention soil.

2. **“Common Excavation”**, per ton or cubic yard as specified in Section 2-04
3. **“Mineral Aggregate (type)”**, per ton or cubic yard as specified in Section 4-01
4. **“Construction Geotextile for Separation”**, per square yard as specified in Section 2-15

No separate payment will be made for finish grading work required to hand grade bioretention cells and earth berms to final shape as specified.

END OF DIVISION

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DIVISION 8 MISCELLANEOUS CONSTRUCTION

SECTION 8-01 CONSTRUCTION STORMWATER POLLUTION PREVENTION

8-01.1 DESCRIPTION

Section 8-01 describes furnishing, installing, maintaining, removing, and disposing of construction stormwater and erosion controls, tree, vegetation and soil protection, and pollutant prevention and countermeasures. These controls must prevent erosion and scour, treat sediment laden water for acceptable discharge, and prevent conveyance of pollutants and sediment into surface waters, drainage systems, and environmentally critical areas.

The CSECP, the TVSPP, the SP and the TDP described in this Section must apply BMPs that contain elements to protect water quality and downstream resources.

8-01.2 MATERIALS

Materials must comply with the following Sections:

Material	Section
Riprap and Quarry Spall	Section 9-13
Erosion Control Materials	Section 9-14
Geotextile	Section 9-37

Unless the Contract specifies otherwise, erosion control geotextile must be permanent erosion control, high survivability.

8-01.3 CONSTRUCTION REQUIREMENTS

8-01.3(1) GENERAL

Work involving construction stormwater pollution prevention within The City of Seattle limits must comply with this Section and Sections 1-05.13(3), 1-07.15 and 1-07.5. Work involving erosion and sedimentation control not within the City of Seattle limits must also comply with the provisions of the local jurisdiction.

If applicable, SWPPP provisions of a National Pollutant Discharge Elimination System (NPDES) construction permit, local jurisdiction, or both, must be addressed in the CSECP and the TDP.

The Contractor's Work and Project Site conditions must ensure elements are in place to protect water quality and to protect downstream resources. These elements must cover aspects of general water quality protection strategies consisting of: limiting Project Site impacts, protecting the public drainage system and water bodies, preventing erosion and sedimentation, protecting the infiltration rate of soils, and managing activities and potential pollutant sources.

The elements of water quality and downstream resource protection are:

1. Define and field identify clearing limits and environmentally critical areas (CSECP & TVSPP).
2. Keep top layer of soil (TVSPP).
3. Establish construction access (CSECP).
4. Protect downstream properties and receiving waters (CSECP & TDP).
5. Prevent erosion and sediment transport from the Job Site (CSECP).
6. Prevent erosion and sediment transport from the Job Site by vehicles. (CSECP).
7. Stabilize soils (CSECP).
8. Protect slopes (CSECP).
9. Protect Storm Drains and ditches (CSECP).
10. Stabilize channels and outlets (CSECP).
11. Control pollutants (CSECP, TDP, SP & others as applicable).
12. Control dewatering (CSECP & TDP).
13. Maintain BMPs (ALL).
14. Inspect BMPs (ALL).
15. Execute construction stormwater pollution prevention plans (ALL).
16. Minimize open trenches (CSECP).
17. Phase the project (ALL; must also be shown on CPM Schedule, see Section 1-08.3).
18. Install permanent flow control and water quality facilities.
19. Protect infiltrative stormwater BMPs (CSECP & TVSPP).

To the degree possible, the Contractor must coordinate this temporary work with permanent drainage and erosion control work the Contract requires. The Engineer may require additional temporary control measures if it appears pollution or erosion

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may result from weather, the nature of the Materials, or progress on the Work. The Engineer may also require erosion control work to be done with or immediately after grading. Sediment control devices and BMPs must be installed before any ground disturbing activity.

8-01.3(2) CONSTRUCTION STORMWATER POLLUTION PREVENTION SUBMITTALS

Required submittals for Construction Stormwater Pollution Prevention are:

1. Construction Stormwater and Erosion Control Plan (CSECP)
2. Tree, Vegetation, and Soil Protection Plan (TVSPP)
3. Spill Plan (SP)
4. Temporary Discharge Plan (TDP)

The submittals described in this Section must be submitted as individual plans for review by the Engineer. Updates, phasing and locations must be coordinated between all plans. Allow 10 Working Days for review of the CSECP, the TVSPP, the SP, and the TDP as specified in Section 1-05.3.

8-01.3(2)A CONSTRUCTION STORMWATER AND EROSION CONTROL PLAN (CSECP)

The construction stormwater pollution prevention submittals must include a CSECP. When a conceptual CSECP has been developed by the Engineer and included in the Contract, the Contractor must consider these Drawings for information only unless details or Drawing contain elements noted as “required.” The Contractor may propose alternative, change, or adopt the Engineer’s conceptual CSECP elements to reflect the Contractor’s means and methods. The Contractor’s means and methods must comply with any required elements in the Engineer’s CSECP.

If a conceptual CSECP does not exist in the Contract, the Contractor must develop all elements of the CSECP.

Refer to SPU Director’s Rule DWW-200, Volume 2, Construction Stormwater Control of the Stormwater Manual for guidance on the CSECP. Checklists for Selecting Construction BMPs are included in this manual. The Contractor must provide a schedule for CSECP implementation, including installation, maintenance, phasing and removal of each control and incorporate it into the Contractor’s CPM Schedule, see Section 1-08.3.

The CSECP must cover all areas of the Contractor’s Work and may affect areas outside of the Project Site limits, including disposal sites, haul roads, all nearby property, streams, and other bodies of water).

The CSECP submittal must:

1. Describe with Shop Drawings of sufficient scale and detail and showing the Project Site, the locations and types of temporary erosion and sediment controls.
2. As necessary, show by a series of time sequence Shop Drawings, how construction stormwater and erosion control BMPs are to be installed, maintained, removed and coordinated with the Work and the CPM Schedule. Describe how non-work areas will be identified and protected.
3. Describe how stormwater from non-work areas will be kept separate from stormwater in the work area.
4. Describe the details and continuing maintenance of entrance and exit equipment wash areas.
5. Show locations of existing inlets and catch basins within 500 feet downslope of the Work, and describe how they will be protected.
    a. Show locations of existing surface waters and natural or vegetated buffers to be maintained.
6. When stormwater is to be concentrated and collected, show locations with cross-sections as applicable and describe control details of proposed ditch, berm, culvert, pipe, sediment basin, basin outfall, scour control, inlet, catch basin, drain, bypass, subsurface drain and related features and coordinate with the TDP.
7. Show how areas designated for vegetation, rain gardens, infiltrating bioretention, pervious concrete, and existing vegetation to remain, as shown on the Drawings, will be protected from collected stormwater. If detention of collected stormwater is proposed in any of these locations, describe the proposed restoration of the underlying soils.
8. Describe locations, protections, and covering practices for stockpile, muck, and related deposits.
9. Describe the controls to prevent sediment, debris, and other pollutants from entering surface waters and drainage features.
10. Provide manufacturer’s certificate of compliance, certified laboratory test reports, catalog cuts, samples, and other information providing adequate description of Supplies and Material proposed for Construction Stormwater and Erosion Control applications.
11. Provide the name of the Certified Erosion and Sediment Control Lead (CESCL), or Certified Professional in Erosion and Sediment Control (CPESC), including contact information. If the work is of such a magnitude that it requires additional help, describe the qualifications of additional help, any on-site training that may be necessary, and frequency and type of reporting to the CESCL.
12. Include a schedule of typical inspections ensuring timely maintenance and repair of erosion control BMPs; minimum once per week and within 24 hours of a significant precipitation event.
13. Identify and provide timelines for submitting permit required or related documentation; may reference submittal control document, see Section 1-05.3.

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14. Provide details of seed mix, amendment, mulch, and protections for placing and establishing temporary seeded erosion control areas.

15. In areas where exposed erodible soil exceeds 4000 square feet or may be unprotected for more than 2 Calendar Days, describe the controls and the proposed monitoring to ensure runoff from the Job Site remains compliant.

16. Identify the method for collecting, containing, removing, and properly disposing washout of concrete trucks and concrete handling equipment. Concrete washout is not permitted onto the ground, including formed areas awaiting concrete, unless approved by the Engineer.

17. Provide details of other construction stormwater and erosion control measures that may be used in the Work.

The Contractor must provide at a designated location at the Project Site the current (or copies of the current) CSECP.

8-01.3(2)B TREE, VEGETATION AND SOIL PROTECTION PLAN (TVSPP)

The construction stormwater pollution prevention submittals must include a TVSPP.

The Contractor must develop a TVSPP for the specific Project Site. The TVSPP must be accepted by the Engineer before any mobilization occurs at the Project Site. Alteration of protective measures described in the TVSPP must be approved by the Engineer.

The TVSPP must show the location of BMPs used to protect existing trees (not designated for removal), vegetation, and soil for the duration of the Contract. The TVSPP may be submitted in phases when specified or approved by the Engineer. The Contractor must maintain and regularly update the TVSPP submittal as necessary to document site conditions and show required BMPs.

The Contractor's schedule for installation of protective measures must be shown in the Critical Path Schedule and applicable weekly look-ahead schedules. Locations, extent, and type of BMPs must be approved by the Engineer during a joint field review with the Contractor. Conflicts between protection measures and Work required under the Contract must be brought to the attention of the Engineer during the joint field review and during weekly project meetings.

Trees, vegetation, soil, and other areas to be protected may include any of the following:

1. Trees identified by the note "Protect Trees" on the Drawings or trees not identified for removal where Zone B (see Standard Plan 133) is within the construction limits.

2. Vegetation identified by the note "Protect Landscaping" on the Drawings or vegetation identified for protection during the TVSPP joint field review.

3. Soil and existing tree and vegetation roots in areas identified by the note "Do Not Disturb" on the Drawings.

4. Tree roots encountered during excavation, except when the roots are less than 2 inches in diameter and are within roadway surfacing section, driveway surfacing section, sidewalk surfacing section, utility prisms, and within 1-foot of improvement structures geometrics (such as retaining walls, bridge abutments, and pole foundations.) A utility prism is the volume centered about the utility equal to the trench width in both vertical and horizontal dimensions. Utility prisms are not defined for conduit or for trenchless construction methods.

5. Areas marked "Pervious Concrete" on the Drawings.

6. Areas marked "Rain Garden" or "Bioretention" on the Drawings.

7. Other areas to be protected as directed by the Engineer during the joint field review and as documented in the approved TVSPP.

Storage of equipment or materials is not allowed within the areas marked on the Drawings as "Do Not Disturb" or within the Zone B of a tree unless BMPs per the approved TVSPP are in place. BMPs for approved storage within Zone B or areas marked as "Do Not Disturb" must be at a minimum 1-inch steel plate or 4-inch-thick timber planking over 2 to 3 inches of AWCM, or a minimum 3/4-inch plywood over 6 to 8 inches of AWCM.

For protection of trees, as specified in item 1. above, the TVSPP must address the following protective measures unless otherwise approved by the Engineer in writing:

a. Where construction operations are within the limits of Zone B for a duration of more than 30 Calendar Days, protect trees in unpaved planting strips or in tree pits per Standard Plan 132a.

b. Where construction operations are within the limits of Zone B for a duration of 30 Calendar Days or less, protect trees in tree pits per Standard Plan 132b. The temporary tree protection fence must surround the entire tree pit area and be anchored and maintained in a stable upright condition.

c. Where excavation will occur within the limits of Zone B, show the limits of each excavation location and review the excavation method with the Engineer during the joint field review. Within Zone B, excavation methods may include tunneling, air spade or hand digging to minimize root damage. The method of excavation must allow for all roots 2 inches and larger in diameter to be protected. Where roots 2 inches in diameter and larger are discovered, the Contractor must promptly notify the Engineer. If allowed, root pruning must be as specified in Section 8-02.3(7)A.

For protection of soil conditions and existing roots, as specified in items 3. and 4. above, the TVSPP must include the following specific protective measures to prevent damage to existing soils and roots during all construction activities within Zone B:

1) Double-layered burlap cover for all newly exposed soil and/or roots and daily watering for exposure of 5 Working Days or less.

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2) 6 inches of AWCM cover for all newly exposed soil and/or roots and twice weekly watering to protect soil from compaction, retain soil moisture, and control erosion.

3) Temporary or chain link construction fencing enclosing all newly exposed soil and/or roots associated with trees and other vegetation beyond the construction limits.

For protection of pervious concrete sidewalks and pavements, as specified in item 5. above, following the removal of any existing pavement, a Standard Plan 132b enclosure must surround the entire area where pavement was removed, and the enclosure must be anchored and maintained in a stable upright condition.

For protection of rain gardens or bioretention areas, as specified in item 6. above, and where construction operations abut, impact, or are within the limits of rain gardens or bioretention areas for a duration of more than 30 Calendar Days, protection per Standard Plan 132a, surrounding the entire area as shown on the Drawings is required. Where construction operations are within the limits shown on the Drawings for a duration of 30 Calendar Days or less, a Standard Plan 132b enclosure must surround the entire area and be anchored and maintained in a stable upright condition.

The TVSPP must also address the following general protective measures unless otherwise approved by the Engineer in writing:

a) If canopy/clearance pruning is required to perform the Work within standard vertical clearances, the Contractor must notify the Engineer at the TVSPP joint field review, or at least 15 Working Days in advance to allow pruning by the Owner or private property owner. The Engineer may require that this canopy/clearance pruning be performed by the Contractor as specified in Section 1-04.3. Standard vertical clearances are 14 feet for roadway, 10 feet for bicycle paths, 8 feet for sidewalks, and as specified in the Contract.

b) Pruning of canopy for construction clearance above standard vertical clearances is not allowed unless no alternative options, such as temporary tie-up of low limbs or alternative construction methods, are feasible, as determined by the Engineer.

c) Where canopy/clearance pruning above standard vertical clearances is approved by the Engineer, the Contractor is responsible for this pruning and all associated costs.

d) If the Contractor performs canopy/clearance pruning, the Work must be done by a registered Tree Service Provider with a current registration on file with SDOT Urban Forestry, and the pruning work must be performed by technicians with current ISA certification. See Section 8-02.3(7)A for pruning specifications. When pruning is necessary to perform the work and the pruning is not identified and brought to the attention of the Engineer during the TVSPP joint field review, the Contractor must submit a canopy/clearance plan for approval by the Engineer. The canopy/clearance plan must include the current registration and ISA certification as an addendum to the TVSPP. A separate TVSPP-canopy/clearance pruning submittal must be submitted at least 5 Working Days in advance as specified in Section 1-05.3. If pruning is performed at both the Owner's and Contractor's cost as described here within, the cost will be prorated.

e) Where construction activity involves the operation of equipment or redirection of traffic from established travel lanes into Zone B of trees within or overhanging the Right Of Way, the Contractor must depict these conditions on the TVSPP.

f) Protective measures installed over grass, groundcover, or vegetation to be preserved must be removed in a timely manner to minimize impacts to plant health.

g) Soil management/protective measures must include eradication of ivy and other invasive weed species before placement of AWCM in areas to be protected from disturbance.

h) Excavation or tunneling of any kind within the Critical Root Zone (Zone A) of a tree requires approval by the Engineer. The Contractor must provide at least 2 Working Days advance written notice for review and must not proceed without field inspection and approval.

i) Excavation excluded from specific protective measures but within Zone B of a tree must be performed with care to minimize damage to roots. In all excavations, if roots 2 inches and larger are encountered, the excavation at the root location must stop and the Contractor must promptly notify the Engineer. If root pruning is required, see Section 8-02.3(7)A for pruning cuts and methods.

j) Protect trees from exhaust heat. Exhaust deflection panels may be required on some equipment to prevent burning of foliage and branches of trees to be protected.

See Standard Plans 132a and 132b for additional tree protection guidance. See Standard Plan 133 for a description of tree root Zones A, B, and C.

8-01.3(2)C SPILL PLAN

The construction stormwater pollution prevention submittals must include a SP.

As specified in Section 1-07.15(1) and applicable laws, the Contractor must prepare a project specific construction prevention, control and countermeasures SP to be used for the duration of the project. The Contractor must implement, maintain and regularly update the SP, including all materials, equipment, and labor to be used for the duration of the project.

The SP must be approved by the Engineer before the commencement of any Project Site construction activities. The Contractor must maintain a copy of the SP at the Project Site, including any necessary updates as the Work progresses.

The Contractor must update the SP throughout project construction so that the written plan reflects actual Project Site conditions and practices. The Contractor must update the SP at least annually. All project employees must be trained in spill

prevention and containment, and must know where the SP and spill response kits are located and have immediate access to them.

If hazardous materials are encountered or spilled during construction, the Contractor must do everything possible to control and contain the material until appropriate measures can be taken. The Contractor must supply and maintain spill response kits of appropriate size within close proximity to hazardous materials and equipment.

The Contractor must implement the spill prevention measures identified in the SP before performing any of the following: placing materials or equipment in staging or storage areas; refueling, washing, or maintaining equipment; or stockpilings.

The SP must set forth the following information in the following order:

1. Responsible Personnel: Identify the name, title, and contact information for the personnel responsible for implementing and updating the plan, including the Spill Prevention and Response lead (per 1-05.13(3)C) and all spill responders.
2. Spill Reporting: List the names and telephone numbers of the federal, state, and local agencies the Contractor must notify in the event of a spill. The Contractor must also notify the Engineer.
3. Project Site Information: Describe the following items:
    a. The project scope of work;
    b. The Project Site location and boundaries;
    c. The drainage pathways from the Project Site; and
    d. Nearby waterways and sensitive areas and their distances from the Project Site.
4. Potential Spill Sources: Describe each of the following for all potentially hazardous materials brought or generated on-site, including materials used for equipment operation, refueling, maintenance, or cleaning:
    a. Name of material and its intended use;
    b. Estimated maximum quantity on-site at any one time;
    c. Locations (including any equipment used below the ordinary high water line) where the material will be staged, used, and stored and the distance from nearby waterways and sensitive areas;
    d. Decontamination location and procedure for equipment that comes into contact with the material; and
    e. Disposal procedures.
5. Pre-Existing Contamination: Describe any pre-existing contamination and contaminant sources (such as buried pipes or tanks) in the project area that are described in the Contract documents. Identify equipment and work practices that will be used to prevent the release of contamination.
6. Spill Prevention and Response Training: Describe how and when all personnel (including refueling contractors and Subcontractors) will be trained in spill prevention, containment and response per the Spill Plan. Describe how and when all spill responders will be trained per WAC 296-824.
7. Spill Prevention: Describe the following items:
    a. Spill response kit contents and location;
    b. Security measures for potential spill sources;
    c. Secondary containment practices and structures for hazardous materials;
    d. Methods used to prevent stormwater from contacting hazardous materials;
    e. Site inspection procedures and frequency;
    f. Equipment and structure maintenance practices;
    g. Daily inspection and cleanup procedures that ensure all equipment used below the ordinary high water line is free of all external petroleum based products; and
    h. Refueling procedures for equipment that cannot be moved from below the ordinary high water line.
8. Spill Response: Outline the response procedures the Contractor will follow for each scenario listed below. Include a description of the actions the Contractor will take and the specific, on-site, spill response equipment that will be used to assess the spill, secure the area, contain and eliminate the spill source, and clean up and dispose of spilled and Contaminated Material.
    a. A spill of each type of hazardous material at each location identified in 4, above.
    b. Stormwater that has come into contact with hazardous materials.
    c. A release or spill of any pre-existing contamination and contaminant source described in 5, above.
    d. A release or spill of any unknown pre-existing contamination and contaminant sources (such as buried pipes or tanks) encountered during project work.
    e. A spill occurring during work with equipment used below the ordinary high water line (if applicable).

    If the Contractor will use a Subcontractor for spill response, provide contact information for the Subcontractor under item 1. (above), identify when the Subcontractor will be used, and describe actions the Contractor must take while waiting for the Subcontractor to respond.

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9. Project Site Map: Provide a map showing the following items:
    a. Site location and boundaries;
    b. Site access roads;
    c. Drainage pathways from the site;
    d. Nearby waterways and sensitive areas;
    e. Hazardous materials, equipment, and decontamination areas identified in 4, above;
    f. Pre-existing contamination or contaminant sources described in 5, above; and
    g. Spill prevention and response equipment described in 7 and 8, above.
10. Spill Report Forms: Provide a copy of the spill report forms that the Contractor will use to record the release and cleanup.

An environmental spill is considered a release of contaminant or any material that may be hazardous, or dangerous, or harmful to the environment. In addition to the specifications in Section 1-07.5(2), the Contractor must take precautions to assure that contaminants are under control and prevented from release. Contaminants anticipated for use in performing the Work (such as fuel, hydraulic oil, asphalt sealer, pesticide, lubricant, and paint) must be stored, handled, transported, used, and disposed of per each product's Material Safety Data Sheet (MSDS), manufacturer's recommendations, and applicable law, code, and regulation. Equipment (such as valves, pumps, and switches) and Supplies (such as hose, containers, and connections) must be maintained at all times in good operating condition, leak proof, and must be routinely inspected for leaks and releases, and immediately repaired or replaced when needed. MSDS information for each potential contaminant at the Project Site must be maintained on the Project Site in a location that is readily accessible.

Should an environmental spill occur, the Contractor must immediately contain the spill and must make the notifications specified in Section 1-07.28, and as described in the Contractor's approved SP. This contact information must be posted using the Emergency Response for the SP form. The form must be provided on request.

In addition to immediate verbal notification, the Contractor must submit written documentation (spill report) for all releases of hazardous material to the Engineer within 24 hours of initial discovery of the release. The Contractor must submit a written update of the spill report, including documentation of the response and cleanup of the release, to the Engineer within 5 Business Days of completion of the cleanup.

In addition, the Contractor must comply with any instruction provided by the Engineer or any agency having the authority to direct cleanup activities at the Project Site.

8-01.3(2)D TEMPORARY DISCHARGE PLAN

The construction stormwater pollution prevention submittals must include a TDP.

The Contractor must develop, implement, maintain and regularly update a Project Site specific TDP. The TDP must include all materials, equipment, and labor to be used, for the duration of the project for water management per all Owner provided and Contractor obtained permits that identify flow rates, quantity and quality controls of concentrated and collected temporary discharges of groundwater, and process water and stormwater to the drainage and Sewer system (or land, if applicable). See related Sections 1-05.13(3), 1-07.6, and dewatering Specifications.

The TDP must incorporate requirements limiting flow rate, quantity and quality of the proposed discharge, record keeping and reporting to comply with the most restrictive of the following (if applicable):

1. A National Pollutant Discharge Elimination System (NPDES) construction permit;
2. A King County Industrial Discharge permit;
3. Side Sewer permit for Temporary Discharge; and
4. Other applicable permits.

The TDP must include:

a. A schematic flow diagram from collection or generation of water to an approved point of discharge at the drainage and Sewer system that includes any detention, settling, or treatment, flow restrictions, measurement equipment and location, quality sampling equipment and location.
b. Site layout drawing showing the above, which may be incorporated into the CSECP described in 8-01.3(2)A.
c. Description of any weather related permit restrictions and the Contractor's planned response.
d. Description of all flow measuring equipment and any manufacturer recommended calibration and maintenance (if applicable).
e. Sample measurement report and a schedule for recording and reporting all flow measurements (if applicable).
f. Description of all sampling and measuring equipment for turbidity, total settleable solids, chlorine and pH and manufacturer recommended calibration and maintenance.
g. Description of sampling equipment and procedures for all other pollutants that will be sent to an approved Laboratory (if applicable).
h. Sample discharge quality report and a schedule for recording and reporting all quality measurements (if applicable).

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8-01.3(2)D1 SHAFT DRILLING SLURRY WASTEWATER

Do not discharge shaft drilling slurry wastewater to surface waters of the State. The sediment and liquid portions of the shaft drilling slurry wastewater must not contain visible of smellable contamination.

Water-only shaft drilling slurry or water slurry with approved flocculants may be infiltrated on-site. Flocculants used must meet the requirements of Section 9-14.19 or must be chitosan products listed as General Use Level Designation (GULD) on the Department of Ecology's stormwater treatment technologies webpage for construction treatment. Infiltration is permitted if the following requirements are met:

1. Wastewater must have a pH of 6.5 – 8.5 prior to discharge.
2. The amount of flocculant added to the slurry must be kept to the minimum needed to adequately settle out solids. The flocculant must be thoroughly mixed into the slurry.
3. The slurry removed from the shaft must be contained in a leak proof cell or tank for a minimum of 3 hours.
4. The infiltration rate must be reduced if needed to prevent wastewater from leaving the infiltration location. The infiltration site must be monitored regularly during infiltration activity. All wastewater discharged to the ground must fully infiltrate and discharges must stop before the end of each work day
5. Drilling spoils and settled sediments remaining in the containment cell or tank must be disposed of as specified in Section 6-12.3(4)F.
6. Infiltration locations must be in upland areas at least 150 feet away from surface waters, wells, on-site sewage systems, aquifer sensitive recharge areas, sole source aquifers, well head protection areas, and must be marked on the plan sheets before the infiltration activity begins.
7. Prior to infiltration, the Contractor must submit a Shaft Drilling Slurry Wastewater Management and Infiltration Plan as a Structural Shop Drawing. This Plan must be kept onsite, adapted if needed to meet the construction requirements, and updated to reflect what is being done in the field. The submittal must include, at a minimum, the following information:
    a. Plan sheet showing the proposed infiltration location and all surface waters, wells, on-site sewage systems, aquifer-sensitive recharge areas, sole source aquifers, and well-head protection areas within 150 feet.
    b. The proposed elevation of soil surface receiving the wastewater for infiltration and the anticipated phreatic surface (i.e., saturated soil).
    c. The source of the water used to produce the slurry.
    d. The estimated total volume of wastewater to be infiltrated.
    e. The approved flocculant to be used, if any.
    f. The controls or methods used to prevent surface wastewater runoff from leaving the infiltration location.
    g. The strategy for removing slurry wastewater from the shaft and containing the slurry wastewater once it has been removed from the shaft.
    h. The strategy for monitoring infiltration activity and adapting methods to ensure compliance.
    i. A contingency plan that can be implemented immediately if it becomes evident that the controls in place or methods being used are not adequate.
    j. The strategy for cleaning up the infiltration location after the infiltration activity is done. Cleanup must include stabilizing any loose sediment on the surface within the infiltration area generated as a byproduct of suspended solids in the infiltrated wastewater or soil disturbance associated with BMP placement and removal.

Shaft drilling mineral slurry, synthetic slurry, or slurry with polymer additives not allowed for infiltration must be contained and disposed of by the Contractor at an approved disposal facility as specified in Section 1-07.3. Spoils that have come into contact with mineral slurry must be disposed of as specified in Section 6-12.3(4)F.

8-01.3(2)E DEWATERING PLAN

The construction stormwater pollution prevention submittals may include a Dewatering Plan per Section 2-08.3.

8-01.3(3) MAINTAINING CSECP AND TVSPP CURRENT

During the course of the Work, the Engineer may require the Contractor and Construction Stormwater Pollution Prevention Coordinator and the Tree, Vegetation and Soil Protection lead, see Section 1-05.13(3), to discuss with the Engineer the status of the CSECP and the TVSPP controls in-progress and future controls as they relate to the Work, to the progress schedule, to permits, to Change Orders, and as may be required in the Contract.

Significant addition of work, the encountering of unexpected ground water, the occurrence of a slide, or changes in the Contractor's method of operation may require significant modifications to the CSECP or TVSPP. When revisions to the current CSECP or TVSPP are required, the Contractor and applicable leads must update the CSECP, TVSPP, or both and must submit the updated plans to the Engineer within 5 Working Days unless the Engineer agrees to other arrangements.

The Contractor's CESCL and TVSPP lead must verify all BMPs are being followed at least once every calendar week and within 24-hours of runoff events in which stormwater discharges from the site. Inspections of temporarily stabilized, inactive sites may be reduced to once every calendar month. The Construction Stormwater Pollution Prevention Inspection

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Form must be completed for each inspection and a copy must be submitted to the Engineer before the end of the next Working Day following the inspection. Separate inspection may be performed and submitted for the CSECP and the TVSPP.

8-01.3(4) AUTHORITY OF CONSTRUCTION STORMWATER POLLUTION PREVENTION COORDINATOR

See Section 1-05.13(3).

8-01.3(5) EROSION CONTROL SEEDING

8-01.3(5)A GENERAL

The application of seed, fertilizer, lime, mulch, tackifier, and other amendments must be as specified in Section 8-02, as may be required in the Contract, and as described in the construction stormwater pollution prevention submittals.

Where the application of erosion control seeding is within, near, or may contribute to runoff entering into streams, surface waters, and environmental critical areas, all fertilizers must be a slow release formulation.

8-01.3(5)B CULTIVATION

Soil surfaces disturbed, compacted or exposed to erosion must be prepared before seeding by cultivation to incorporate amendments to produce an 8-inch minimum depth of homogeneous mixture containing 5 percent organic matter suitable for seeding, see Section 8-02.

Clearing, grubbing, grading, removal of debris and delineation of areas to be excluded from cultivation must be completed by the Contractor and inspected by the Engineer before cultivation. Exposed soil surfaces within areas excluded from cultivation must be top-dressed with 1 inch of amended soil for seeding or mulched as directed by the Engineer.

Cultivating may be by rototiller, farm disc, harrow, or other equipment approved by the Engineer.

On slopes or grades, cultivating must follow the contours or be done at right angles to the natural flow of water. Where the slope grade is relatively steep, including but not limited to areas identified as Environmentally Critical Areas, the Contractor must submit a cultivating plan to the Engineer for review at least 2 Working Days in advance. When near streams and other bodies of water, including but not limited to Environmentally Critical Areas, designated Wetlands, Wildlife Corridors, and Fish and Wildlife Habitat Conservation Areas cultivating must be done reasonably parallel to the water bodies' boundaries and must gradually transition with distance from the water to slope or grade cultivating.

Cultivation within the drip line of existing trees, shown as "Zone B" on Standard Plan 133, is excluded from areas unless otherwise directed by the Engineer.

8-01.3(5)C COMPACTION

After cultivation and before seeding, cultivated areas must be compacted for a depth of 4 inches to not less than 80 percent and not more than 85 percent as maximum dry density, as determined by the method specified in Section 2-11.

On slopes, and as the grade may permit, equipment must make a series of passes that compact parallel strips following the contour. Where parallel to the contour sequencing of compaction cannot be accomplished, the Contractor must follow the contour to the maximum extent feasible.

Soil to be seeded that is adjacent to curb, sidewalk, driveway, walking path, pavement, and other improved surface for pedestrian or vehicular traffic, must be at least 1 inch below the finished grade of the improved surface.

8-01.3(5)D SEEDING

Unless the Contract specifies otherwise, areas must be seeded immediately following cultivation and compaction.

Seeding, fertilizing, and mulching must be performed at times when environmental conditions are conducive to satisfactory growth. Do not seed during windy weather that would interfere with uniform distribution of seed or mulch, when the ground is frozen, or when the ground is excessively wet or dry as determined by the Engineer. If environmental conditions are not conducive to satisfactory growth, the Contractor must install an alternative cover method until environmental conditions improve.

Seed of the mix type specified must be placed at the rate of application for the seed mix as specified in Section 9-14.2, unless otherwise specified.

The application of seed, fertilizer, mulch, and other identified amendment in the construction stormwater pollution prevention submittals must be a single operation for all seed applications. Seeding must be applied by the following methods, as applicable:

1. Hydroseeding: A hydroseeder may be used that uses water as the carrying agent, and can acceptably handle fertilizer, mulch, and other amendment as identified. The hydro-seeder must have an operating and feed capacity sufficient to agitate, keep in suspension, and mix the required mixture of seed, water, and amendment into a homogeneous slurry. Distribution and discharge lines must be sized to prevent blockage and binding, and must allow for uniformity in required application rates. Spray nozzles must be designed to provide a uniform and consistent slurry application.
2. Seeding with Blower-Applied Compost: A pneumatic blower device equipped with a computer-calibrated seed injection system may be used to apply a mixture of seed, compost, and other amendment as needed. The blower

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device must have an operating and feed capacity sufficient to uniformly mix and apply the specified growing medium and seed.

3. Small area applications: Areas of a size not economical for hydroseeding methods must be seeded by hand or by small-scale equipment or both. The Contractor must provide the proposed method for applying seed or seed mixture to the Engineer at least 2 Working Days in advance.

8-01.3(5)E HYDROSEEDING

For hydroseeding applications, seed, fertilizer, mulch, and other identified amendment must be applied in 1 application, provided that:

1. The quantity of fertilizer added to the seed mixture must produce the specified rates in Section 9-14.3(1) for all ingredients. Place fertilizer in the hydro-seeder tank no more than 30 minutes before application.
2. Unless the CSECP indicates otherwise, wood cellulose fiber mulch is added to the seed mixture to act as a buffer. The mulch can substitute as a tracer; however, the rate of mulch application must not exceed 250 pounds per acre.
3. The seed mixture must have a tracer added to aid in uniform application by visual means. If a tracer other than wood cellulose fiber mulch is used, it must not be harmful to the environment.

8-01.3(5)F SEEDING WITH BLOWER-APPLIED COMPOST

For blower applications, seed, fertilizer, mulch, and other identified amendment must be applied in 1 application, provided that:

1. Compost must comply with specifications in Section 9-14.4(8).
2. The quantity of fertilizer added must be adjusted allowing for the nutrients provided in compost.
3. Before application of the growing medium and seed, the Contractor must ensure that the pneumatic blower has been properly calibrated to apply the specified quantity of seed.
4. Seeding is not done when winds interfere with uniform application.

8-01.3(5)G ESTABLISHMENT PERIOD AND MAINTENANCE

The seeding establishment period for temporary erosion control seeding must start on the Day the seed is applied and must continue for the greater of 90 Days or as identified in the Construction Stormwater Pollution Prevention submittals. The Contractor must perform the following maintenance during this establishment period:

1. Protect seeded areas from vehicle and pedestrian traffic.
2. Employ erosion and sediment control measures to protect seeded areas.
3. 60 Days after seeding, seeded areas exhibiting no germination or germination insufficient to provide 90 percent coverage, damaged by traffic, covered by sediment or eroded must be repaired as needed. Repair may include all of the following required to remediate: removal of sediment, regrading, reseeding, refertilizing, and remulching.
4. Repaired areas must be re-inspected 30 Days after repair is completed to ensure establishment with a minimum of 90 percent coverage.

Seeding applications that do not comply with establishment and coverage requirements after 90 days are subject to a supplementary establishment period of 30 Days until requirements are met.

8-01.3(6) EROSION CONTROL MULCHING

8-01.3(6)A GENERAL

When the CSECP indicates a separate mulch application for an area in addition to seeding, Mulch Material must be coarse compost applied as specified in Section 8-01.3(6)F, unless otherwise specified in the Contract.

If Compost mulch cannot be applied along with seed using blower equipment as specified in 8-01.3(5)F, then mulching must immediately follow the seeding, unless otherwise specified by the Engineer.

Areas not accessible by mulching equipment must be mulched by approved hand methods.

8-01.3(6)B STRAW MULCH

Straw mulch erosion control application must use a forced air mulch spreader. In spreading straw mulch, the spreader must not cut or break the straw stalks into lengths less than 2 inches. Where a forced air equipment mulch application is providing unacceptable results, the Contractor must use other application methods such as hand spreading and raking.

Straw mulch coverage must have a minimum thickness of 2 inches.

If straw mulch coverage at any time exposes bare ground of more than 50 percent in any 100 square foot area, then the Contractor must promptly remulch the exposed area to full coverage of the thickness required.

8-01.3(6)C ARBORIST WOOD CHIP MULCH

Arborist Wood Chip Mulch or approved equal as specified in Section 9-14.4(4) must be the Material used to comply with erosion control and tree/vegetation protection requirements unless otherwise specified in the Contract.

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Wood chip mulch erosion control application must use a forced air mulch spreader, or by a delivery method that does not disturb the surface to be protected, followed by hand-raking to obtain uniform coverage and clearance around tree trunks. Where a forced air equipment mulch application is indicated as providing unacceptable results, the Contractor must use manual or other application methods such as hand spreading and raking.

AWCM must be applied to provide a 2-inch minimum thickness coverage.

Mulch must be raked or manually cleared 6 to 8 inches from the trunk of each tree, to prevent damage from rot or rodents.

Should the wood chip mulch coverage expose at any time bare ground of more than 50 percent in any 100 square foot area, the Contractor must promptly remulch the exposed area to full coverage of the thickness required.

8-01.3(6)D BARK MULCH

Bark mulch as specified in Section 9-14.4(3) must be the Material used to comply with erosion control and tree/vegetation protection requirements. Application must be with a pneumatic blower device, or by a delivery method that does not disturb the surface to be protected, followed by hand raking to obtain uniform coverage and clearance around tree trunks. Where a bark mulch spreader application is providing unacceptable results, the Contractor must use other application methods such as hand spreading and raking.

Bark mulch must be applied to provide a 2-inch minimum thickness coverage.

Mulch must be raked or manually cleared 6 to 8 inches from the trunk of each tree, to prevent damage from rot or rodents.

Should the bark mulch coverage expose at any time bare ground of more than 50 percent in any 100 square foot area, then the Contractor must promptly remulch the exposed area to full coverage of the thickness required.

8-01.3(6)E WOOD CELLULOSE FIBER MULCH

Wood fiber mulch as specified in Section 9-14.4(2) must be applied using a hydroseeder. Where a hydroseeder application is providing unacceptable results, the Contractor must use other methods such as hand spreading and raking.

When used without seeding for the sole purpose of erosion control, the rates of application specified in Section 9-14.4(2) are amended as follows:

1. 70 pounds per 1000 square feet, or 3000 pounds per acre, for areas ranging from level to having a slope of 4 horizontal to 1 vertical.
2. 100 pounds per 1000 square feet, or 4000 pounds per acre, for areas having a slope ranging from greater than 4 horizontal to 1 vertical to as much as 4 horizontal to 1 vertical.
3. 120 pounds per 1000 square feet, or 5000 pounds per acre, for areas having a slope greater than 2 horizontal to 1 vertical.

Should the wood cellulose fiber mulch coverage expose at any time bare ground of more than 50 percent in any 100 square foot area, the Contractor must promptly remulch the exposed area to full coverage of the thickness required.

8-01.3(6)F COMPOST BLANKET (COMPOST MULCH)

Compost mulch for erosion control (i.e. compost blanket) must consist of coarse compost meeting the specifications in Section 9-14.4(8). Where the compost will later be incorporated into the soil as an amendment for turf areas, the Engineer may specify the use of fine compost instead of coarse compost.

Compost blanket erosion control application must use a blower as specified in Section 8-01.3(5)F. Where a forced air mulch spreader application is indicated as providing unacceptable results, the Contractor must use manual or other methods such as hand spreading and raking, or other mechanical methods if approved by the Engineer.

Coverage applications must have a minimum thickness of 2 inches, and a maximum thickness of 4 inches.

Should the compost blanket mulch coverage at any time expose bare ground of more than 25 percent in any 100 square foot area, the Contractor must promptly re-mulch the exposed area to full coverage of thickness required.

8-01.3(7) EROSION CONTROL MATTING

8-01.3(7)A GENERAL

Erosion control matting may consist of one or more applications of coir, jute, or excelsior matting; per Section 9-14.4.

Erosion control matting must be installed and secured per the manufacturer’s recommendations.

Unless the matting manufacturer recommends otherwise, seeding, with or without amendment or mulch, must be applied before the placement of matting.

Staking must be driven flush with grade and must penetrate the earth by a minimum of 12 inches.

The Contractor must maintain the integrity of the matting by promptly repairing or replacing as necessary all improperly anchored, torn, uplifted, and missing matting. Torn or missing matting must be covered with additional matting overlapping the tear or the exposed area with a minimum 24-inch overlap of all surrounding matting. This patch must be staked at each corner 3 inches from the edge of patch and along all edges with a spacing not exceeding 12 inches. Uplifted and improperly anchored matting must be repaired by replacing failed anchors, or by increasing the density of anchors as applicable.

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8-01.3(7)B NON-DITCH AND NON-CHANNEL MATTING INSTALLATION

Matting must be placed flush with the soil surface with the first matting installed at the lowest elevation. Additional upper elevation matting must be installed over lower elevation matting with a minimum 6-inch overlap. Matting must be installed with the long axis of matting parallel to the contour.

Unless the matting manufacturer recommends otherwise, the higher elevation edge of matting must be buried in an anchor trench 6 inches deep by 12 inches wide with soil firmly tamped against the matting. Upper elevation matting must be installed over lower elevation matting with an overlap the full width of anchor trench. Before backfilling the anchor trench, staking must penetrate the matting in the center of the anchor trench. Spacing of staking within the trench must not exceed 3 feet. A stake must be placed through the mat fabric 6 inches from edges at the corner including if overlapped by another mat. Backfill in the trench must be tamped firm.

Trenching to anchor matting is not allowed within the dripline area of trees. Staking to anchor the upslope edge of matting must be installed approximately 3 inches from the edge. Spacing of the stakes must not exceed 3 feet, except at ends where the stake must be installed through the mat fabric 6 inches from all edges including when overlapped. Upper elevation fabric installed over lower elevation fabric must have a minimum 12-inch overlap with staking placed in the overlapping area 3 inches from the upper edge of fabric.

For all width matting fabrics, spacing of stakes within a row must be 3 feet or less and spacing between rows of stakes must be 3 feet or less. Each long edge of matting fabric, whether overlapped or not, must be staked 3 inches from the long edge with stake spacing not exceeding 3 feet. The fabric ends, the short edge, must be staked 3 inches from the end whether overlapped or not, with a minimum 3 stakes along the short edge.

8-01.3(7)C DITCH AND CHANNEL MATTING INSTALLATION

Matting installed in ditches and channels must have the long axis of the matting parallel to the direction of water flow. The first matting installation must be at the invert of the ditch or channel. Additional matting installation must be installed overlapping the upper edge of previously placed fabric by at least 12 inches. In the direction of flow, upstream matting must overlap downstream matting by 12 inches. Matting must be held in place with ballast by other means capable of withstanding peak flows.

8-01.3(8) PLASTIC COVERING

Stockpiles, areas with no vegetative growth, areas where vegetative growth is to be inhibited, and areas with disturbed soil may be covered with permeable or impermeable black plastic covering. Sandbag or similar ballast must be placed on the cover in a grid with no less than 5 feet spacing in 2 right angle directions. At all ends without overlap, ballast must be placed within 12 inches of the edge and spaced no more than 5 feet along the perimeter.

Clear plastic covering must cover areas where the growth of vegetation is not to be inhibited.

With the exception of stockpiles, plastic covering sheets must be installed with the long axis parallel with slope contours.

The upper edge of the fabric must be placed into a 12-inch wide by 6-inch deep anchor trench and backfilled with native soils tamped into place. Upper slope fabric must overlap downslope fabric in the anchor trench a minimum of 12 inches. Along the same contour, the ends of new fabric must overlap in-place fabric a minimum of 24 inches. Within the dripline of trees, excavation of anchor trenches will not be allowed. Rather, ballast must be placed on the fabric and the overlaps secured by rope tied to anchor stakes upslope of the dripline area.

In general, ballast must be placed on the cover using sandbags or similar ballast distributed over the cover as to prevent uplift, slippage, and any other movement of the cover. Spacing of ballast must be not more than a 10-foot grid in line with and against the long axis of the sheet. All overlaps, edges, and corners must be ballasted. Uplifted areas must receive additional ballast resulting in reduced ballast spacing. On steep slopes and where slippage of ballast or ballasted fabric is indicated, the ballast must be secured in-place by rope tied to upslope anchors firmly set in the earth.

Rips and tears must be repaired by placing additional covering over the defect with a minimum 24-inch overlap in all directions from the defect. The repair must be ballasted with spacing in any direction of no more than 5 feet and along all edges and at all corners. Ballast must be anchored to upslope stakes. Areas where covering has slipped and the underlying surface becomes exposed must be promptly repaired in the same manner as rips and tears.

Clear plastic covering intended to cover a vegetated surface without long term inhibiting effects requires frequent monitoring ensuring permanent damage is not occurring. Should vegetative degradation be indicated, the Contractor must amend the cover practice to a condition not detrimental to the vegetation.

8-01.3(9) STRUCTURAL AND BIOMECHANICAL EROSION CONTROLS

8-01.3(9)A EQUIPMENT WASH AREA

Where equipment and vehicular traffic may contribute to the transport of sediment and other debris beyond or within a Project Site, the Contractor must have in place a stabilized construction wash area to remove sediment, mud, and other debris from tires, equipment and vehicles.

Stabilized construction wash areas must be in place and ready for operation before the potential for transporting such material occurs.

The wash area must consist of one or more of the following as the Work requires and as the Contract may require:

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1. Graded entrance and exit wash area for all equipment and vehicles.
2. A water trough for each direction. The depth of water in the trough must be maintained at a level adequate for the size of equipment and vehicle expected. The length and width of the trough must be sized to ensure all equipment and vehicles can be acceptably cleaned.
3. Hose, hose brush, long handled brush, and similar Supplies, and adequate labor to acceptably handle the size and volume of traffic.
4. Adequate source of water and means to contain the water within the designated wash area.
5. Regular removal and disposal of sediment and debris.
6. Removal and disposal of non-debris and non-sediment pollutants and contaminants.
7. As may be necessary, an area before and after the wash area of sufficient size with quarry spall or other coarse aggregate to allow for after-wash drip collection.

8-01.3(9)B ROAD STABILIZATION AND STABILIZED CONSTRUCTION ENTRANCE

Stabilized construction entrances are required in locations where traffic leaves the construction site, and moves onto a public road or other paved area, or as shown on the CSEC Plan as specified in Section 8-01.3(2). The stabilization required must be adequate for the equipment and vehicular traffic and for the Project Site local condition, local climate, and weather typical for the Contract Time.

Temporary road stabilization measures may be required in areas within and beyond the Project Site, such as access roads, haul roads, subdivision roads, parking areas, staging areas, and other vehicular and equipment traffic routes.

Stabilized construction entrances consist of a 12-inch (minimum) thick rock pad of quarry spalls placed over geotextile across the full width of vehicle ingress and egress area. The minimum length of stabilized construction entrances is 100 feet, unless otherwise approved by the Engineer.

Temporary road stabilization measures may consist of placing and compacting a thickness of quarry spall, a thickness of Mineral Aggregate Type 2 or Type 13, other aggregate, or a combination of these and other Material.

Where stabilized construction entrances or temporary road construction cannot be aligned to avoid areas within the dripline of trees not identified for removal, the Contractor must comply with Section 1-07.16(2).

Stabilized construction entrances must be maintained in a condition that will prevent tracking or flow of mud onto public Rights-of-Way. Maintenance must include repairing ruts, tracks, settling, and other failing areas. Such repairs may include placing and compacting additional aggregate. Any quarry spalls loosened from a stabilized construction entrance pad that enter the roadway must be removed immediately. Settled, broken, rutted and otherwise damaged timber, mulch, and other material within the driplines of trees must be repaired by increasing the thickness of the material.

Upon completion of the Work, or as may be required to accommodate the Work, stabilized construction entrances and temporary road stabilization measures must be removed and disposed. Within the dripline of tree, the removal must be conducted to prevent damage to feeder and surface roots and minimize compaction soils.

8-01.3(10) TEMPORARY SEDIMENT CONTROLS

8-01.3(10)A SILT FENCE (SEDIMENT FENCE OR FILTER FENCE)

Silt fences must act as a filter to both allow the passage of water through the fence and also to prevent the passage of sediment through, under, or over the fence. Silt fences must be either in-place before the area is disturbed, or must be coordinated with beginning soil disturbance activity.

Silt fences must be constructed at locations downstream or downslope of surface runoff areas, and upstream or upslope of surface bodies of waters. Silt fences must be spaced to account for grade of slope, runoff flow rate and velocity, sheeting and rilling, type and relative density of soils, rate of sediment loading, expected maintenance type and frequency, and other factors as the Project Site and Work require. Do not place silt fences across or in streams, channels and ditches.

Silt fences must be located along contours with the ends turned uphill to capture runoff and prevent flow around the end of the fence. Where the installation requires crossing of contours in areas except at the ends, gravel check dams must be placed perpendicular to the uphill face of the fence to minimize concentrated flow and erosion along the fence. The gravel check dams must be approximately 1 foot deep at the fence and must continue perpendicular to the fence at the same elevation until the top of the check dam intercepts the ground surface. The gravel check dams must consist of crushed surfacing base course gravel backfill for walls, or shoulder ballast. The gravel check dams must be spaced at intervals not exceeding 10 feet along the fence where the fence crosses contours. The slope of the fence line where contours are crossed must not be steeper than 3 horizontal to 1 vertical.

The height of the fence fabric, the geotextile, above ground surface must be 30 inches minimum and 36 inches maximum.

Posts must be either wood or steel. Wood posts must have minimum dimensions of 1-1/4” x 1-1/4” and must be white oak or other hardwood resistant to rot, and with no defects. Steel posts must consist of U, T, L, or C shape posts with a minimum weight of 1.33 pounds per foot, or other steel posts having equivalent or greater strength and bending resistance than those listed in this paragraph. Posts must be of a length to be installed to a depth and with a spacing to withstand maximum loading for the durations estimated between sediment removals. Unless the Contractor can justify otherwise to the Engineer, posts must be installed to a minimum 30-inch depth, except as specified below within the dripline of trees, and must

be spaced within a fence line of not greater than 6 feet. Where required post depth penetration cannot be obtained, the posts must be secured on the upslope side by bracing or guying to an anchor to prevent overturning.

The fence fabric and support backing systems must be attached on the up-slope side of the posts with staples, wire, hog rings, or other connection device as recommended by the manufacturer, in a manner that does not tear or damage the fabric.

At the bottom of the fence, the fabric and support backing system must be buried at least 6 inches below the ground surface, and then backfilled with native soils compacted by tamping or other appropriate compaction methods.

Excavation for installation of silt fence within the dripline of trees, and around other vegetation to be kept, is not allowed. Alternative methods necessary to comply with functional requirements to keep sediment without excavation within the dripline must be submitted for approval by the Engineer. Trenchless silt fence installation must be designed and installed to ensure consistent ground contact and stability.

Fence support backing system, in the form of wire or plastic mesh with maximum mesh spacing of 2” x 4” and of adequate strength to withstand maximum loading, must be attached to posts and fabric as recommended by the Supplier. Plastic mesh must have the same or greater ultraviolet (UV) resistance as the geotextile fabric. All geotextile fabric must have backing whether exposed or buried.

Fence fabric must be continuous along any single length of filter fence. Continuous fence is defined as follows:

1. The geotextile fabric may be sewn together at the point of manufacture or by the Supplier to form a single length of geotextile for a continuous fence application. All sewn seams must be at a support post.
2. Separate geotextile fabric may be installed across posts with a minimum 10-foot overlap where the overlap is supported by no less than 3 posts with spacing between any posts not greater than 4 feet. Overlapped fabric must always be secured to support backing.
3. The Contractor may place 2 posts, one on each side of the overlapped fabric and backing, and twist the overlapped fabric at least 2 complete revolutions before driving the posts into the earth. The overlaps must extend a minimum 1 foot beyond the 2 posts before twisting.
4. Lapped or twisted fabric and backing that slip is considered defective and must be replaced with sewn geotextile. For pre-staked silt fence, laps may be performed per the manufacturer’s written recommendations.

8-01.3(10)B SEDIMENT REMOVAL

Sediment must be removed and disposed of when the sediment build-up reaches a height of 6 inches.

8-01.3(10)C DAMAGED FENCE REPAIR

Damaged or improperly functioning silt fence must be promptly repaired or replaced.

Rips, tears, holes, and other defects in the geotextile fabric or the backing or both must be promptly repaired by placing new materials over the damaged materials the full width and height of fence including buried or covered fabric and backing, and must overlap existing fence materials a minimum 5 feet each side of the defect. The repaired fence must be supported by and securely tied to 5 evenly spaced posts.

Broken posts must be replaced with 2 posts spaced 1 foot on each side of the broken post driven 30 inches into the soil, or braced to upslope anchors. The fabric and backing must be securely tied to each new post.

Posts that lean greater than 1 horizontal to 4 vertical must be replumbed and must be supported at the top with bracing or guying to an installed upslope anchor.

Water or sediment escaping beneath the silt fence must be repaired by installing new fabric and backing over the existing material extending 3 feet upslope with a minimum 3-foot overlap on both sides. Ballast must be placed over the surface repair with a minimum 6-inch depth aggregate ballast. New post or posts must be installed along the leak with spacing not exceeding 2 feet.

Any other conditions that reduce the effectiveness of the silt fence must require immediate repair and/or replacement.

8-01.3(11) SHEAR BOARDS

Shear boards must be spaced horizontally to allow not greater than a 6-foot vertical change of grade between boards. Shear board must be securely nailed to four 2” x 4 “stakes – one stake at each end and the remaining stakes spaced evenly between. Stakes must be driven a minimum 24 inches into the earth and must extend to the full height of shear board.

The Contractor must promptly repair or replace shear boards and stakes exhibiting decay, structural failure, or leaning more than 1 horizontal to 4 vertical. Frequency of removal of sediment build-up against the board must be such that build-up does not exceed 1/3 the height of the shear board.

8-01.3(12) PROTECTION OF THE DRAINAGE AND SEWER SYSTEM

The Contractor must take measures to prevent blockage of the surface flow path and drainage Structures; to prevent the introduction of pollutants, contaminants, sediment, and other material into drainage Structures; to promptly clean out material that has entered drainage Structures; and to dispose of groundwater, process water and stormwater per all permits and the Temporary Discharge Plan. See Section 1-07.6 and permit restrictions on discharge quality, quantity and flow rates to maintain the function of the drainage and Sewer system. Gutters and drainage Structures are to remain functional except when designated for removal on the Drawings, or as approved by the Engineer.

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8-01.3(12)A PREVENT BLOCKAGE OF SURFACE FLOW PATH

The Contractor must submit a CSECP as specified in Section 8-01.3(2) that identifies the surface flow path and all drainage Structures within 500 feet downslope of the Work. Staging, storage, and stockpiles must be identified on the plan, must be contained and must not be placed in the gutter, and must not block any existing drainage Structure. Sweep or vacuum daily to remove any debris and material that enters the gutter.

8-01.3(12)B INLET AND CATCH BASIN PROTECTION

The Contractor must submit a CSECP as specified in Section 8-01 that identifies drainage inlets and catch basins within the work zone and within 500 feet downslope of the Work. Existing Structures with sufficient depth (minimum 12 inches) to allow insertion of a manufactured filter sock must be identified in the CSECP as “Protect Inlet”. New inlets, catch basins and pipelines must be protected from sediment and sediment-laden water until Job Site stabilization.

Manufactured filter socks must have a high flow bypass opening oriented towards the pipe outlet of the Structure. Excess material that extends beyond the grate must be trimmed to allow normal flow into the Structure. After placement of a filter sock under an inlet or catch basin grate, curb inlet openings may be plugged as approved by the Engineer.

Filter socks must be cleaned or removed and replaced when sediment has filled 1/3 of the available storage, or the fill limits recommended by the manufacturer. Filter socks must be removed within 5 Business Days after final Job Site stabilization.

8-01.3(12)C CLEANING INLETS AND CATCH BASINS

The Contractor must submit a CSECP as specified in Section 8-01.3(2) that identifies drainage inlets and catch basins within the work zone and within 500 feet downslope of the Work. Structures with insufficient depth to comply with Section 8-01.3(12)B, must be identified in the CSECP as “Clean Inlet”.

Existing inlets and catch basins must be cleaned when protection is not possible and when protection measures have failed. Inlets must be cleaned whenever debris or sediment is visible within the Structure. Catch basins must be cleaned when debris or sediment have filled more than one-half the volume of the Structure below the outlet pipe, or is within 18 inches of the outlet pipe invert. Inlets and catch basins may be cleaned by vacuum truck or shovels. Jetting material downstream is not allowed.

8-01.3(12)D TEMPORARY DISCHARGE OF GROUNDWATER, PROCESS WATER AND STORMWATER

The Contractor must submit reports on flow rate, quantity and quality controls for groundwater, process water and concentrated and collected stormwater as detailed in the Temporary Discharge Plan. During the Work, the Contractor and temporary discharge lead must be prepared to discuss with the Engineer the status of temporary discharge controls in-progress and to come as they relate to the Work, to the progress schedule, to permits, and as may be required in the Contract.

8-01.3(13) COMPOST SOCKS, COMPOST BERMS, AND STRAW WATTLES

Use compost socks or compost berms instead of straw wattles unless otherwise specified.

8-01.3(13)A COMPOST SOCKS

Compost socks may be used as shown in the CSECP or as directed by the Engineer in these applications:

1. As an alternative to silt fence, or in addition to silt fence, to filter out sediment, protect project perimeters, or channel runoff to treatment;
2. As an alternative to earthen dikes at the top or bottom of a slope, to intercept drainage from areas above and direct it to a stabilized outlet or treatment;
3. Around drain inlets as a temporary protection from sediment-laden water;
4. As temporary check dams in swales or ditches, or when seeded as permanent check dams where specified;
5. To contain small temporary pools for pumping, or for settling sediment; and
6. To filter and neutralize pH of runoff from new cement concrete installations, or to filter water contaminated by oil or grease.

Compost socks must consist of mesh fabric tube with a minimum strand thickness of 5 mils, and must be warranted by the manufacturer as appropriate for use in compost socks. It must be clean, evenly woven, and free from cuts, tears, and broken or missing yarns. The fabric must be of a biodegradable type for applications where the sock will be filled planted or seeded to be left on-site. Compost socks must be at least 8 inches in diameter; larger diameter socks may be required where ponding behind the sock is anticipated or observed.

Socks must be filled with coarse compost as specified in Section 9-14.4(8).

The socks must be filled on-site by forced-air mulch spreader equipment, and must be firmly packed yet flexible. Sections less than 15 feet long may be filled off-site. The sock must be blown full continuously, if a break is necessary the socks must be overlapped 5 feet at their ends and staked in place.

Soil surfaces must be graded smooth, and the compost filled sock must be placed directly onto the soil surface. The sock must then be walked to press it firmly to the surface. 2” x 2” stakes must be driven through the sock into the soil at intervals of 10 feet, unless otherwise shown in the CSECP or as specified by the Engineer.

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On slopes, compost socks must be placed parallel with the contour and perpendicular to runoff or other flow. Ends of socks must be placed angling upslope to prevent water flowing around. Socks must be placed at the top of the slope, and at intervals across the slope to allow not greater than a 6-foot vertical elevation change between sock rows, or as shown in the CSECP or specified by the Engineer, to prevent concentrated water flows from running down the slope.

Compost socks must be maintained in contact with the soil, and must be inspected immediately after a runoff producing rainfall to verify soil contact.

Where compost socks are not intended to be left in place to support permanent plantings (e.g. planted with live stakes for slope stabilization efforts), compost socks must be slit and removed from Project Site, and compost spread for incorporation into the soil.

8-01.3(13)B COMPOST BERMS

Compost berms are triangular cross-section rows of compost that can serve the same functions as compost socks or straw wattles on a temporary basis. The Engineer may specify and approve the temporary use of compost berms for any of the applications specified in Section 8-01.3(13)A Compost Socks.

Compost berms must be applied using a pneumatic blower device or equivalent, to create a uniform cross-section and berm density.

Compost berms must have a 2:1 base to height ratio, with a minimum size of 2 feet wide at base by 1 foot high in cross-section. Larger sizes may be specified by Engineer.

The compost used must be coarse compost as described in Section 9-14.4(8).

Compost berms may be used for up to 2 weeks. Berms may be used longer if seeded and vegetated, or if backed up by silt fence as shown in the CSECP or specified by the Engineer.

On slopes, compost berms must be placed parallel with the contour and perpendicular to runoff or other flow. Ends of berms must be constructed angling upslope to prevent water flowing around. Berms must be placed at the top of the slope, and at intervals across the slope to allow not greater than a 6-foot vertical elevation change between berms, or as shown in the CSECP or specified by the Engineer, to prevent concentrated water flows from running down the slope.

The compost berm must be maintained at the specified height, and any breaches or depressions must be immediately repaired to restore that height.

After use, the compost may be spread and reused as a compost blanket or for soil amendment.

8-01.3(13)C STRAW WATTLES

Wattles must be installed within shallow trenches parallel with the contour and perpendicular to runoff or other flow. A sequence of wattles must start at the base of the slope and proceed uphill. Excavated material must be spread evenly along the upslope side and must be compacted using hand tamping or similar method. On gradually sloped or on clay and plastic silt type soils, trenches must be 2 to 3 inches deep. On loose granular soils, in high rainfall areas, or on steep slopes, trenches must be 3 to 5 inches deep or half the thickness of the wattle, whichever is greater.

Wattles must be spaced horizontally to allow not greater than a 6-foot vertical change of elevation between wattle rows.

The wattle must be installed snugly into the trench, abutting adjacent wattles tightly end to end with minimal overlapping of ends. Wattles must be staked at each end, and in between at 4-foot maximum centers. Where trench conditions require, pilot holes for the stakes must be driven through the wattle and into the soil using a straight bar. Stakes must be driven through the center of the wattle at least 6 inches into the earth leaving 2 to 3 inches of the stake protruding above the wattle.

Wattles must be maintained in contact with the soil in the trench, and must be inspected immediately after a runoff producing rainfall verifying soil contact.

8-01.3(14) EROSION AND SEDIMENT CONTROL MAINTENANCE

Construction stormwater and erosion control measures must be inspected at regular intervals (at least once every calendar week), and within 24 hours following significant runoff producing rainfall events. The various devices must be inspected for damage, bypass, undercutting, and nonperformance, and must be promptly repaired.

The individual functions and the whole must be verified performing acceptably and must be maintained until the Job Site is stabilized, or until they are to be converted as part of a permanent erosion and sediment control when specified in the Contract.

Sediment buildup must be removed as specified or more frequent intervals when performance becomes questionable. Debris and contaminated sediment must be properly disposed.

8-01.3(15) REMOVAL AND REUSE OF TEMPORARY EROSION AND SEDIMENT CONTROLS

When a temporary erosion or sediment control feature is no longer required, the Contractor must remove the feature. The Contractor must remove all temporary erosion or sediment control features within 5 Business Days of Job Site stabilization.

Reuse of a control measure may be acceptable if:

1. The measure or device has been thoroughly cleaned of all debris;

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2. The measure or device is free of tears, holes, or other damage; and
3. The measure is verified it can perform as intended.

8-01.3(16) SWEEPING AND WASHING

In addition to the complying with Section 1-04.10, the Contractor must ensure that soil, debris, or other material tracked and deposited are removed by sweeping or by washing and properly disposed. In particular, when wet weather is forecast, the On-Site Erosion Control lead must verify that all measures are in-place and are functioning effectively and acceptably.

8-01.4 MEASUREMENT

Construction Stormwater Pollution Prevention plans specified in Section 8-01.5 and in the Bid Form will be measured by lump sum.

8-01.5 PAYMENT

1. "**Construction Stormwater and Erosion Control Plan (CSECP)**", per lump sum
2. "**Tree, Vegetation and Soil Protection Plan (TVSPP)**", per lump sum
3. "**Spill Plan (SP)**", per lump sum
4. "**Temporary Discharge Plan (TDP)**", per lump sum

The Bid Item price for each construction stormwater pollution prevention submittal indicated above and included in the Bid form must include all costs for the work required to prepare, submit and update as necessary all Plans described in this Section and to furnish, install, maintain, remove, relocate, restore and dispose of, construction stormwater pollution prevention measures including documentation, inspection, testing, provisions of permits, and, Specifications of Sections 1-07.15, 1-07.16(2), Section 8-01, and other Contract provisions.

The Bid Item price must also include all costs for the work required by the: Construction Stormwater and Pollution Prevention Coordinator (CSPPC); Certified Erosion and Sediment Control lead (CESCL); Tree, Vegetation and Soil Protection lead (if applicable); Spill Prevention and Response lead; Temporary Discharge lead (if applicable) and any other supporting staff as may be necessary. See Section 1-05.13 for descriptions.

Payments for progress estimates will be made as follows: 20 percent upon approval of the plan (including leads); 10 percent retained until all BMPs are removed and all required documentation is accepted; and 70 percent as work progresses as determined by the Engineer.

If the TVSPP is not included in the Bid form no plan is required and no separate payment will be made.

If the TDP is not included in the Bid form and the Contractor chooses to discharge water on-site, a TDP is required and the cost of the TDP and any permits must be included in applicable Bid Items of work; no separate payment will be made for a TDP when not included in the Bid form.

All fines for non-compliance are the sole responsibility of the Contractor. No payment will be made for fines, clean-up or additional stormwater or erosion control measures caused by or resulting from the Contractor's operations, negligence or omissions.

SECTION 8-02 LANDSCAPE CONSTRUCTION

8-02.1 DESCRIPTION

Section 8-02 describes the Work consisting of the preparation of soil; furnishing, planting, and maintaining of lawns and planting beds; furnishing and installing paver blocks, grid blocks, cedar edging, bollards, benches, root barriers, and tree grates; and furnishing and installing soil cell systems. Finished Soil cell systems will provide subsurface storage for stormwater management, extend tree rooting volume under HL-93 load bearing surfaces, and create favorable conditions to grow large trees in urban areas.

Plant Material. Trees, whips, shrubs, ground covers, seedlings, cuttings, and sod are collectively referred to as, "plants" or "plant material."

Soil cell systems must be furnished and installed in accordance with the Drawings, Specifications, Standard Plans 150a, 150b, 151, and 152, manufacturer's requirements, and/or as directed by the Engineer.

8-02.2 MATERIALS

Materials must comply with the following specifications and provisions:

1. Erosion Control and Landscape Materials: Section 9-14.
2. Plant Names: Nomenclature for plants and varieties per the current edition of Standardized Plant Names as prepared by the American Joint Committee on Horticulture Nomenclature.
3. Soil: Planting Soil must be used unless otherwise specified in the Contract. See Section 9-14.1(5).
4. Seed: The type of seed mix must be as specified in the Contract or as directed by the Engineer. See Section 9-14.2.

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5. Compost: Soil amendment (organic matter to be mixed into the soil) must consist of fine compost as specified in Section 9-14.4(8), unless otherwise approved by the Engineer for compatibility with management practices for the Job Site or specified in the Contract.
6. Mulch: Planting mulch for topdressing must consist of arborist wood chip mulch as specified in Section 9-14.4(4) unless otherwise specified in the Contract.
7. Rock Mulch: Topdressing required for tree pits in Right Of Way areas with high pedestrian volume is specified in Section 8-02.3(9)A.
8. Concrete: The concrete mix for wood bollard footings must be Class 3000, see Section 6-02.3(2).
9. Vertical Root Barrier: Root barriers must be an injection molded or extruded modular component made of high-density polypropylene or polyethylene plastic as specified in Section 9-14.17.
10. Horizontal Root Barrier: Root Barrier to cover a 4' x 4' area centered 1 foot below the rootball to comply with utility requirements must be Copolymer Polypropylene of 0.080-inch (2.032 mm) thickness, 50 percent post-consumer recycled plastic, injection molded and ISO 9002 certified.
11. Watering Bags: Slow release watering bags must conform to the requirements specified in Section 9-14.18.
12. Flexible porous surface treatment: Topdressing required for tree pits must be as shown on the Drawings.
13. Soil cell: Soil cells must conform to Section 9-14.20. Protect soil cell components from damage during delivery, storage, and handling. Deliver packaged components in original, unopened containers. Cover soil cell components with a tarp to protect them from sunlight when storage exceeds 30 days prior to installation.

8-02.3 CONSTRUCTION REQUIREMENTS

8-02.3(1) RESPONSIBILITY DURING CONSTRUCTION

8-02.3(1)A GENERAL

The Contractor must prepare soil in compliance with the TVSPP as specified in Section 8-01.3(2)B, and must provide adequate and proper care of all plant Material (both retained and newly installed) and landscape work, including irrigation, done on the project from the time of installation to the end of the landscape establishment period as specified in Section 8-02.3(12).

8-02.3(1)B LANDSCAPE CONTRACTOR QUALIFICATIONS

All landscaping must be performed by a licensed Landscape Contractor registered in the State of Washington. The Contractor must be qualified for landscaping work through certification by the Washington Association of Landscape Professionals (WALP) or by the Washington State Nursery and Landscape Association (WSNLA).

8-02.3(1)C SOIL CELL INSTALLER QUALIFICATIONS

Soil Cells must be installed by a Contractor with a minimum of 5 years of experience installing soil cells or successful installation of planting soils and planter drainage systems, underground piping, chambers and vault structures of similar size and scope having similar work tasks as shown on the Drawings. The Contractor must submit to the Engineer, for acceptance at least 20 Working Days prior to installation, the qualifications of the Soil Cell Installer, including a list of completed projects of similar scope and size demonstrating capabilities and experience.

The installer and the field supervisor must have a minimum of five years of successful experience with construction of similar scope in dense urban areas.

Installer is required to maintain an experienced full-time supervisor on the Project Site when work is in progress. This person must be identified during the Preconstruction Meeting as defined in Section 8-02.3(27)B, with appropriate contact information provided, as necessary. The same supervisor must be utilized throughout the duration of the Project, unless a substitution is submitted and approved in writing per Section 1-05.13.

8-02.3(2) TOPSOIL, PLANTING SOIL, AND TURF AREA SOIL

8-02.3(2)A GENERAL

Topsoil, planting soil, turf area soil, compost or fertile mulch must be evenly spread and incorporated into subsoil as specified in Section 8-02.3(15) for seeded lawn installation and as specified in Section 8-02.3(4) for areas to be planted.

Topsoil, planting soil, turf area soil, compost and/or fertile mulch must not be placed or worked when the ground or topsoil is frozen, excessively wet or, in the opinion of the Engineer, in a condition detrimental to the Work.

8-02.3(2)B TOPSOIL TYPE A – (IMPORTED)

Topsoil Type A must be obtained from a source provided by the Contractor as specified in Section 9-14.1(2).

Should the Contractor propose a soil not meeting these specifications, the Contractor must provide a manufacturer's certificate of compliance stating the proposed substitute soil complies with the organic matter specifications in Section 9-14.1(2), meets regulatory and legal provisions, and must perform as at least as acceptably as Topsoil Type A. Material taken from the Project Site and used as Reused Amended Site Soil will not be deducted from the Bid Item quantities for the respective Bid Items.

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8-02.3(2)C REUSED AND AMENDED SITE SOIL

Reused and amended site soil must be native topsoil taken from within the Project Site as specified in Section 9-14.1(3), including the requirement to amend it if needed with compost to comply with the minimum organic matter specified in Section 9-14.1(3). Reused and amended site soil will not be considered as selected Material as specified in Section 2-10.2(1), and the specifications of Section 2-10.2(1) will not apply.

When Reused and amended site soil is specified in the Contract, it must be the Contractor's responsibility to perform the excavation operations in such a manner that sufficient Material be set aside to satisfy the needs of the project.

Reused and amended site soil must be amended with compost as specified in Section 9-14.4(8), to provide 5 percent organic matter content for lawn areas, and 10 percent organic matter content for planting areas, using Loss-On Ignition test method (ASTM D2974 or TMECC 03.07A). Compost amendment may be added at default rates of 22 percent for turf or 38 percent for planting beds; or calculated based on tests of the soil and compost, using the Soil Amendment Rate Calculator at http://your.kingcounty.gov/solidwaste/compost-calculator.htm.

Upon completion of the Work, any topsoil remaining and not required for use on the project must be disposed, unless the Engineer agrees otherwise.

Should a shortage of reused amended site soil occur and the Engineer has determined the Contractor has wasted topsoil Material, the Contractor must furnish topsoil Type A at no expense to the Owner.

8-02.3(2)D TURF AREA SOIL

Turf Area Soil must be as specified in Section 9-14.1(6), and must be installed as specified in Section 8-02.3(4), or in the Contract.

8-02.3(2)E PLANTING SOIL

Unless the Contract specifies otherwise, Planting Soil must be as specified in Section 9-14.1(5) and must be installed as specified in Section 8-02.3(4).

8-02.3(2)F HIGH PERFORMANCE TURF SOIL

High performance turf soil must be as specified in Section 9-14.1(7), and must be installed as specified in the Contract.

8-02.3(3) PESTICIDES

All uses of pesticides and herbicides (hereafter 'pesticide') within the municipal limits of the City of Seattle must comply with the City of Seattle's pesticide reduction strategy (as found under the keyword "pesticide reduction" at http://www.seattle.gov). The City's strategy attempts to (1) eliminate use of the most hazardous pesticides and (2) achieve a 30% reduction in overall pesticide use. Pesticides include, but are not restricted to, any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any pest, including but not limited to, insecticides, herbicides, fungicides, adjuvants, and additives, including plant regulators, defoliants, and desiccants.

The City's Integrated Pest Management Interdepartmental Team (IPM-IDT) is responsible for evaluating the hazardous characteristics of pesticides and the City's use of those pesticides. The Contractor must submit a Weed and Pest Control Plan to the Engineer for review a minimum of 10 Working Days before scheduled use so the City has sufficient time to allow review by the IPM-IDT. The Contractor's submittal must include:

1. Means and methods of pest control, including a site plan indicating where the pest control will be implemented; site-specific restrictions such as avoidance of surface waters and permit condition-related requirements; and the plan to ensure worker safety until pesticide re-entry periods are met;
2. Application rate and Safety Data Sheet (SDS) for the pesticide product;
3. Verification the pesticide product complies with all laws and regulations and is registered for use within the State of Washington;
4. Verification the pesticide product is not a soil residual pesticide and is not toxic to non-target landscaping and lawn, unless the Contract specifies otherwise; and
5. The name of the pesticide applicator, including a copy of the applicator's current Washington State pesticide applicator license with applicable endorsements for the intended application.

Apply pesticides per pesticide label recommendations, the Washington State Department of Ecology requirements, City of Seattle environmentally critical area (SMC 25.09) and Shoreline Management (SMC 23.60A) regulations, and Washington State Department of Agriculture laws and regulations, including Chapter 16-228 WAC. All personnel applying pesticides within the project limits, including off-site mitigation and staging and stockpile areas, must be licensed by the State of Washington as a Commercial Applicator or Commercial Operator, with additional endorsements as required by physical work locations, or the proposed Weed and Pest Control Plan. All licenses and endorsements must be current and in good standing for the duration of the project.

The Contractor must ensure pesticide application is confined to the target area(s). Broadcast spray-applied pesticides must use anti-drift and activating agents and a spray pattern indicator, unless otherwise allowed by the Engineer. Pesticide application must be restricted when near surface waters as specified in Section 1-07.5. Pesticide must not be applied during unreasonable wind conditions, when wet conditions exist, or when wet weather is forecast within 24 hours of pesticide

application, unless the pesticide manufacturer recommends otherwise as provided in the submittal. The Contractor must notify the Engineer at least 2 Working Days in advance of the location of any pesticide application.

The Contractor must post information on pesticide application at the Project Site for 24 hours post-application. Postings must include the name of licensed applicator, pesticide used, time of application, method of application, and target vegetation or pest. The Contractor is responsible for rendering any area unsatisfactory for planting by reason of pesticide application. Damage to adjacent areas, either on or off the Project Site, must be repaired to the satisfaction of the Engineer or the property owner at no additional cost to the Owner.

8-02.3(4) PLANTING AREA PREPARATION

Areas to receive plant Material must be cleared, grubbed, cultivated and graded to accommodate the Work before planting and to provide the optimum conditions for plant and lawn, establishment and growth.

Planting area preparation must take into account as applicable, work requiring field inspection and Engineer's approval within the driplines of trees and other vegetation to be kept; the incorporation of topsoil, planting soil, turf area soil, decomposed organic amendment, fertile mulch, or other amendment; and the finish grade to accommodate the Work.

The Contractor must have on-site current copies the Washington State Noxious Weed List and Monitor List (http://www.nwcb.wa.gov), and the King County Noxious Weed list (http://www.kingcounty.gov/environment/animals-and-plants/noxious-weeds/laws/list.aspx). All weeds on these lists must be removed from the area of planting using the Integrated Pest Management method recommended by the King County Noxious Weed Board consistent with the City of Seattle Pesticide Reduction Program. Soil containing roots or seeds of noxious weeds must be disposed.

Weed clearing must be by non-chemical methods unless the Contract specifies otherwise, or the Contractor requests and receives approval from the Engineer to apply pesticide as specified in Section 8-02.3(3).

Subgrade must be established at level specified on plan. Before placement of specified topsoil or amendment, subgrade must be thoroughly scarified a minimum of 4 inches deep; by ripping, rototilling, plowing or discing. Finished subgrade must be cleaned of all debris including concrete, stumps, sticks, roots and rocks or lumps larger than 3 inches; and inspected and approved by the Engineer before soil mix is placed.

The Contract may require certain areas be built-up by embankment construction methodologies as specified in Section 2-04, Section 2-10 and Section 2-11 before preparing for planting. Such areas will be identified in the Contract.

Imported topsoil mixes, per Section 9-14.1, must be added in 2 lifts of equal depth. The first topsoil lift must be thoroughly blended with scarified subsoil, and compacted per Section 8-02.3(4) before placement of second lift. Where reused amended site soil (Section 9-14.1(3) is specified, compost amendment must be thoroughly incorporated to create a homogenous blend 8 inches deep. The Contractor must apply and shape the lifts in such a manner that the planting area has a continuously sloped final surface allowing for drainage from higher elevations to lower outer edges of the planting area. Where possible, ridges and ridge lines must be the approximate center point, or centerline, of the planting area.

Any amendments, excluding fertilizers to be applied in planting holes and on lawn starter, must be applied evenly on the soil surface at rates specified by soil test per Section 9-14.1(1), using a calibrated spreader. Lime and other amendments must be thoroughly blended into the top 8 inches of soil using rototiller. Fertilizers must not be used in bioretention installations.

The area must be rolled in 2 directions, the second rolling at right angles to the first. The roller must be of a standard, water-filled type to apply 150 to 300 pounds per square foot ground pressure.

Soils and amendment must not be placed when the ground is frozen, excessively wet, or in a condition not amenable to acceptable planting area preparation as determined by the Engineer.

The finished grade of planting area included any surface mulch top dressing must be 1 inch below the finished grade of any surface improvement such as sidewalk and other pedestrian walking area.

8-02.3(5) LAYOUT OF PLANTING

Plants must be placed at spacings and locations as indicated on the Planting Plan. Plant layout must be approved by the Engineer before installation of any plants. Unapproved plantings must be removed and replanted at the Contractors expense.

The Contractor is responsible for location layout and staking , subject to the approval of the Engineer, before planting or construction of each item begins.

All plant Material must be inspected and determined by the Engineer to be acceptable for planting before planting. All plants must be furnished disease and pest free, in good health and condition, true to form, and must be vigorous growers.

The Contractor must notify the Engineer at least 5 Working Days in advance of projected completion of staking and allow 2 Working Days after the projected Completion Date for review and any adjustments of the layout by the Engineer. Contracts requiring plant placement based on field layout by the Engineer require 5 Working Days notice for field layout before the Contractor's scheduled plant installation.

The Contractor must sequence the planting to minimize disturbance to new plantings and existing landscaping, and to comply with the TVSPP as specified in Section 8-01.

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8-02.3(6) PLANTING

8-02.3(6)A GENERAL

Plants brought to the planting site must be bare root, balled and burlapped, or in containers, as specified in the planting schedule in the Contract for the particular type of planting Material.

Do not plant during freezing weather or when the ground is frozen or saturated. Do not plant during excessively wet conditions. Do not plant on any Day in which temperatures are forecast to exceed 80 °F unless the Engineer approves otherwise. Do not plant in areas that are below finished grade.

Planting trees, shrubs, and groundcovers within the City of Seattle limits must be performed during the period between October 1st and April 30th. Outside the City of Seattle limits, dates to plant will be specified in the Contract. See Section 8-02.3(14)A for dates to seed for lawn installation.

If groundwater is encountered upon excavation of planting holes, the Contractor must promptly notify the Engineer.

Containers may require vertical cuts down the full depth of the container to accommodate removal. All circling roots must be loosened to ensure natural directional growth after planting. Plants must be removed from containers in a manner that prevents damage to the root system.

8-02.3(6)B TREES

The Contractor must provide the Engineer a minimum 2 Working Days advance notice of the first trees to be planted. The Engineer must be present to approve the planting method of the first trees. The approved method must be consistently applied for all remaining tree plantings.

Tree planting holes must be excavated over a minimum surface area of 12 inches beyond the outside edge of the rootball in all directions, and to a depth equal to the depth of the rootball less 2 inches. Tree pit excavation near a curb or sidewalk must allow a horizontal clearance of at least 3 inches from the curb or sidewalk without undermining foundation support of adjacent improvements.

Trees must be placed with the root crown 2 inches above surrounding curb and sidewalk finished grade where applicable. In their final position, trees must have their root crowns positioned above the surrounding backfill as indicated on the Standard Plans.

Before planting, twine and burlap and wire basket must be removed from the upper 2/3 of the root ball. However, the Contractor must be prepared to remove all twine and burlap and wire basket before placing in planting holes at locations directed by the Engineer. All trees grown in containers and root bags must be removed from container and inspected for acceptability of root condition before planting.

Untangle circling roots to prevent strangulation of plants, and spread in direction of desired growth Containers may require vertical cuts down the full depth of the container to accommodate removal. For ball and burlap and container trees, roots showing at the edge of the root ball must be loosened without tearing and must be placed in a manner ensuring roots are properly spread for lateral directional growth.

Backfill:

1. Backfill must be carefully placed and compacted in loose lifts not exceeding 6 inches.
2. Unless the Contract specifies otherwise, 2/3 excavated native soil must be mixed with 1/3 Compost per Section 9-14.4(8) to form a thoroughly mixed homogeneous blend for backfill.
3. Backfill must be placed and compacted without voids. For bare root trees, backfill must be placed in a manner ensuring roots are properly spread to avoid circling, and tamped or compacted ensuring that no voids exist. Water settling of backfill will not be allowed.

Where no sidewalk and curb is present, the finished grade of the backfill must have a soil berm or soil saucer (watering ring) as shown on Standard Plans 100a, 100b and 101. On Standard Plan 113, the mulch thickness to curb and sidewalk finished grade will be considered the watering ring.

Water must be applied after installation as set forth in Section 8-02.3(12) item 4. If settling occurs, the Contractor must add enough soil to cover the roots but must not rework the soil.

Provide 2 to 3 inches of mulch of the type specified in the Contract or otherwise specified in Section 8-02.2.

Materials must then be added to top dress the entire tree pit including the watering ring, with the depth tapered at the tree to prevent contact at the trunk.

8-02.3(6)C SHRUBS AND GROUNDCOVERS

Planting holes for shrub and groundcover plants must be as shown on Standard Plans 110 and 111.

All plastic, burlap, ties, and other container material must be removed from the plant before planting.

Containers may require vertical cuts down the full depth of the container to accommodate removal. Untangle circling roots to prevent strangulation of plants, and spread in direction of desired growth.

Backfill with soil removed from hole. Backfill must be firmly tamped or compacted without voids around the roots

Water must be applied after installation as specified in Section 8-02.3(12). If settling occurs, the Contractor must add enough soil to cover the roots but must not rework the soil.

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Mulch must be applied according to Section 8-01.3(6)C, or as otherwise directed by the Engineer, with the depth tapered at the tree to prevent contact at the trunk.

8-02.3(7) PRUNING AND STAKING

8-02.3(7)A PRUNING

Pruning necessary for the Work is per the TVSPP, see Section 8-01. Pruning must be done in such a manner as to maintain or to encourage the natural growth characteristics and proper form of the particular plant. Pruning must be done with a sharp tool to produce a clean cut without bruising or tearing the bark. All completed pruning cuts must be in the living wood where callous tissue can develop properly.

At the time of planting, all plants must be pruned to remove any minor broken or damaged twigs and branches. Notify the Engineer of any major broken or damaged limbs at planting, before attempting to repair through pruning.

When roots are encountered during construction and pruning is necessary per the TVSPP, all roots must be pruned a minimum 4 inches from improvement limits defined and as determined by the Engineer to be necessary for construction forms or safety systems.

All tree trimming must be done by an ISA Certified Arborist, or a trained arboricultural technician working under the immediate supervision of an ISA Certified Arborist and must adhere to ANSI A300 standards. When major tree pruning work is required, the Contractor must notify the Engineer 3 Working Days before start of pruning and provide the name of the company or individual proposed for doing the pruning.

Tree pruning must be either minor or major as follows:

1. Minor pruning is limited to: removal of less than 10 percent of the foliage, or if foliage has not developed, less than 10 percent of the foliage buds including branches up to 1-1/2 inches diameter; and removal that does not adversely impact the central leader, and does not significantly change the natural form of the tree being pruned.
2. Major pruning work is all other pruning work. All major pruning work must be done by an arborist with current certification by the International Society of Arboriculturists, and must arrange in advance with the Engineer for observing and approving the pruning of the first trees. The first pruning must be representative of all trees to be pruned and must be adequate demonstration of the proper pruning method to apply to all trees that require pruning.

8-02.3(7)B STAKING

Unless otherwise specified in the Contract, all deciduous trees must be staked during planting as described in Standard Plans 100a, 100b and 113.

Each tree must be staked with two 8-foot long, 2-inch diameter doweled treated wood stakes per Section 9-14.7. For deciduous tree installation, the stake must penetrate a minimum of 1 foot into undisturbed subgrade. For coniferous tree, see Standard Plan 101. Alternate methods of staking may be proposed by the Contractor and require approval of the Engineer.

Tress must be secured to trees using chain lock tree tie per Section 9-14.7, (or approved equal) installed to allow for trunk growth.

Damaged stakes must be promptly removed and replaced. Trees and shrubs found out of plumb by wind or other cause must be re-plumbed by loosening the soil around the root system and re-plumbing the tree or shrub, and backfilling and compacting as necessary. Do not make adjustment by pushing, pulling or restraining the trunk or stem. If, in the opinion of the Engineer, damage to the root system has occurred as a result of replumbing a tree or shrub, the tree or shrub must be replaced at the Contractor's expense.

All tree stakes and guys must be removed at the end of 1 year, except as noted on plans or as directed by the Engineer.

8-02.3(8) FERTILIZERS

Fertilizers must be applied in a form and at a rate recommended by Certified Agronomist or Soil Scientist, based on soil analysis by an independent accredited laboratory, as specified in Section 9-14.1(A) General Testing and Submittal Requirements.

A minimum of 50 percent of nitrogen fertilizer must be applied in a slow- or controlled-release form; such as sulfur- or polymer-coated urea, IBDU, trinitromethane (Nitroform), or organic forms.

All fertilizers must be furnished in standard unopened containers with weight, name of plant nutrients and manufacturer's guaranteed statement of analysis clearly marked, all per state and federal law.

The Contractor must submit to the Engineer for approval at least 5 Working Days in advance, an analysis of the proposed fertilizer, a 1-pound sample, and manufacturer's certificate of compliance indicating all Specifications are met.

8-02.3(9) MULCH

Mulch used as topdressing for tree pits and planting beds must be arborist wood chip mulch per Section 9-14.4(4), unless otherwise specified in the Contract or specified under Section 8-02.2 Materials. Wood chips salvaged from clearing and grubbing operations may be used as mulch for topdressing as approved by the Engineer.

Mulch that will be reused as a soil amendment must be Compost (i.e. compost) as described in Section 9-14.4(8), applied and incorporated into soils as specified in Section 8-02.3(4).

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8-02.3(9)A ROCK MULCH

Crushed rock mulch must consist of 200 pounds of 1/4 inch minus crushed rock as specified, mixed with 1 pound of soil stabilizer as specified below. Contractor must submit a particle gradation (sieve) analysis from a certified test lab for the approval of the Engineer.

Stabilizer must be an aggregate binder that is natural, nontoxic, non-staining, odorless, environmentally safe powder specifically manufactured for binding aggregates to produce a firm stable surface. Stabilizer binder must be 'Stabilizer Solutions Inc.' or approved equal.

Dry stabilizer and crushed rock must be thoroughly pre-blended while the materials are dry per the manufacturer's recommendations. Mixing must be accomplished using a cement mixer, pug mill, or in any paddle type blender; leaving material in blender for several passes of the mixing paddles. Bucket blending and screw type blenders and not approved blending methods. Drop spreading of stabilizer over preplaced aggregate or mixing by rototilling may only be done with written approval by the Engineer.

Do not place crushed rock mulch in wet conditions (no rain fall within the previous 24 hours) or at temperatures at or below 40 °F and falling.

The prepared base must be free of weeds. Place the crushed rock mulch on the prepared base, and rake smooth to desired grade and cross-section. Place material to minimum 2 inches of compacted depth. Top of the compacted crushed rock mulch must be 1/4 inch below the adjacent top surface of concrete walk.

Crushed rock mulch must be lightly compacted. Do not use a vibratory compactor unless approved by the Engineer. Compact material after tamping by foot does not leave an evident depression. During compaction, the crushed rock mulch must be dampened with a limited quantity of clean water.

8-02.3(9)B FLEXIBLE POROUS SURFACE TREATMENT

Flexible porous surface treatment must be designed, mixed, and installed per the manufacturer's recommendations. Flexible porous surface treatment must be Porous Pave XL, KBI Flexipave, or approved equal. Color must be grey-black or granite, or an approved equivalent or alternate color. Mix must have 25 to 30-percent void ratio and be comprised of 50-percent recycled rubber chips and 50-percent kiln-dried aggregate.

For approval of equal material, the Contractor must submit product information, including limitations related to weather conditions or site-specific conditions, to the Engineer for approval. Submittal must also include a minimum of three examples of product installations within the last five years at a project location within 75 miles of the work site.

All material submittals must include confirmation from the manufacturer that the Contractor or Subcontractor installing the flexible porous surface treatment has been trained and is currently certified to install the product.

Install a base course of Mineral Aggregate Type 22 to a minimum 2-inch depth prior to placement of flexible porous surface treatment to provide a stable and uniform base. Flexible porous surface treatment must be placed to a minimum depth of 2 inches where applied adjacent to a sidewalk or curb, or a minimum depth of 4 inches where applied adjacent to multi-use trails. The finished surface of the flexible porous surface treatment must be uniform and flush with adjacent surfaces. Uniform and flush surface conditions must be maintained throughout the landscape establishment period.

Flexible porous surface treatment must not be placed adjacent to trees within 10 Working Days of when the tree was installed and the pit and surrounding areas were backfilled and allowed to settle under natural conditions. See Section 8-02.3(6)B.

Flexible porous surface treatment is subject to inspection and repair at the time of project acceptance, at quarterly inspections, and at the end of the landscape establishment period or warranty period described in Section 1-05.10.

8-02.3(10) SOIL AMENDMENTS

Soil amendments must be applied during planting area preparation, see Section 8-02.3(4). The soil amendments must be thoroughly mixed with soils and other Material as specified in the Contract to produce a homogeneous blend.

All amendments must be delivered to the Job Site in the original, unopened containers bearing the manufacturer's name and guaranteed components analysis. Instead of containers, amendments may be furnished in bulk, with a manufacturer's certificate of compliance indicating the components analysis complies with the Contract.

8-02.3(11) CLEANUP

Upon completion of planting, all excess Material must be disposed. Planting areas immediately adjacent to walks, curbs, pavements, driveways, and other improvement must be graded and compacted to accommodate the depth of mulch cover, with the mulch surface flush with the surface of adjacent improvement.

8-02.3(12) LANDSCAPE ESTABLISHMENT

Landscape Establishment must consist of the Contractor providing regularly scheduled, adequate and proper care for all new planting for the landscape establishment period. The landscape establishment period must start on the date of written notice from the Engineer of the acceptance of plantings and the automatic irrigation system (if included in the project), and must end 365 Calendar Days thereafter--unless the Contract specifies otherwise.

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Once all other Work is physically complete, Contract Time will not be assessed for the landscape establishment period. No supplemental contract for landscape establishment will be allowed.

At least 5 Working Days before the beginning of the landscape establishment period, the Contractor must submit a weed control plan for approval by the Engineer. The weed control plan must identify methods and timing intervals to assure weed control throughout the plant establishment period. This weed control plan will be subject to revision dependent on results of the implemented plan.

See Section 8-02.3(3) for specifications on application of pesticides.

All irrigation system components installed as part of the Work must be maintained and operated by the Contractor as part of the landscape establishment work.

A watering schedule must be submitted indicating how and when every component of the landscaping receives water. If there is an installed irrigation system, submittal must include a Microsoft Excel file describing the location of every irrigation zone; including the irrigation equipment in each zone.

The Contractor must water plants as needed to promote healthy and vigorous growth:

1. Hand-watered trees: 15 gallons must be applied per tree per watering on a 3 Day schedule; or more frequently if weather conditions justify. Slow release watering bags must be installed and maintained per the manufacturer's recommendations for efficient hand watering of trees during the growing season. Use a single-bag installation for 1-inch to 3-inch caliper trees. For trees 4-inch caliper or larger, a double-bag installation must be used. Remove all sharp objects from the irrigated area before installation. Place the slow release watering bags on top of mulch, not directly on soil. Place each bag around the tree trunk with the zippers on the uphill side of the tree. Wrap both sides of bag until zippers meet and zip together from bottom to top. Lift tag to expose fill opening at top of bag. Fill bag to ¼ capacity. Gently lift up on straps at top of bag to expand bottom. Fill to the desired level and let empty. Fill 1-2 times per week during the growing season during Landscape Establishment period, frequency based on adequate soil moisture to support root growth and tree vigor.
2. Automatic irrigation installation: Contractor must be responsible to conduct an irrigation audit to set watering frequency and timing, and must submit audit results by a Certified Irrigation Auditor to the Engineer for review and approval. Automatic irrigation systems must be operated fully automatic during the plant establishment period, must operate during the time period of 2:00 a.m. to 5:00 a.m., and must be coordinated with the work of Section 8-03. If water restrictions are established, the Contractor must develop watering schedules in consultation with the Engineer. See Section 2-12 for hydrant use specifications.
3. Adjustments Based on Weather: Change in the established watering schedule may be required to accommodate weather and seasonal factors. The Contractor must monitor watering to ensure compliance with the Tree, Vegetation and Soil Protection Plan (TVSPP), see Section 8-01.

Mulch must be applied to the required thickness and must be maintained by applying additional mulch when needed to maintain consistent depth. Final mulch application must be made in conjunction with the final progress estimate payment period, see Section 8-02.5.

Tree fastenings must be kept intact and effective in maintaining firm support for plant Material. Fastenings must be adjusted as needed by the Contractor to prevent trunk strangulation and non-plumb growth. Fastenings and stakes must be removed as indicated on Standard Plan 100a or at the completion of the first year establishment period, whichever is later. Reusable, doweled wood stakes must remain the property of the Owner and arrangements must be made by the Contractor to provide for their delivery to an Owner storage facility identified by the Engineer.

A general cleanup must be made after any landscape establishment work.

The Contractor must maintain all areas, whether mulched or not, in a weed-free condition during the landscape establishment period. Weed removal must be by mechanical control methods unless alternatives are approved by the Engineer in writing.

Replacement plants required during establishment must be planted within a time period set by the Engineer, which will depend on the season and availability of the replacement plants. Missing plants must be replaced by the Contractor in kind. Scheduling of plant replacement must be coordinated with the Engineer.

Plantings and landscaped areas will be inspected regularly by the Engineer during the landscape establishment period. Should the Engineer determine that the Contractor is not providing regular adequate and proper care of plant Material or is performing unacceptable landscape establishment work, the Engineer will provide written notice to the Contractor of such determination. The Contractor must reply to the Engineer within 7 Days of the date of written notice with proposed corrections. Such corrective measures must occur within 14 Days after the date of written notice unless the Engineer agrees otherwise.

Approximately 15 Days before the end of the landscape establishment period, the Contractor must request a final Job Site inspection by the Engineer. Conditions found unacceptable by the Engineer must be corrected by the Contractor within a 10-Day period immediately following the inspection. After correction, the Contractor must notify the Engineer for a reinspection. Corrective work must include replacement of dead, missing, or unacceptable landscaping Material; weeding; pick-up of all litter; and repair and/or readjustment of the irrigation system. Necessary replanting must be arranged by the Engineer per the best planting time of the year.

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8-02.3(13) PLANT REPLACEMENT

The Contractor is responsible for replacement of all dead and unacceptable plant material throughout the landscape establishment period.

All replacement plants must be of the same species and size as the plants they replace, and must be healthy and vigorous growers, unless the Engineer determines an equal value substitute plant be provided. Relocated trees larger than 4 inches DBH that fail to survive must be replaced with a 3-1/2 to 4-inch caliper tree approved by the Engineer. Difference in value between relocated tree and replacement tree must be assessed by the Engineer per Section 8-02.3(22).

8-02.3(14) LAWN INSTALLATION

8-02.3(14)A GENERAL

Areas planted with sod or seeded lawn must be cleared, grubbed, cultivated and graded to accommodate the Work before planting and to provide the optimum conditions for lawn, establishment and growth.

Lawn installation must be by sodding unless “Seeded Lawn Installation” is specified in the Bid Form, and must include lawn establishment as specified in Section 8-02.3(15) when specified in the Bid Form. The Contractor may request the Engineer to approve the option of sodding instead of seeding for lawn installation; however, seeding instead of sodding will not be allowed.

In areas with automatic irrigation, lawn installation must not start until the sprinkler system is operational.

Seeding and fertilizing must be performed during the allowable time frames April 1 to May 31 or September 1 to October 31. For seeding outside of the allowable time frames, written permission from the Engineer will only be given when completion of the project is imminent and the environmental conditions are conducive to acceptable growth as determined by the Engineer. Application of pre-germinated seed, moisture retention agents and/or provision for supplemental watering may be required by the Engineer if the Contractor schedules this portion of the Work outside the allowable time frames.

The Contractor must have on-site current copies the Washington State Noxious Weed List and Monitor List (http://www.nwcb.wa.gov), and the King County Noxious Weed list (http://dnr.metrokc.gov/wlr/lands/weeds/weedid.htm). All weeds on these lists must be removed from the area of planting using the Integrated Pest Management method recommended by the King County Noxious Weed Board consistent with the City of Seattle Pesticide Reduction Program. Soil containing roots or seeds of noxious weeds must be disposed.

Subgrade must be established at the level specified on the Drawings. Before placement of specified topsoil or amendment, subgrade must be thoroughly scarified a minimum of 4 inches deep; by ripping, rototilling, plowing or discing. Finished subgrade must be cleaned of all debris including concrete, stumps, sticks, roots and rocks or lumps larger than 3 inches; and inspected and approved by the Engineer before soil mix is placed.

Imported topsoil mixes, per Section 9-14.1, must be added in 2 lifts of equal depth. The first topsoil lift must be thoroughly blended with scarified subsoil, and compacted per Section 8-02.3(14)A.11 before placement of second lift. No incorporation of topsoil is required in high performance turf areas with sub-drainage. Where reused amended site soil (Section 9-14.1(3) is specified, compost amendment must be thoroughly incorporated to create a homogenous blend 8 inches deep.

Fertilizer and lime must be applied as specified in Section 9-14.3(1), using a calibrated spreader set to apply fertilizer and lime at rates recommended by testing laboratory or Agronomist.

After the addition of any amendment and application of lime, the area must be mechanically tilled to a depth of 4 inches to achieve a homogeneous blend. Soil must then be raked by approved hand or mechanical methods to remove and dispose of all large clods, rocks, debris, and litter larger than 1 inch in any dimension.

Do not place soils and amendment when the ground is frozen, excessively wet, or in condition not amenable to acceptable planting area preparation as determined by the Engineer.

The finished grade of planting area must be 1 inch below the finished grade of any surface improvement such as sidewalk and other pedestrian walking area.

The area must then be rolled in 2 directions, the second rolling at right angles to the first. The roller must be of a standard, water filled type to apply 150 to 300 pounds per square foot ground pressure. The finished grade must comply with the vertical clearance requirements adjacent to improvements as specified in Section 8-02.3(4).

8-02.3(14)B SEEDED LAWNS

Apply the Contract-specified lawn seed mix by hydroseeding, mechanical, or hand application methods as the area may require as specified in Section 9-14.2.

Rake seed and fertilizer into the top 1/2 to 1 inch of soil to produce a uniform, dense lawn. Application of seeding may be accomplished by hydroseeding as specified in Section 8-01.3(2)D, if approved by the Engineer.

For firming, roll the area in one direction.

Use sprinklers to provide 1-inch average application of water to seeded area without causing seed to be uncovered or washed away, erosion or sedimentation.

Temporary flagging and warning signs must be installed preventing the public from disturbing or damaging newly installed lawn.

The lawn establishment period as specified in Section 8-02.3(15) must follow the Engineer's acceptance of the newly installed lawn.

8-02.3(14)C SODDED LAWNS

The sod strips must be placed within 48 hours after being cut.

The soil must be adequately pre-moistened by sprinkling water before laying the sod.

Sod must be placed so that it is in full contact with the soil without voids and with a snug fit with previously laid sod. Joints must be staggered with adjacent sod strips with no voids.

On sloped areas, place sod along the contour. Where change in grade is variable, cut the sod to follow the contour as reasonably as can be done.

When installing sod to restore partially disturbed lawn areas, set the root crown of the new sod flush with the root crown of the adjacent lawn. Areas of existing lawn bordering on partial lawn restorations must be hand seeded and top dressed with a mixture of 50 percent sand and 50 percent decomposed organic mulch amendment. Such areas, not more than 2 to 4 feet in width, must provide a smooth transition between new and existing stands of grass.

Visible joints between sod strips must receive mixture of 50 percent sand and 50 percent decomposed organic mulch amendment.

Firming: Following placement, the sod must be rolled with a smooth water-filled type roller. After rolling, the sod must receive a minimum 1 inch depth of water. Lawn areas must have smooth finished grading.

Protection: Temporary flagging and warning signs must be installed to prevent the public from disturbing and damaging newly sodded area.

Conditions: Soils and amendment must not be placed when the ground is frozen, excessively wet, or in condition not amenable to acceptable planting area preparation, as determined by the Engineer.

Establishment: The lawn establishment period follows the Engineer's acceptance of the newly installed sod.

8-02.3(15) LAWN ESTABLISHMENT

Lawn establishment must consist of providing adequate and proper care for all public and private lawn areas installed within the limits of the project. During the lawn establishment period, the Contractor must ensure the continuing healthy growth of the lawn.

Adequate and proper care must include the labor, materials, and equipment necessary to keep installed lawn in a presentable condition including, but not limited to: watering, mowing, trimming, cutting with an acceptable mulch mower, litter and debris removal, edging, fertilization, weed control, repair and reseeding damaged areas, and repairing and keeping in operation irrigation systems installed as part of the Work. Use of pesticides in conjunction with lawn establishment is specified in Section 8-02.3(3). Lawn establishment work must be performed by personnel qualified in and experienced with, sustainable turf management practices. As a part of lawn establishment:

1. The Contractor must submit at least 5 Working Days in advance, the proposed watering and mowing schedules to the Engineer. The submittal must also identify the type of mower equipment to be used.
2. The lawn establishment period must start on acceptance by the Engineer based on both a uniform stand of grass and upon completion of a first mowing, and extend for a minimum of 90 Days during the active growing season (defined as consecutive Days from April 30th to October 30th).
3. Mow and edge to limit the maximum height of lawn to 3 inches. The cutting height must be 1-1/2 inches with all cuttings kept using mulching mower equipment. At Engineers direction, clippings may be collected in designated high-traffic areas during periods of heavy growth. Collected clippings must be disposed at a WDOE permitted composting facility
4. Apply a turf fertilizer with organic fertilizer or a slow release form of nitrogen at the end of the lawn establishment period at the rate of application and formulation specified in Section 9-14.3(1). Following fertilizer application, the lawn must be thoroughly watered with at least a 1 inch depth of water.
5. Watering must be accomplished as frequently as needed from March through September, with exception of periods when rainfall is adequate to supply all water needs. When water application is by automatic irrigation system, then watering must be done between the hours of 2:00 a.m. and 5:00 a.m. At a minimum, a uniform application of 1 inch of water each week is required over all lawn areas. The Contractor must be prepared to water more frequently if very dry conditions persist.
6. Lawn areas will be inspected by the Engineer during the lawn establishment period. Should the Engineer determine at any time that the Contractor is not providing adequate and proper care of the lawn or is performing unacceptable lawn establishment work; the Engineer will provide written notice to the Contractor to correct and remedy such unacceptable work or practice. The Contractor must make the necessary corrections within 5 Working Days of the date of the written notice and must provide at least 2 Working Days advance notice of doing such corrective work.
7. Approximately 10 Days before the end of the lawn establishment period, the Contractor must request a final inspection for acceptance of the established lawn. Conditions found unacceptable by the Engineer must be corrected by the Contractor within 5 Working Days of such notice. When such correction is required, the lawn establishment period must extend an additional 45 Days including performance of the requirements listed in items 1 through 4

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above. Acceptance of lawn planting as specified here must be based on a healthy, full, vigorously growing, and well-manicured stand of grass at the end of the lawn establishment period. Areas that are bare, have a poor stand of grass, are dead or dying, have weeds, or have a spotty or non-uniform grade through any cause must be remedied by regrading, removing and reseeding or resodding, refertilizing, remowing, and rewatering, as appropriate. Upon acceptance of lawn establishment by the Engineer, remove all temporary flagging and warning signs.

8-02.3(16) REMOVABLE PAVER BLOCKS IN TREE PITS

The Contractor must install paver blocks of the size and type specified at the locations shown and as specified in the Contract.

Paver blocks must be installed after the trees have been planted and the tree pits backfilled and compacted to a finished grade to allow the paver block surface to be flush with the top surface of adjacent sidewalk and curb. Use a bed of compacted sand as a setting bed for the pavers.

Voids or joints between pavers must not be wider than 1/4 inch and all voids between pavers and sidewalk and between pavers must be filled with sand. The installation method must provide a secure edge adjacent to sidewalk and curb and any slack must be around the tree trunk for trunk growth.

If for any reason paver installations in the tree pits become loosened or dislodged during the Contract Time, the Contractor must restore the paver installation to a condition acceptable to the Engineer. Excess sand and dirt must be swept up and disposed.

8-02.3(17) TURF REINFORCING GRID BLOCKS

The Contractor must install grid blocks of the type specified at the locations and as specified in the Contract.

Areas receiving grid blocks must be excavated to an 8-inch depth plus the thickness of sand bedding and grid block below the surface of adjacent sidewalk, curb, and other pedestrian traffic improvement, and then graded and compacted to a minimum depth of 1 foot to 95 percent as determined by Section 2-11.

After the subgrade has been approved by the Engineer per Section 2-09, the Contractor must install a sub base of Mineral Aggregate Type 1 to a compacted depth of 6 inches where the relative density must meet or exceed 95 percent as determined in Section 2-11. Thereafter, a 2-inch sand setting bed must be spread and tamped or rolled on top of the crushed rock base.

The grid blocks must then be placed on the sand bed and each block leveled with each adjacent block. The top of the blocks must be laid flush with the top surface of adjacent sidewalks and curbs. After the blocks have been installed and leveled, joint filling sand per Section 9-14.9(13) must be spread and worked into all voids.

The area receiving grid blocks must thereafter be seeded with grass seed of the type and in the quantity specified in the Contract.

8-02.3(18) EDGING

8-02.3(18)A EDGING, CEDAR

The Contractor must install cedar edging as required and specified in the Contract. Edgings must be installed on edge with the top of the form level with the top of the existing grades or the top of the existing adjacent concrete sidewalks and curbs. Forms must be secured with 2” x 2” x 12” cedar stakes as specified in the Contract, driven to the inside of the forms and attached to the cedar edging with eight-penny galvanized common nails.

8-02.3(18)B EDGING, PAVER RESTRAINT SYSTEM

Where a paver edge restraint system is shown on the Contract, the Contractor must prepare the soil subgrade, place and compact the base course (if required), and install the paver edge restraint system per the manufacturer’s instructions. The edging must be black or dark in color. For added support, selected Material or planting soil must be placed against the restraint system before pavers are installed. The paver restraint system must be inspected and approved by the Engineer before any backfilling occurs.

8-02.3(18)C EDGING, LANDSCAPE TIMBERS

The Contractor must install 6” x 8” landscape timbers where required in the Contract. Timbers must be installed on the 8-inch base with the top of the timber flush with the top of the concrete sidewalk or the interlocking pavers or finished surfacing as specified in the Contract. Timbers must be secured with four No. 4” x 30” long reinforcing steel bars placed along the centerline axis and driven flush with the timber surface. Reinforcing steel must be provided a minimum of 2 feet on center. Each timber must have a minimum of 2 reinforcing steel bar. The Contractor must arrange the timber edging such that no individual timber length is less than 4 feet.

8-02.3(19) BOLLARDS

8-02.3(19)A GENERAL

The Contractor must install bollards of the type and at the locations specified in the Contract. The Contractor must furnish 1 padlock and 2 keys for each removable bollard. Padlock cores must be provided as specified in the Contract. Bollards must be set in excavated holes true to line and grade in a plumb position with suitable backfill thoroughly compacted around them.

8-02.3(19)B WOOD BOLLARDS

The tops of concrete footings for wood bollards must be formed and troweled level with surrounding surfaces.

8-02.3(19)C CONCRETE BOLLARDS

The Contractor must construct reinforced concrete bollards of the type and at the location specified in the Contract.

8-02.3(19)D STEEL BOLLARDS

The Contractor must construct steel bollards of the type and at the location specified in the Contract.

8-02.3(20) BENCHES

The Contractor must install benches of the type specified and as located in the Contract. The Contractor must provide at least 4 Working Days advance notice before placement to the Engineer of proposed bench locations for verification

8-02.3(21) TREE GRATES

The Contractor must install tree grates at locations specified in the Contract. The tree pit opening in concrete sidewalk must be sized to accommodate the tree grate. Tree grates must comply with Section 9-14.14.

The tree grate must be supported by an angle iron frame, with a horizontal tolerance of 1/4 inch between grate edges and vertical legs of the angle iron support frame. This frame must be dimensioned for compatibility with the grate, and must typically consist of legs that are 1" x 1" x 1/4" structural shapes, mitered and welded at the corners. To secure the steel frame in place, anchors made of No. 4 reinforcing bars 6 inches long must be welded to the horizontal bottom leg of the angle iron frame at 18-inch centers, and embedded in the concrete sidewalk. The grates must be sized to have a minimum of 1/2-inch bearing on each horizontal angle frame leg. Top of grates must be flush with top of adjacent sidewalk. A continuous tooled scribe line must be made in the concrete sidewalk, 6 inches from and parallel to each leg of steel angle around the tree opening. Where tree grates are adjacent to curb, the scribe line must end at the curb.

Concrete sidewalk placed against the tree grate frame must have a thickened edge surrounding the grate. The thickened edge must be 8 inches wide with the depth of thickened edge nearest the grate being 8 inches deep for a width of 4 inches. The thickened edge thickness must taper to sidewalk thickness in the remaining 4-inch width.

When concrete collar is detailed on the Drawing instead of thickened edge, such collar must be no less than 8 inches deep by 8 inches wide, and must be separated from the sidewalk pavement by a through joint. The angle iron frame details and anchorage will be specified in the Contract.

8-02.3(22) RELOCATE TREE

The Contractor must perform tree relocation work per standard nursery practice. Tree removal work must be performed with the Engineer present. The tree must be relocated while in a dormant state. See dates to plant in Section 8-02.3(6)A.

The tree to be relocated must be hand watered as required for new trees in Section 8-02.3(12) if necessary to provide a fully hydrated condition for a minimum of 30 Days before digging.

The tree must be dug by hand or approved equipment. The Contractor must exercise extreme caution when working within the drip line of the tree to avoid damage to the trunk, branches or root structure. The Contractor must prevent damage to adjacent plant material. Should adjacent plant material become damaged, the Contractor must remove the damaged plant material and replace and establish new plant material as specified in Section 8-02.3(12) at no separate or additional expense to the Owner.

The root ball must be formed to encompass the entire fibrous root system within the minimum root ball diameters provided for corresponding tree trunk diameters in the table below. The depth of the root ball must be no less than 1/2 of the root ball diameter listed in the table. Exposed tree roots of 1-inch diameter and more must be cut clean before wrapping the root ball. The root ball and moisture protecting medium must be thoroughly wrapped with burlap, laced with 1/4-inch polypropylene rope, and must be kept continuously moist until planted.

Tree Trunk Diameter	Min. Root Ball Diameter
2-4 inches	2-1/2 feet
4-5 inches	4 feet
5-7 inches	5 feet
7-10 inches	6-7 feet

The Contractor must handle the tree by the root ball only. Under no circumstances will the Contractor be allowed to lift or remove the tree by the trunk. The tree must be carefully reset into the designated tree pit and planted in the same manner as a new tree. At all times, the tree root system must be kept moist.

The landscape establishment specifications in Section 8-02.3(12) must apply to relocated trees.

If a relocated tree is damaged and does not reasonably and acceptably establish itself after relocation, then the Contractor must replace the tree at the sole expense of the Contractor. Replacements for trees larger than 4-inch DBH, must

be provided in a minimum 3-1/2 to 4-inch caliper size and must be installed as specified for new trees, see Section 8-02.3(6)B. When the replacement tree is smaller in caliper than the relocated tree to be replaced, then the Contractor must reimburse the Engineer for the difference in value between per the Guide For Establishing Values of Trees and Other Plants prepared by the Council of Tree and Landscape Appraisers current edition. The Contractor is responsible for removal and proper disposal of unacceptable trees.

8-02.3(23) TREE ROOT PRUNING PROCEDURE

See Sections 1-07.16(2) and 8-02.3(7).

8-02.3(24) TUNNELING OR TRENCHING, AND TREE ROOTS

See Sections 1-07.16(2) and 8-02.3(7).

8-02.3(25) MOWING

The Contractor must mow all grass growing areas and slopes 2-1/2 horizontal to 1 vertical or flatter except for naturally wooded and undergrowth areas. Prospective Bidders must verify the estimated acreage for mowing as shown on the Contract, the topography, irregularity of the area, slopes involved, and access limitations to determine the appropriate equipment to use.

Equipment and tools must be provided such as, but not limited to, tractor operated rotary or flail type grass cutting machines and tools or other approved equipment. Power driven equipment must not cause ruts or deformation of improved areas. Sickle type grass cutters will be permitted only on slopes of drainage ditches, berms, or other rough areas. The equipment and tools must be in good repair at all times and maintained so that a clean, sharp cut of the grass results. Equipment that pulls or rips the grass or damages the turf in any manner will not be allowed. The Engineer will be the sole judge of the adequacy of the equipment and methods of use.

Grass cutting equipment must be operated in such a manner and equipped with suitable guards as to avoid throwing rocks or debris onto the pedestrian and vehicular traffic areas or beyond the Right of Way.

The Contractor must return and disperse all lawn clippings to the lawn from all pedestrian and vehicular traffic areas, and from any other improvement. At Engineers direction, clippings may be collected in designated high-traffic areas during periods of heavy growth. Collected clippings must be disposed at a WDOE permitted composting facility.

Each mowing is considered as 1 coverage of all grass areas to be mowed within a defined area. The actual number of mowings will be based on the growth rate of the grass where mowing is required. Cutting must occur at a grass height of 3 to 4 inches, producing 1-1/2 to 2-inch grass blade height.

Trimming around traffic facilities, Structures, curbs, tree pits, planting areas, or other features extending above ground must be accomplished by use of power driven or hand operated machinery and tools to achieve a neat and uniform appearance. Edging along curb and sidewalk interfaces is incidental to mowing and must be provided by the Contractor when directed to control encroachment of grass.

8-02.3(26) TREE ROOT BARRIERS

Vertical Root barriers must be installed between proposed trees and concrete sidewalk or curb as shown on the Standard Plans and Drawings per manufacturer's recommendations. Panels must be installed flush with the finished grade unless the root barrier is covered by a tree grate, covered by mulch, or out of pedestrian circulation routes, then the top barrier must be installed 1/2 inch to 9/16 inch above finished grade. Panels must be joined with locking strips or integral male/female sliding locks. Locking mechanism must have a close tolerance to restrict slippage between panels. Barriers must be installed with root deflectors facing inward.

Horizontal Root barriers must be installed as a component of tree pit preparation. Locations must be field approved by the Engineer. Root Barrier placement must be centered on the tree root ball and placed on level subgrade 1 foot below the root ball. Backfill operations must be executed to ensure compact soil conditions between the root barrier and bottom of the root ball to avoid settlement or instability of the tree during establishment.

8-02.3(27) SOIL CELLS

Install soil cells at the depths and locations shown in the Drawings and in accordance with Standard Plans 150a, 150b, 151, and 152, and the manufacturer's instructions. When conflicts arise between the manufacturer's instructions and these Specifications, the Engineer will determine and direct the applicable requirements to resolve the conflict, per Section 1-05.3(6).

8-02.3(27)A SUBMITTALS

All submittals must be made in accordance with the requirements of Sections 1-05.3 and 1-06.1.

The Contractor must submit catalog data for soil cell systems and other appurtenances per Section 1-05.3(11). Shop Drawings must include typical cross sections, profiles and plan views; minimum cover requirements; complete system configuration, including connection details, elevations, and restraint mechanisms; interface points with pavement, utilities, tree openings, and drainage elements; material specifications confirming compliance with performance and structural standards.

No fabrication or installation may begin prior to written Engineer acceptance of submittals.

For each facility, submit a soil cell layout installation plan per Section 1-05.3. The Engineer will review and accept this submittal before any ground-disturbing activity begins.

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The plan must include:

1. A facility layout plan identifying product configuration, soil cell spacing, elevations, dimensions, and all temporary lateral support requirements;
2. Measures for protection of the prepared subgrade, including methods to prevent weather damage, runoff intrusion, erosion, or contamination;
3. Procedures for subgrade preparation, verification of bearing capacity, and any conditioning of native materials prior to placement of imported fill;
4. A material management plan identifying sourcing, blending, hauling, protection, and placement methods, including compaction and consolidation criteria;
5. Identification and sequencing of all major work activities, showing coordination with other Project Site utilities, pavements, and plantings;
6. Details for installation of geotextiles, geogrids, aggregates, pavement and soil cell systems;
7. Step-by-step work sequence for constructing each facility;
8. Inspection and quality assurance activities, per Sections 8-02.3(27);
9. Performance testing procedures, such as compaction testing, geomembrane seam testing, subgrade condition assessment, soil cell condition inspection, geogrid and geotextile installation verification, or other verification required under these Specifications;
10. Planting plan and schedule with species identification, procurement timelines, and sequence relative to facility completion; and
11. Identification of responsible work crews, trades, and Subcontractors.

Any deviations from the approved soil cell installation plan require resubmission of the revised portion of the plan to the Engineer for review. The Contractor must obtain written approval for the deviation, as specified in Section 1-05.3, before implementing changes.

The Contractor must describe how soil cell installation activates will align with the Temporary Discharge Plan (TDP) outlined in Section 8-01.3(2)D. The TDP must explicitly address or cross-reference other submittals to demonstrate measures that ensure no negative impacts on surface water leaving the Project Site.

All work activities related to each soil cell must be incorporated into the most current versions of the look-ahead schedule. The schedule must include inspection activities as specified in Section 8-02.3(27).

Refer to Section 1-08.3(1)B4 for additional details on look-ahead schedule requirements.

At least 20 days prior to installation of the items in this Section, the Contractor must submit the manufacturer's product data including compressive strength, service temperature, and unit weight; the manufacturer's protection recommendations and installation instructions; and a product sample for review. Reviewed and accepted samples will be kept at the Project Site for comparison purposes and will not be returned to the Contractor.

At least 20 days prior to installation of the items in this Section, the Contractor must submit a letter from the soil cell manufacturer confirming their review and acceptance of the project, including Drawings and Specifications, Addenda, clarifications and modifications, and compliance with product installation requirements.

At least 20 days prior to installation of the items in this Section, the Contractor must also submit a test and evaluation report, including the following:

a. Compaction testing results required by these Specifications for acceptance.
b. Compost material testing results demonstrating materials meet the requirements of Section 9-14.4(8).
c. Mineral Aggregate testing results demonstrating materials meet the requirements of Section 9-03.0.
d. Planting soil testing results demonstrating materials meet the requirements of Section 9-14.1(2).

Prior to project closeout, submit the manufacturer's warranty, fully executed.

8-02.3(27)B PRECONSTRUCTION MEETING

Prior to the start of construction of the soil cell system, including excavation and any required shoring, the Contractor must coordinate, schedule, and attend a preconstruction meeting at the Project Site with the Engineer and soil cell installer. The meeting must include:

1. Review of installation layout, procedures, and means and methods (including shoring);
2. Verification of existing conditions, such as utilities and site constraints; and
3. Identification of the field supervisor and their contact information.

8-02.3(27)C LAYOUT AND ELEVATION CONTROL

Prior to excavation, stake the limits of the soil cell excavation tree pit openings using horizontal points established from the stationing, offsets, and dimensions as shown in the Drawings. Submit a layout with ties to project control for Engineer acceptance.

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After excavation and acceptance of the prepared subgrade, re-establish vertical control using project benchmarks and verify the subgrade conforms to the requirements in Section 1-05.4.

Mark the following on the prepared subgrade as shown in the Drawings:

1. Inside dimensions and centerlines of all tree pit openings;
2. Locations of light pole bases, drain inlets, utility structure and other project features within or adjacent to the soil cell layout;
3. Required minimum horizontal and vertical clearances to all existing and proposed utilities; and
4. Extent of soil cell modules to be omitted, trimmed or modified around conflicting features.

Submit a final layout for the Engineer's acceptance prior to placing and soil cell components.

8-02.3(27)D INSTALLATION REQUIREMENTS

8-02.3(27)D1 EXCAVATION

Excavate to the depths, lines, grades, and dimensions shown in the Drawings. The base of excavation for the soil cells must be uniform, level, and free of lumps, debris, or soft yielding subgrade areas.

Questions about the base of excavation, including about unsuitable soils or other soil conditions, must be directed to the Engineer. The Engineer will accept the subgrade conditions prior to placement of geotextile and aggregate subbase.

If unsuitable soils are encountered at the subgrade, or if the subgrade is pumping or appears excessively soft, repair the area in accordance with the Contract Drawings and as directed by the Engineer. If indications of the water table are observed during excavation, the Engineer must be notified in writing to provide recommendations. Do not begin installation of soil cells until unsatisfactory subgrade conditions are accepted by the Engineer.

Over-excavate beyond the soil cell perimeter to allow for the extension of aggregate subbase a minimum of 6 inches beyond the soil cell frames, and to provide adequate space for compaction of backfill around the soil cell system.

Notify the Engineer in writing of any conflicts during excavation and propose actions. Proceed only after written approval.

Where applicable, protective systems must be provided in accordance with Section 2-07.3.

8-02.3(27)D2 BASE PREPARATION

Subgrade for soil cells must be excavated, graded, and compacted as specified in the Contract Documents and in conformance with the lines, grades, and cross-sections shown on the Standard Plans, Drawings, or as established by the Engineer.

Compact the subgrade to a minimum of 95 percent of the maximum density as specified in Section 2-11.

The subgrade slope must not exceed 5 percent in any direction. If exceeded, consult the manufacturer's representative for guidance.

8-02.3(27)D3 GEOTEXTILE INSTALLATION OVER SUBGRADE

Install geotextile per Section 2-15.3. Geotextile must be placed on the prepared subgrade prior to placing the aggregate subbase. Provide full coverage and prevent the geotextile from being torn. Damaged geotextile must be repaired as indicated by the manufacturer and to the satisfaction of the Engineer. Overlaps of the geotextile must be a minimum 24 inches or to the manufacturer's recommendation, whichever is greater.

8-02.3(27)D4 IMPERMEABLE MEMBRANE INSTALLATION

An impermeable membrane liner must be installed along the side slope of the roadway zone of influence adjacent to the soil cell system following excavation as shown in the Standard Plans.

Unroll the membrane along the side slope, starting at the top and working downward, ensuring alignment with the soil cell boundary. Overlap adjacent panels by a minimum of 12 inches or as specified by the manufacturer. Secure the membrane temporarily with sandbags or approved weights to prevent movement during installation. Ensure temporary anchors do not puncture the membrane.

Seal overlaps using manufacture-approved sealant, tape, or thermal welding techniques. Ensure all seams are continuous, watertight, and free of gaps. Test seams for integrity using non-destructive methods as specified by the manufacturer.

Secure the membrane at the curb or pavement edge using one of the following methods, unless otherwise specified in the Drawings:

1. Anchor Trench: Excavate a shallow anchor trench 6-12 inches deep by 6-12 inches wide immediately adjacent to the curb or pavement edge, parallel to the roadway. Place the membrane's edge into the trench, fold neatly, and backfill with compacted soil or gravel and compact to 95%; or
2. Mechanical Fastening: Fasten the membrane to the back of curb or pavement edge using corrosion-resistant battens or strips. Lay the membrane edge over the curb lip, secure with a batten strip, and fasten with concrete anchors or bolts spaced 2 feet apart. Apply a manufacturer-approved waterproof sealant along the fastening edge to ensure a watertight seal.

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Secure the membrane along the slope and at the base using corrosion resistant landscape pins or staples as needed to prevent uplift or slippage. At the base of the slope, bury the membrane's lower edge below a thin layer of aggregate.

Place non-woven geotextile fabric over the membrane to protect against puncture during installation of aggregate subbase and backfill operations.

8-02.3(27)D5 AGGREGATE SUBBASE INSTALLATION BELOW SOIL CELL BASES

See Section 4-01.3 for Mineral Aggregate construction requirements.

Install Mineral Aggregate Type 22 for discharge subbase gravel to the depths shown in the Drawings, extending a minimum of 6 inches beyond the soil cell frames.

Unless addressed elsewhere in the Contact, construction methods used must comply with the applicable requirements of Sections 4-04.3. Ensure the subbase surface slope does not exceed 5 percent. Step soil cells if grades exceed this limit to maintain proper relation to finished grade.

8-02.3(27)D6 SOIL CELL SYSTEM AND GEOGRID INSTALLATION

Starting at tree pit openings and working outward as shown on the Drawings, place and anchor the soil cell base components on the compacted aggregate subbase following the manufacturer's installation instructions, starting at tree pit openings and working outward as shown on the Drawings.

Ensure full contact with the subbase, adjusting material to eliminate rocking or bending. The maximum tolerance for deviations in the subbase plane under soil cell base is 1/4 inch in 4 feet.

Install soil cell bases around, over, or under existing or proposed utility lines, as shown in the Drawings or as directed by the Engineer.

Check each component for damage prior to placement. Cracked or chipped units will be rejected.

Where showing on the Drawings, install perforated lateral aeration pipes within 24 inches of the soil cell frame edge in the top layer, with vertical risers at 12-ft intervals, trimmed to 6 inches above pavement level, secured with caps.

Wrap geogrid around the sides of the soil cell system, where backfill and planting soil interface, to prevent the clean aggregate backfill from entering the soil cell. Do not place geogrid between the edge of the soil cells and adjacent planting area. Cut geogrid to allow for a 6-inch overlap at the soil cell base and a 12-inch overlap over the soil cell deck or lid. Provide a minimum 12-inch overlap between adjacent geogrid sheets. Secure geogrid with cable ties along post ridges per manufacturer's instructions.

8-02.3(27)D7 BACKFILL AND PLANTING SOIL WITHIN SOIL CELL

Install backfill and planting soil in lifts with a maximum thickness of 6 inches. Place the first lift of backfill material loosely around the perimeter of the soil cell system, between the geogrid and the excavation sides.

Place the first lift of planting soil within the soil cell system to match the backfill level. Level the planting soil throughout the system, moisten and walk through the placed soil to remove air pockets and settle the soil, ensuring compaction does not exceed 80 percent.

Compact the first lift of backfill to a minimum of 95 percent of the maximum density as specified in Section 2-11.

Continue adding backfill and planting soil in 6-inch lifts as described above until the material is 2 to 3 inches below the top of the soil cell, maintaining geogrid separation. Do not compact backfill until after planting soil has been placed to backfill level.

Use special care to ensure the compaction process does not allow machinery to come into contact with the soil cells to prevent damage to the geogrid and soil cells.

No compaction equipment is permitted to operate directly on the soil cells.

During construction, keep the soil cell system free from foreign materials. The cells must be clean to the satisfaction of the Engineer.

Obtain Engineer acceptance for backfill and planting soil before installing decks and geotextile.

8-02.3(27)D8 SOIL CELL DECKS AND GEOTEXTILE

After Engineer acceptance of planting soil, remove any temporary support structure material, level soil, and install soil cell decks or top units per the manufacturer's instructions, ensuring clips lock into posts.

Fold the geogrid, installed between the backfill and planting soil, over the top of the decks, overlapping the decks by at least 12 inches. Obtain Engineer acceptance before proceeding to geotextile installation.

Install geotextile over the decks, extending to the excavation edge with a minimum 18-inch joint overlap. Leave sufficient slack for the pavement base course to push the geotextile into gaps between the decks.

For soil cell-supported sidewalk sections, install an impermeable membrane liner over the geotextile.

For soil cell-supported flexible pavement sections, place and compact final lift of backfill material to a minimum of 95 percent of the maximum density as specified in Section 2-11, such that the backfill is flush with the top of the installed deck. Compacting equipment must not come in contact with the decks. Obtain Engineer acceptance before proceeding.

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8-02.3(27)D9 PAVEMENT BASE COURSE OR FULL DEPTH SIDEWALK

For soil cell-supported sidewalk sections, install reinforced sidewalk directly over the impermeable membrane liner. Install dowel bars between all transverse through joints per Section 5-05.3(10) and install reinforcement grid in concrete as shown in the Standard Plans.

For soil cell-supported flexible pavement sections, immediately install the pavement base course over the geotextile to protect it, working from one side to conform to deck contours, if applicable.

Equipment must be kept outside the excavation area to prevent damage. For confined areas, obtain manufacturer acceptance for equipment and procedures.

Compact to a minimum of 95 percent of the maximum density as specified in Section 2-11 using a vibration or plate compactor weighing no more than 800 lbs.

Obtain Engineer acceptance before installing pavement or sidewalk.

8-02.3(27)D10 ROOT BARRIER

Install root barrier in accordance with Section 8-02.3(26).

8-02.3(27)D11 PLANTING SOIL WITHIN TREE PLANTING AREA

Remove all rubble, debris, dust, and silt from the top of the planting soil within the tree opening that may have accumulated after the initial installation of the planting soil within the soil cell.

Install additional planting soil within the tree openings to the depths indicated in the Drawings. Use the same soil used within the soil cell for planting soil within the tree openings.

Compact planting soil under the tree root ball to between 85 and 90 percent of maximum density in accordance with ASTM D698, Standard Proctor Method, to prevent settlement of the root ball.

Place trees in accordance with the Drawings.

8-02.3(27)D12 PROTECTION OF SOIL CELLS

Keep construction traffic away from the limits of the soil cell system until the final pavement or sidewalk is installed. The soil cell system does not meet full loading strength until the final paving is installed.

Provide fencing or other barriers to prevent vehicles from entering the soil cell area.

8-02.4 MEASUREMENT

Measurement for "Tree, (Type), (Size)," for "Shrub, (Type), (Size)," and for "Ground Cover, (Type), (Size)" will be per each type and size plant Material accepted by the Engineer. See Section 9-14.6(1) for typical Bid Item plant descriptions.

Seeded lawn and sod installations will be measured by ground slope measurement in square feet of actual lawn completed, established, and accepted.

Measurement for “Planting Soil,” “Compost,” and for “Mulch, (Type)” will be per cubic yard.

Measurement for “Tree Root Barrier,” will be per linear foot of the length of panels installed in the field, measured parallel to the ground surface.

Measurement for concrete collar will be as specified in Section 8-14.4 for "Sidewalk, Thickened Edge."

Measurement for “Relocate (Item)” will be per each.

Measurement for “Rock Mulch” will be per cubic yard.

Measurement for “Flexible Porous Surface Treatment” will be per square foot.

Measurement for “Soil Cell” is measured by the cubic foot based on the vertical neat line limits of the facility’s excavation footprint. The vertical neat line limits for measuring the soil cell will be a vertical plane: 1 foot, measured horizontally, outside of and parallel to the neat line of the soil cell footprint. No measurement will be made for material removed outside of the vertical neat line limits.

8-02.5 PAYMENT

1. “**Tree**, **(Type), (Size)**”, per each
2. “**Shrub**, **(Type), (Size)**”, per each
3. “**Ground Cover**, **(Type), (Size)**”, per each

The Bid Item price for "Tree, (Type), (Size)", for "Shrub, (Type), (Size)", and for "Ground Cover, (Type), (Size)" must include all costs for the work required, and not otherwise provided for in other Bid Items in this Specification Section, to furnish, plant, fertilize, cultivate, mulch, stake and maintain the size and type of planting until the initial acceptance of the planting.

4. “**Landscape Establishment, Minimum Bid ($ _____)**”, per lump sum

The Bid Item price for “Landscape Establishment, Min. Bid ($ _____)” must include all costs for the work required to establish the landscape including all costs to provide and apply water and all costs for the work required in Section 8-02.3(12). Should the Contractor determine that the cost for this work is greater than the Bid Item lump sum minimum price listed in the Bid Form, the Contractor may Bid a higher Bid Item lump sum price by crossing out the Bid Item lump sum minimum price and

extension shown on the Bid Form, writing in a higher Bid Item lump sum price and extension in the Bid Form, and initialing the change. Bids received on this Contract that contain a cost for landscape establishment of less than the Bid Item lump sum minimum price shown on the Bid Form will be changed to reflect the Bid Item lump sum minimum price allowed including the extension and must govern as becoming a part of the Bid. Payment will be made at the rate of 20 percent of the Bid Item lump sum price for "Landscape Establishment, Min. Bid ($ _____)" at the following periods: May 31, July 31, September 30.The final 40 percent will be paid at the end of the landscape establishment period and after the necessary corrections and replacements have been made. The Contractor must submit a statement on the 25th of May, 25th of July and the 25th of September including the schedule for work provided to maintain the plantings during that period.

5. "**Planting Soil**", per cubic yard
6. "**Topsoil, (Type)**", per cubic yard
7. "**Turf Area Soil**", per cubic yard

The Bid Item price for "Planting Soil", "Topsoil, (Type)", and for "Turf Area Soil" must include all costs for the work required to furnish, mix, place and grade the specified type soil.

8. "**Mulch**, **(Type)**", "Compost", per cubic yard

The Bid Item price for "Mulch, (Type)" and "Compost" must include all costs for the work required to furnish, install and rototill the specified mulch type or compost.

9. "**Paver Block**, **(Size)**", per each

The Bid Item price for "Paver Block, (Size)" must include all costs for the work required to furnish and install the specified type paver block.

10. "**Grid Block**", per square foot

The Bid Item price for "Grid Block" must include all costs for the work required to furnish and place the grid including crushed rock base, sand setting bed, planting soil and seed.

11. "**Edging**, **(Material)**", per linear foot

The Bid Item price for "Edging, (Material)" must include all costs for the work required to furnish and install the specified type edging.

12. "**Bollard**, **(Type)**", per each

The Bid Item price for "Bollard, (Type)" must include all costs for the work required to furnish and install the specified type bollard and must include the padlock for removable bollard.

13. "**Bench**", per each

The Bid Item price for "Bench" must include all costs for the work required to furnish and install the specified size and type bench.

14. "**Tree Grate**", per each set

The Bid Item price for "Tree Grate" must include all costs for the work required to furnish and install the specified tree grate including the thickened sidewalk edge or collar and iron frame as specified in the Contract. See Section 8-14.5 regarding payment for sidewalk collar as "Sidewalk, Thickened Edge" to support the tree grate.

15. "**Relocate Tree**", per each
16. "**Relocate Shrub**", per each
17. "**Relocate Ground Cover**", per each

The Bid Item price for "Relocate Tree", for "Relocate Shrub", and for "Relocate Ground Cover" must include all costs for the work required to remove, protect, store and replant the tree, shrub, or ground cover.

18. "**Sodding**", per square foot
19. "**Seeded Lawn Installation**", per square foot

The Bid Item price for "Seeded Lawn Installation" and for "Sodding" must include all costs for the work required to prepare the area, seed or sod the lawn, and establish the lawn area. If no Bid Item for Lawn Establishment is included in the Bid Form, all costs for lawn establishment must be included in the Bid Item price for the Bid Item "Sodding" or "Seeded Lawn Installation" as applicable.

When the Bid Item "Seeded Lawn Installation" is included in the Bid Form, but the Contractor (with approval of the Engineer) substitutes sodding instead of seeding for lawn installation, payment will be at the Bid Item price bid for "Seeded Lawn Installation" and no additional or separate payment will be made.

Any incidental work required to complete the seeded lawn installation or sod installation, as specified here but not specifically mentioned, is incidental to, and all costs must be included in, the Bid Item price of the Bid Item.

20. "**Lawn Establishment, Minimum Bid ($ _____)**", per lump sum

The Bid Item price for "Lawn Establishment, Min. Bid ($ _____)" must include all costs for the work required to establish the lawn including all costs to provide and apply water, to mow and to edge. To prevent unbalanced Bids, the Bid Item lump sum price Bid for "Lawn Establishment" must not be less than the Bid Item lump sum minimum price noted in the Bid Form. Should the Contractor determine that the cost for this work is greater than the Bid Item lump sum minimum price listed in the Bid Form, the Contractor may bid a higher lump sum price by crossing out the Bid Item lump sum minimum price and

extension shown on the Bid Form, writing in a higher Bid Item lump sum price and extension in the Bid Form, and initialing the change. Bids received on this Contract which contain a cost for lawn establishment of less than the Bid Item lump sum minimum price shown on the Bid Form will be changed to reflect the Bid Item lump sum minimum price allowed including the extension and must govern as becoming a part of the Bid.

Payment will be made in 2 payments at the rate of 50 percent of the Bid Item price for "Lawn Establishment, Min. Bid ($ _____)". The first payment will be processed based on the Contractors statement including a 60 Day schedule for mowing, edging, and other work provided to maintain the lawn as required by the Contract. The second and final payment will be processed at the end of the lawn establishment period based on the Contractors statement including a schedule for mowing, edging, and other work provided to complete the Contract terms.

21. "**Relocate (Item)**", per each

The Bid Item price for "Relocate (Item)" must include all costs for the work required to remove and relocate the specified item.

22. "**Tree Root Barrier**" per linear foot

The Bid Item price "Tree Root Barrier" paid per linear foot for root barriers must include full payment for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all work involved in installing root barriers, complete in place, as shown on the Standard Plans and Drawings at locations determined by the Engineer.

23. "**Rock Mulch**", per cubic yard

Payment for "Rock Mulch" must include all work required to furnish and install crushed rock mulch per Section 8-02.3(9)A in the tree pit or the location show in Drawings.

24. "**Flexible Porous Surface Treatment**", per square foot

Payment for "Flexible Porous Surface Treatment" must include all costs for the work required to furnish and install the flexible porous surface treatment product complete as specified and per the manufacturer's requirements, including excavation, subgrade preparation, and base course.

25. "**Soil Cell**", per cubic foot

Payment for "Soil Cell" includes all costs for the Work to furnish and install a complete soil cell system as specified and per the manufacturer's requirements within the soil cell vertical neat line limits, including the soil cell system components, excavation, subgrade preparation, aggregates, geotextile, geogrid, geomembrane, anchors, ties, placement of soil in soil cell and tree pit areas, root barrier, backfill, dewatering, and disposal of excavated material.

Pavement or sidewalk installed above the soil cell limits and tree planting will be paid separately.

Payment for protective system, when applicable, will be as specified in Section 2-07.5.

26. **Other payment information**

When the Bid Form does not include a Bid Item for lawn establishment and mowing and edging is required, all costs for mowing and edging must be included in the applicable Bid Items and no separate or additional payment will be made. If the Bid Form does not contain either a lawn establishment or a mowing Bid Item, payment will be as specified in Section 1-04.1(2).

Payment for clearing and grubbing will be as specified in Section 2-01.5.

Payment for establishing the subgrade of planting areas before actual planting by excavation or embankment construction will be as specified in Section 2-04.

Payment for fill Material of the type specified will be as specified in Section 4-01.5.

All costs for fertilizer and other soil amendments specified in the Contract but not set forth in the Bid Form as a separate Bid Item must be included in the Bid Item price of the applicable Bid Item.

Any incidental work required to complete the specified roadside planting, but not specifically mentioned in these Specifications is incidental to the roadside planting, and all costs must be included in the Bid Item prices of the Bid Items.

SECTION 8-03 IRRIGATION SYSTEM

8-03.1 DESCRIPTION

Section 8-03 describes furnishing and installing a complete and functional sprinkler irrigation system as specified in the Contract.

The Contractor or Subcontractor must be a Washington State licensed irrigation contractor. The irrigation system must be installed by an irrigation sprinkler installer and must be installed according to the local plumbing codes. A plumbing permit will not be required for irrigation work in the street Right of Way. At least 3 Working Days before backfilling, the Contractor must provide notice to the Engineer for SPU Customer Service Division to inspect and approve the piping and back flow prevention devices in accordance with 1-07.28 item 8D.

Electrical work must be performed by a licensed electrical contractor. Required permits for electrical work except irrigation, and except street lighting and signals, must be obtained as specified in Section 1-07.6. The Contractor must obtain a class 2 electrical permit from the Seattle Department of Construction and Inspections when required in the Contract. The Contractor must become thoroughly familiar with the electrical environment within the Project Site and with the relevant work.

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Excavations over 4 feet deep are subject to the provisions of Section 2-07.3(2).

8-03.2 MATERIALS

Materials must comply with the following Sections:

Material	Section
Irrigation System Materials	Section 9-15
Backflow Prevention Assemblies	Section 9-30.13
Electrical Conduit	Section 9-34.3
Geotextile	Section 9-37

8-03.2(1) APPLICABLE ELECTRICAL CODES

See Section 8-30.1(2).

8-03.3 CONSTRUCTION REQUIREMENTS

8-03.3(1) GENERAL

The Contractor must coordinate installation and operation of the irrigation system with landscaping construction.

The Contractor must check and verify all pertinent dimensions at the Project Site before proceeding with the Work. Before installing the irrigation system, the Contractor must carefully note all finish grades. Finish grades changed in the course of the Work must be restored so that the terrain conforms to the finished grade.

The Contractor must furnish the necessary equipment for proper execution and completion of all irrigation work and must make the connections to the water and electrical services.

After payment for the new service has been received, SPU Water Operations will furnish and install the water service, water meter and meter box. The Contractor must request service coordination with the Engineer and must allow 8 weeks for installation by SPU Water Operations.

After installation of the water service and meter, an acceptable backflow prevention assembly (BPA) between the water meter and the irrigation system must be installed and tested. The Contractor must use only a Washington State Department of Health approved backflow prevention assembly for the intended application. Contact SPU Inspection Services for inspection of the installation after the BPA is installed and tested. All backflow assemblies are required to be tested annually by backflow device testers certified by the Washington State Department of Health. See Sections 9-30.13 and 1-07.28 item 8D.

The Contractor must provide a minimum 5 Working Days advance notice to the Engineer for inspection and approval of electrical installations before Seattle City Light will make the final service connection to the hot line. Thirty Days advance notice is required for the inspection and service connection by SCL.

Where indicated on the Drawings, piping and wiring must be installed within plastic pipe sleeves of sufficient inside diameter to allow easy withdrawal and reinserting of the piping or wire. Pipe sleeves and piping must have a minimum of 12 inches soil cover for water pipes. Electrical conduit including conduit sleeves must have 18 inches soil cover or depth of soil cover conforming to the applicable electrical code for electrical wire or conduit with electrical wire, whichever is greater. The detect-a-tape must be installed 6 inches above the piping or conduit, and 4 inches above the sleeve as shown on Standard Plan 128.

8-03.3(2) LAYOUT OF IRRIGATION SYSTEM

Before construction begins, the Contractor must stake the irrigation system layout following the schematic design shown on the Drawings. Alterations of the design and changes in the layout may be expected to conform to ground conditions and to obtain full and adequate coverage of sprinkler water. The Contractor is responsible for informing the Engineer of any anticipated coverage inadequacies. However, the system as planned must not be changed without the prior authorization of the Engineer.

8-03.3(3) EXCAVATION

All pipe must be laid in trenches that must be no wider than necessary to lay pipe and install equipment (see Standard Plan 128). The top 6 inches of topsoil, when such exists, must be kept separate from other subsoil and must be used as the topmost 6-inch layer when backfill is made. Trench bottoms must be relatively smooth and be of suitable Material free from rocks, stones, or other deleterious material that might damage the pipe. All trenches must be excavated 4 inches below the required depth and backfilled to the required depth with sand or other suitable Material free from rocks or stones as approved by the Engineer.

If possible, all trenches must be on a straight line between sprinkler heads or other appurtenances and must be without abrupt changes in grade.

Care must be exercised by the Contractor when excavating trenches near existing trees. In addition to the requirements of Section 1-07.16(2), where roots are 2 inches or more in diameter, the pipe trench must be hand excavated or tunneled.

When tree roots 2 inches or larger are exposed, they must be wrapped with heavy burlap for protection and be kept moist to prevent drying. Cutting of tree roots larger than 2 inches will not be allowed. When tree roots 2 inches or less in diameter are exposed during excavation, the Contractor must clean cut the exposed roots to minimize further damage to the tree. Tree roots must not be removed by pulling them from the soil. Trenches with exposed tree roots must be backfilled within 24 hours. Trenches with burlapped roots must have the burlap removed before backfilling.

8-03.3(4) PIPING

All lateral lines and power supply lines must be a minimum of 18 inches below finished grade measured from the bottom of the pipe, and all mainlines and sleeved pipe must be a minimum 24 inches below finished grade measured from the bottom of the pipe or sleeve (see Standard Plan 128). All irrigation pipe placed under pavement, without exception, must be placed in sleeves. Such sleeves must extend a minimum of 1 foot beyond the limits of pavement.

All jacking operations must be performed per an approved jacking plan which must be submitted to the Engineer at least 5 Working Days in advance for review. Where possible, mains and laterals or section piping must be placed in the same trench and horizontally separated by 6 inches. Bedding Material must extend from 4 inches below to 6 inches above laterals, mainlines, and sleeves with the exception that power supply lines do not require 4-inch excavation or bedding below the conduit.

Mainlines and lateral lines are defined as follows:

Mainlines: All pressurized supply pipe and fittings between the water meter and the irrigation control valves.

Lateral lines: All supply pipe and fittings between the irrigation control valves and the connections to the irrigation heads. Swing joints, thick-walled pipe, flexible risers, rigid pipe risers, and associated fittings are not considered part of the lateral line but are considered incidental components of the irrigation heads.

Pipe pulling will not be allowed for installation and placement of irrigation pipe.

All sleeves required but not used in this Contract must be capped and their locations marked with metal stakes and painted blue to provide reference for the as built Drawings submitted to the Engineer upon completion of the irrigation work, see Section 8-03.3(12).

8-03.3(5) JOINTING

During construction, pipe ends must be plugged or capped to prevent entry of dirt, rocks, or other debris.

All galvanized steel pipe must have sound, clean cut, well fitted standard pipe threads. All pipe must be reamed to the full diameter and have all burrs removed before assembly. Threaded joints must be constructed using either a non-hardening, non-seizing multipurpose sealant or thread seal tape or paste as recommended by the pipe manufacturer. All threaded joints must be made tight with wrenches without the use of handle extensions. Joints that leak must be cleaned and remade with new Material. Caulking or thread cement for making joints tight will not be permitted.

PVC pipe, couplings, and fittings must be installed per the manufacturer's recommendation. The outside of the PVC pipe must be chamfered to a minimum of 1/16 inch at approximately 22 degrees. Pipe and fittings must be joined by solvent welding. Solvents used must penetrate the surface of both pipe and fitting to produce complete fusion at the joint. Use solvent and cement only as recommended by the pipe manufacturer.

PVC pipe ends must be cut at 90 degrees to their longitudinal axis and cleaned of all cutting burrs before cementing. Use approved reaming tool. Pipe ends must be wiped clean with a rag and lightly wetted with PVC primer. A light coat of cement must be applied on the inside of the fitting and a heavier coat on the outside of the pipe. The pipe must be inserted into the fitting and given a quarter turn to seat the cement. Excess cement must be wiped from the outside of the pipe. Pipe must be tested as indicated elsewhere in these Standard Specifications. No backfilling will be permitted, except at the midsection of pipe lengths, leaving joints exposed until the pressure test is completed and approved.

When connecting plastic pipe to metal pipe, install a female threaded Schedule 80 PVC coupling onto the metal pipe first; then glue the plastic pipe into the other end of the PVC coupling. No PVC pipe may be threaded or connected to a threaded fitting without an adapter.

Due to the nature of PVC pipe and fittings, the Contractor must exercise care in their handling, loading, unloading and storing to avoid damage. The pipe and fittings must be stored under cover. Pipe must be transported on a vehicle bed long enough to support its entire length so as not to subject it to undue bending or concentrated external loads. Pipe that has been dented or damaged must be set aside until such damage has been cut out and the pipe sections rejoined with a coupling.

Solvent welded joints must be given at least 15 minutes set up time before moving or handling. Pipe must be partially center loaded to prevent arching and slipping. No water must be permitted in pipe until a period of at least 10 hours has elapsed for solvent weld setting and curing.

Backfilling must be done when pipe is not in an expanded condition due to heat or pressure. Cooling of the pipe can be accomplished by operating the system for a short time before backfilling or by backfilling in the early part of the morning before the heat of the Day.

Before pressure testing, solvent welded joints must be given at least 24 hours curing time.

8-03.3(6) INSTALLATION

Final position of planting bed sprinkler heads must be as shown on Standard Plans 121 and 126 unless specified otherwise in this Section, with depth of planting mulch adjusted to expose heads in planting beds. Final position of turf

sprinkler heads must be flush with finish grade. All sprinklers adjacent to walks, curbs, and pavement must be placed 6 inches clear of the edge unless otherwise specified in Contract.

Shrub sprinkler heads must be placed on permanent risers approximately 12 inches above finished grade, except pop up risers must be used when located adjacent to walks or driveways. All risers must have approved flexible swing joints.

Final position of valve boxes, capped sleeves, and quick coupler valves in planting beds must be between 1/2 and 1 inch above finished grade or mulch. Final position of valve boxes must be flush with finish grade. The geotextile placed under the Mineral Aggregate Type 4 for the quick coupler valve as indicated on Standard Plan 121 must be a nonwoven low survivability underground drainage geotextile as specified in Section 9-37.

Drip irrigation emitters must be installed per the manufacturer's recommendations.

The irrigation Drawings are diagrammatic and are not intended to show exact locations of existing or proposed pipe valves or controllers. New items must be located in landscaped areas as closely as possible to adjacent curbs or paving.

8-03.3(7) ELECTRICAL WIRE AND CONTROLLER INSTALLATION

Wiring between the automatic controller and automatic valves can share a common neutral. Separate control conductors must be run from the automatic controller to each valve. A white colored wire must be used for the neutral as specified in the National Electrical Code. Wires must be taped together with electrical tape at 5-foot intervals and attached to the irrigation mains by at least 3 wraps of electrical tape at 10-foot intervals.

Wire must be common to each valve in the system. A loop must be provided at each valve in any wire that passes or ends at that valve. Loop knot end of spare wire at valves where wire dead ends.

Splice insulation must consist of electrical conductors twisted and bonded by approved pressure connectors and contained in a rigid plastic epoxy filled mold. Splices will be permitted only at junction boxes, valve boxes, pole bases or control cabinets. An additional 2-foot minimum length of conductor must be left at each junction box and automatic control valve to facilitate splicing and inspection.

Electrical service must be provided at controller enclosures as shown on the Drawings.

A diagram of the wiring schedule must be pasted in the controller cabinet to facilitate the selection of valves to be operated.

The minimum size of wire is determined strictly by the following table:

No. of Valves	Maximum Length of Common Wire			
	500 ft.	1000 ft.	2000 ft.	3000 ft.
1	14	14	14	14
2	14	14	14	10
3	14	14	10	8
4	14	14	10	8
5	14	10	8	6
6	14	10	6	6
7	14	8	6	4
8	14	8	6	4
9	14	8	4	4
10	10	6	4	2
11	10	6	4	-

NOTE: Wire sizes in the above table are AWG.

The control wires must be color coded as follows:

Wire Type	Color
Neutral or common wire	White
Lead-in wire	Black
Extra wire	Orange

Automatic irrigation installations include an automatic controller inside a weatherproof and tamperproof metal housing as described in Section 9-15.4. See Section 8-03.1 electrical contractor qualification requirements. When the Contractor is required to provide power supply to the controller as specified in the Contract, all electric work must be installed by an electrician licensed in the State of Washington.

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Completion of irrigation work may require inspection and approval of the electrical system by SDCI. It is the Contractor's responsibility to arrange for this inspection.

8-03.3(8) BACKFLOW PREVENTION ASSEMBLY (BPA)

Backflow prevention assemblies as specified in Section 9-30.13 must be furnished and installed in an approved vault as indicated on Standard Plan 125. The installation must be verified acceptable by the Engineer. The Contractor must notify the Engineer at least 3 Working Days in advance to have SPU Customer Service perform the inspection, also see Section 1-07.28 item 8D for notification requirements. All backflow prevention assemblies must have acceptable drainage outlets and must not be submerged in water. Any drainage problems encountered during system layout or installation must be immediately brought to the attention of the Engineer. The double check valve backflow prevention assembly is the only BPA that will be allowed installed below ground surface.

8-03.3(9) FLUSHING AND TESTING

After BPA installation and approval of the Engineer, all flushing and pressure testing must be completed before backfilling irrigation system trenches.

The Contractor must notify the Engineer at least 24 hours before conducting pressure tests.

All gauges used in the testing of water pressures must be certified calibrated within the last 6 months by an independent ASTM (or other acceptable reference standards organization) accredited testing laboratory for use on the project.

Automatic controllers must be tested for a consecutive 2 week period under normal operating conditions. If adjustments are required, the Contractor must carry them out per the manufacturer's directions and continue tests until operation is acceptable.

Flushing must be accomplished as follows:

1. All main supply lines must receive 2 fully open flushings to remove debris that may have entered the line during construction: the first one before placement of valves; the second one after placement of valves and before testing.
2. All main supply lines must be purged of air and tested with a minimum static water pressure of 150 psi for 60 minutes without introduction of additional service or pumping pressure. Testing must be done with 1 pressure gauge installed on the line at a location specified by the Engineer. The Contractor must provide a back-up pressure gage on site during pressure testing. Lines which show loss of pressure exceeding 5 psi at the ends of test periods specified in the Contract will be rejected. The Contractor must correct rejected installations and must retest them for acceptance.
3. All lateral lines must receive 1 fully open flushing before placement of sprinkler heads, emitters, and drain valves. The flushing must be of sufficient duration to remove any dirt or debris that may have entered the lateral lines during construction.
4. All lateral lines must be purged of air and tested under operating line pressure with risers capped and drain valves closed. The operating line pressure must be maintained for 30 minutes through open valves and pressure regulating devices. Lines which show leaks at the end of the specified test periods must be rejected. When conditions exist which prevent effective visual inspection of lateral lines, the Engineer may require that the lines be tested by use of pressure gauges. In that event, static water pressure, equal to operating line pressure, must be maintained in the lines for 30 minutes with valves closed and without introduction of additional service pressure. Lateral lines which show loss of pressure exceeding 5 psi at the end of specified test periods will be rejected. The Contractor must correct and retest lateral line installations that have been determined unacceptable.

Throughout the life of the Contract, the Contractor must repair, flush, and test, all main and lateral lines that have sustained a break or disruption of service. Upon restoration of the water service, the affected lines must be brought up to operating pressure. The Contractor must then conduct a thorough inspection of all components such as but not limited to sprinkler heads or emitters, located downstream of the break, disruption of service, and repair. This inspection is required to ensure that the entire irrigation system is operating properly. A minimum 2 Working Days advance notice to the Engineer is required.

8-03.3(10) ADJUSTING SYSTEM

Before system operation inspection per Section 8-03.3(13), the Contractor must adjust and balance all sprinklers to provide adequate and uniform coverage. Spray patterns must be balanced and fogging minimized by adjusting individual sprinkler heads with the adjustment screws or replacing nozzles to produce a uniform pattern. Sprinkler spray on pavement, walks, or Structures will not be permitted. The Contractor must provide the Engineer at least 2 Working Days advance notice for this inspection. See Section 1-05.11(3) for general requirements regarding operational testing.

Inadequacies not rectified by adjusting or replacing nozzles must be corrected by the Contractor to an acceptable condition at the Contractor's sole expense.

8-03.3(11) BACKFILL

The Contractor may start backfilling (except at joints, fittings, risers and valves) as soon as the section of piping and wiring has been inspected and approved by the Engineer. Once the system has been tested against leaks, and the "as built" location of the risers, fittings, and valves have been recorded by the Engineer, the remaining trench openings may be backfilled. All backfill Material placed within 6 inches of the pipe must be sand or selected Material approved by the Engineer. Backfilling from the bottom of the trench to approximately 6 inches above the pipe must be done by continuous compacting in

a manner that does not damage pipe or wiring and must proceed evenly on both sides of the pipe. The remainder of the backfill must be thoroughly compacted, except that heavy equipment must not be used within 18 inches of any pipe. The top 6 inches of backfill must consist of either topsoil or the upper 6 inches of excavated Material if found suitable by the Engineer.

Detectable marking tape must be placed in the trench 6 inches directly above, parallel to, and along the entire length of all nonmetallic water pipes and all nonmetallic and aluminum conduits placed under existing or future pavement. The width of the tape must be as recommended by the manufacturer for the maximum burial depth to be encountered on the project.

The Contractor must provide 24 hour notice to the Engineer each time an inspection or a check on system location is required. If any part of the sprinkler system is backfilled before being approved for correct location or before full inspection or testing have been carried out, the trench must be re-excavated, the system uncovered and left exposed until it is approved for backfilling by the Engineer.

Restoration of ground surface must include the resetting of removed sod. The Contractor is responsible for sod survival.

8-03.3(12) AS BUILT DRAWINGS, O&M MANUAL, AND SYSTEM ORIENTATION

Upon Physical Completion of the irrigation work including flushing and testing, and at least 5 Working Days before the training and orientation session, the Contractor must submit preliminary as-built Drawings, schematic circuit diagrams, or other Drawings as necessary so that the Engineer can prepare corrected Drawings to show the irrigation work as constructed. The as-built Drawings must be reproducible and on sheets conforming in size to the provisions of Section 1-05.3(11).

Before system operation testing (Section 8-03.3(13), the Contractor must conduct a training and orientation session covering the operation, adjustment, and maintenance of the irrigation system. The preliminary as built drawings will be reviewed and all features are to be explained. At this session, the Contractor must provide the Engineer with an Operations and Maintenance Manual (O&M Manual) per Section 1-05.11(3). The Contractor must provide written notice to the Engineer at least 2 weeks before the training and orientation session. The date and time of the training session is subject to approval of the Engineer.

The Operations and Maintenance Manual (O&M Manual) must include the following:

1. Catalogues of Materials used;
2. Parts lists;
3. Summary of all operations (including but not limited to spring start up and winterization techniques, controller programming, valve cleaning, sprinkler adjustment, backflow prevention); and
4. Names and addresses of local distributors.

Upon system operation and approval of all tests, acceptance of the system will be contingent upon the Contractor providing:

a. Signed and approved sprinkler, plumbing, electrical and health department permits;
b. Reproducible final as-built Drawings and all catalogue cuts, manufacturer's instructions and maintenance and operating information;
c. All necessary keys and tools to activate, operate and drain the system; and
d. Provide all needed instructions to insure that it continues to operate normally after departure of the Contractor.

8-03.3(13) SYSTEM OPERATION INSPECTION

After the training and orientation session per Section 8-03.3(12), the irrigation system must be completely tested and fully operable in the automatic mode before planting in the sprinkled area except where otherwise specified in Contract. The Contractor must, in the presence of the Engineer, do a water coverage test for each sprinkler zone in the system. The Contractor must change nozzles and make all necessary adjustments to obtain full coverage with minimum overspray. All balancing and adjusting of the system must have been completed before requesting system operation testing. The Contractor must be fully responsible for all maintenance, repairs, tests, inspections, and the automatic operation of the system until Work is considered complete as determined by the final inspection specified in Section 1-05.11. The Contractor's responsibility also includes draining the system before winter and reactivating it in the spring and at other times when directed by the Engineer. This responsibility continues through the landscape establishment period if a landscape establishment Bid Item is included in the Bid Form. Irrigation system maintenance must include restoration of the ground surface to compensate for settling of trenches.

For the life of the Contract, the Contractor is responsible for having annual inspections and tests performed on all cross connection control devices as required and specified by the Washington State Department of Health.

Adjustments made in the irrigation system during the system operational testing must be shown on the final as-built record set of drawings and must be submitted to the Engineer for approval within 5 Working Days after the date of system operation testing accepted by the Engineer.

8-03.4 MEASUREMENT

Bid Items of Work completed under the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs in this Section.

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8-03.5 PAYMENT

1. "**Irrigation System**, **Automatic**", per lump sum

The Bid Item price for "Irrigation System, Automatic" must include all costs for the work required to furnish, install, and test a complete working system including, but not limited to, excavation, backfill, controller, vaults, valves, valves boxes, conduit, wiring, quick couplers, risers, sprinkler heads and piping. If a hose bib assembly is included in the Contract with an irrigation system and no "Hose Bib Assembly" Bid Item is in the Bid Form, payment for the hose bib assembly is considered included in the Bid Item price for the Bid Item "Irrigation System, Automatic".

2. "**Irrigation System"**, **Manual**", per lump sum

The Bid Item price for "Irrigation System", Manual" must include all costs for the work required to furnish, install and test a complete working system including, but not limited to, excavation, backfill, valves, valve boxes, vaults, quick couplers, risers, sprinkler heads and piping.

3. "**Hose Bib Assembly**", per each

The Bid Item price for "Hose Bib Assembly" must include all costs for the work required to furnish and install the type and size of hose bib assembly specified when not installed as a component of an automatic irrigation system.

4. "**Sleeve**, **(Material), (Schedule), (Size)**", per linear foot

The Bid Item price for "Sleeve, (Material), (Schedule), (Size)" must include all costs for the work required to furnish and install the sleeve of the type and size specified.

5. "**Valve Box**, **Plastic**", per each

The Bid Item price for "Valve Box, Plastic" must include all costs for the work required to furnish and install the valve box of the type specified when "Irrigation System, Manual" and "Irrigation System, Automatic" is not in the Bid Form.

6. **Other payment information**

All costs of annual inspections and tests performed on cross connection control devices during the life of the Contract must be included in the Bid Item prices for the complete irrigation system.

All costs associated with furnishing and installing the service tap, water meter and meter box will be at Owner expense.

Payment for submittals will be made as specified in Section 1-05.3.

SECTION 8-04 CEMENT CONCRETE CURB, CURB AND GUTTER

8-04.1 DESCRIPTION

This work consists of constructing Portland cement concrete curb, and curb and gutter.

8-04.2 MATERIALS

Materials must comply with the specifications of the following Sections:

Material	Section
Non-Roadway Cement Concrete	Section 5-05
Non-Roadway Cement Concrete, w/25% pozzolans	Section 5-05
Non-Roadway Cement Concrete, High Strength	Section 5-05
Premolded Joint Filler	Section 9-04.1
Reinforcing Steel	Section 9-07

The cement concrete must be as specified in Section 5-05. Concrete mix for curb and gutter Type 410B must be Non-Roadway Cement Concrete, High Strength. Concrete mix for curb Type 410C must be Non-Roadway Cement Concrete or Non-Roadway Cement Concrete W/25% pozzolans per Section 5-05. Slump of the concrete mix must not exceed 3-1/2 inches.

Epoxy grout for curb dowel anchored in concrete must be ASTM C 881, Type 1 epoxy grout.

Dowels and reinforcing steel must be #3 deformed steel billet bars, ASTM A 615, Grade 60.

Forms may be of wood or metal or any other material at the option of the Contractor, provided that the forms as set result in a curb, or curb and gutter of the specified thickness, cross-section, grade and alignment shown on the Drawings.

8-04.3 CONSTRUCTION REQUIREMENTS

8-04.3(1) GENERAL

Excavation work to install forms for concrete curb and gutters within the dripline of trees must be accomplished by hand methods. Where curb or curb and gutter construction is in an area with exposed tree roots 2 inches or greater in diameter, the Contractor must work with the Engineer as specified in Section 1-07.16(2).

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The subgrade must be prepared as specified in Section 2-09 and properly compacted to the specified grade and width per Section 2-11. The compacted subgrade must extend at least 1 foot beyond each edge of the curb and gutter sections to provide a solid base for erecting forms.

Curb associated with monolithic curb and sidewalk must be as specified in Section 8-14.

The opening of new pavement placed with new curb must be as specified in Section 5-05.

8-04.3(1)A ERECTING FORMS

Before erecting forms, the Contractor must bring the subgrade to the required line, grade and compaction. Curbs must not be set until the subgrade has been compacted to within 1 inch of established grade.

Forms, wood or steel, must be staked securely in place, true to line and grade.

Sufficient support must be provided to the form to prevent movement. Forms must be clean and well-oiled before setting in place. After the forms are set, the top of the form must not depart from grade more than 1/8 inch when checked with a 10-foot straight edge. The alignment must not vary more than 1/8 inch in 10 feet. Immediately before placing the concrete, forms must be carefully inspected for proper grading, alignment and rigid construction. Adjustments and repairs as needed must be completed before placing concrete.

Where approved by the Engineer, curb and curb and gutter may be constructed using approved slip-form equipment. The curb must be constructed to the same requirements as the cast-in-place curb.

8-04.3(1)B PLACING CONCRETE

The subgrade must be properly compacted and brought to specified grade before placing concrete. The subgrade must be thoroughly dampened immediately before the placement of concrete. Concrete must be placed and consolidated into the forms to provide a dense, compacted concrete free of rock pockets. The exposed surfaces must be floated, finished, and brushed longitudinally with a fiber hair brush approved by the Engineer, see Section 5-05.

The rate of concrete placement must not exceed the rate at which the various placing and finishing operations can be acceptably performed as specified in this Section.

8-04.3(1)C DOWELS

Dowels must be placed in the pavement slab as detailed on Standard Plan 411.

The dowel bars must be set while the concrete is still plastic enough to not require hammering them into place.

8-04.3(1)D STRIPPING FORMS AND FINISHING

The face form of the curb must be stripped early enough in the curing process to allow correction of all irregularities that may appear.

Forms may be removed on the Day following the pour if the concrete has set sufficiently to keep its true shape and removal causes no chipping or spalling. When forms are removed before the expiration of the curing period, the concrete must be protected and cured. The exposed surface of the curb must be brushed with a fiber hair brush.

8-04.3(1)E CURING

Liquid membrane curing compound must be type 1D per Section 9-23.2 and applied to all exposed surfaces immediately after finishing. However, liquid curing compound as specified in Section 5-05 may be used with approval of the Engineer.

If, at any time during the curing period any of the forms are removed, a coat of curing compound must be applied immediately to the exposed surface. The curing compound must be applied in sufficient quantity to obscure the natural color of the concrete. Additional coats must be applied if the Engineer determines that the coverage is not adequate. The concrete must be cured for the minimum period of time set forth for pavement in Section 5-05.

8-04.3(1)F EXPANSION AND DUMMY JOINTS

Joints must be constructed in the manner shown on Standard Plans 410 and 411 at locations to match joints in new concrete pavement, unless otherwise specified in the Contract. In no case must joint spacing exceed 15 feet center to center. All expansion and construction joints must extend entirely through the curb section. Joint filler in the curb must be normal to the pavement and in full butt contact with the pavement joint. Joints must match existing transverse joints or cracks in existing pavement.

Locations of joints associated with depressed curbs for curb ramps must comply with Section 8-14.3(7).

8-04.3(1)G FINISHED WORK

When checked with a 10-foot straight edge, grade must not deviate more than 1/8 inch, and alignment must not vary more than 1/4 inch.

8-04.3(2) CURB BLOCK OUTS AT CURB RAMPS

Where new cement concrete curb is to be constructed and a new curb ramp is also to be constructed, the Contractor must block out the new curb at the locations of the new curb ramps as shown on the Standard Plans unless the Drawings indicate otherwise. New curb ramps must be constructed monolithic with curb as shown on Standard Plan series 422.

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New curb installation with no sidewalk must have depressed curb for future curb ramp installation. Typically, curb ramps are paired with each curb ramp on opposite sides of a vehicular pavement.

8-04.3(3) TYPE 410B CURB AND GUTTER

Curb and gutter must be constructed as shown on Standard Plan 410 on a compacted subgrade prepared per applicable subgrade Specifications for cement concrete pavement in Section 5-05. When extruded curb and gutter is called for, it may be extruded as a unit as specified in Section 8-06, or the curb may be extruded on the gutter section in which case steel dowels must be provided as specified in Section 8-04.3(1)C.

Premolded joint filler must be as shown on Standard Plan 411.

8-04.3(4) TYPE 410C CURB

8-04.3(4)A CEMENT CONCRETE CURB ON EXISTING PAVEMENT

Cement concrete curb constructed on an existing pavement must be doweled into the existing pavement as shown on Standard Plans 410 and 411 where indicated on the Drawings or designated by the Engineer.

Drilling holes into concrete pavement, or concrete pavement base, for # 3 dowel pins must be as specified in Section 5-05. After cleaning the hole of all debris, place #3 dowel pins into the hole and fill with epoxy grout in the manner specified in Section 5-05. Holes must be spaced as indicated on the Standard Plans. The distance from the top of the finished curb to the top of the dowel must be 1 inch. The epoxy resin system used must be Type I as specified in Section 9-26.

Premolded joint filler must be placed as shown on Standard Plan 411.

8-04.3(4)B CEMENT CONCRETE CURB ON NEW PAVEMENT

Doweled curb on new pavement must be constructed as shown on Standard Plans 410 and 411.

The pavement width must extend to the back of the curb. The pavement where the curb is to be placed must be roughened or otherwise treated so that a permanent bond can be secured between the curb and the pavement. Do not use curing compound on the pavement where curb will be constructed.

Dowels, as detailed in Standard Plans 410 and 411 must be placed at 28 inches on center in the fresh concrete pavement.

Premolded joint filler must be placed as shown on Standard Plan 411.

8-04.3(5) MOUNTABLE CURB

Mountable curb for traffic circles must be constructed with the alignment and configuration as shown on the Drawings.

The extended depth cement concrete mountable curb to be installed adjacent to asphalt pavement must have the same dimensions as other mountable curb, except the depth of curb must be extended an additional 7 inches, or more to match the greater depth of adjacent asphalt pavement.

8-04.3(6) DRAIN CURB CUT FOR BIORETENTION SWALE

Drain curb cuts must be constructed at locations shown on the Drawings per Standard Plans 295a – 295d.

8-04.3(6)A DRAIN CURB CUT NOTIFICATION REQUIREMENTS

The Contractor must notify the Engineer of the completion of the first drain curb cut constructed on the Project Site for the Engineer's review and approval per Section 1-05.6. The Contractor must have the Engineer's approval of the first installation before additional drain curb cuts are constructed.

8-04.3(6)B DRAIN CURB CUT GUTTER FLOW TEST

Gutter flow tests must be performed for all drain curb cuts, inlets and catch basin discharging into a bioretention cell. The flow tests must be performed prior to planting bioretention cells.

Gutter flow test procedure:

1. All gutter flow tests will be recorded on video in the presence of the Engineer.
2. Ensure roadway and gutter upstream of the drain curb cut and/or inlet and catch basin are free of sediment and debris. Remove debris and sediment as needed prior to conducting flow test.
3. Flow test will use potable water, see Section 2-12.3(2) for hydrant permit requirements, if applicable.
4. Remove temporary plug or other flow diversion measures used at drain curb cuts, inlets or catch basins.
5. Place the discharge hose in the traveled lane a minimum of 15 feet upstream along the gutter line of the drain curb cut, inlet or catch basin to be tested and 3 feet away from the gutter line.
6. Adjust the flow of water and/or the upstream distance as necessary such that the flow in the gutter line spreads to cover 18 inches from the curb, 1 foot prior to reaching the drain curb cut, inlet or catch basin. For an inlet test, the flow in the gutter will spread 24 inches from the curb 1 foot prior to reaching the inlet.
7. Videotape gutter flow test to document flow patterns through each drain curb cut, inlet or catch basin in presence of Engineer.

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8. All water in the gutter must flow through the drain curb cut, inlet or catch basin into the bioretention cell.
9. Upon completion of the gutter flow test, replace the temporary plug.
10. If flow is not freely flowing through the drain curb cut, inlet or catch basin to the bioretention cell as required, the Engineer will note deficiencies where adjustments are required including, but not limited to, adjusting or grinding drain curb cuts or pavement, adjusting landscaping boulders, adjusting frame and grates on new inlets and new catch basins, removing and replacing drain curb cuts, removing debris and other material inhibiting gutter flow from freely flowing into cell.
11. If erosion occurs, restore soils and plants and other materials affected.
12. Once adjustments are made, re-conduct gutter flow test including the video taping in the presence of the Engineer to confirm water flows through the drain curb cut, inlet or catch basin as required. Upon completion of the additional gutter flow test, replace the temporary plug.
13. Bioretention cell must not be planted until gutter flow test is successfully completed and documented.

8-04.3(6)C GUTTER FLOW TEST VIDEO SUBMITTAL REQUIREMENTS

Within 5 Working Days of completion of each gutter flow test, the Contractor must submit a video recording of the flow test to the Engineer. Video recording files must be submitted in MP4 format or as requested by the Engineer.

Corresponding data files must be named to indicate the location of the drain curb cut. The videos must be submitted in accordance with Section 1-05.3, with a transmittal letter defining the contents. Include the following information in the transmittal letter for each gutter flow test:

1. Date and time of day flow test performed.
2. Names of test crew members and their company name.
3. Project name, vault plan number listed on Drawings, and Drawing sheet number.
4. Location (e.g., NW 130th St, 2nd Ave NW to 3rd Ave NW).

8-04.4 MEASUREMENT

Measurement for new curb and gutter, and new curb of the type specified, will be by the linear foot along the front face of the curb for the length constructed, excluding that portion installed monolithically with new driveways or curb ramps unless otherwise specified in the Contract. Alley access ramps are considered driveways.

Unless otherwise specified in the Contract, no measurement will be made for curb where curb is placed monolithically with new driveways or new curb ramps, See Standard Plan series 422, Standard Plan 430, or Drawing details.

Measurement for “Drain Curb Cut (Type)” will be per each.

8-04.5 PAYMENT

1. “**Curb**, **Cement Concrete**”, per linear foot
2. “**Curb**, **Cement Concrete, Mountable**”, per linear foot
3. “**Curb and Gutter**, **Cement Concrete**”, per linear foot
4. “**Curb**, **Cement Concrete, w/25% Pozzolans**” per linear foot
5. “**Curb**, **Cement Concrete, Mountable, w/25% Pozzolans**” per linear foot
6. “**Curb and Gutter**, **Cement Concrete, w/25% Pozzolans**” per linear foot

The Bid Item price for “Curb, Cement Concrete…”, for “Curb, Cement Concrete, Mountable…”, and for “Curb and Gutter, Cement Concrete…” must include all costs for the work required to construct the curb or curb and gutter of the size and type specified.

Payment for Type 410C curb does not include the pavement slab on which it is placed. That portion of the pavement slab underneath Type 410C curb that is new will be paid for as concrete pavement as specified in Section 5-05.5.

7. “**Drain Curb Cut (Type)**”, per each

The Bid Item price for “Drain Curb Cut (Type)” includes all costs for the Work to install a drain curb cut, perform flow tests, and make one initial adjustment if the flow rate test results are unacceptable.

Payment for gutter flow tests and performing one initial adjustment if necessary for inlets or catch basins will be incidental to the payment for those structures.

No separate payment or extension of time will be allowed for delay to schedule based on rejection of any drain curb cut by the Engineer.

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SECTION 8-05 RESERVED

SECTION 8-06 EXTRUDED CURB

8-06.1 DESCRIPTION

This Work consists of constructing extruded asphalt concrete and cement concrete curb per these Specifications at locations shown on the Drawings and to the dimensions shown on Standard Plan 412. Except as noted otherwise in Section 8-06, all requirements for cement concrete curb as specified in Section 8-04 must apply to extruded cement concrete curb.

8-06.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Materials	Section
Non-Roadway Cement Concrete HES, High Strength	Section 5-05
Non-Roadway Cement Concrete, High Strength	Section 5-05
HMA	Section 5-04
Reinforcing Steel, Tie Bars	Section 9-07

Extruded asphalt concrete curb must consist of a hot mix asphalt concrete as specified in Section 5-04 and must be of the HMA Class specified in the Contract.

The concrete mix design for extruded cement concrete curb must be Non-Roadway Cement Concrete HES, High Strength or Non-Roadway Cement Concrete, High Strength as specified in Section 5-05.

8-06.3 CONSTRUCTION REQUIREMENTS

8-06.3(1) PREPARATION OF PAVEMENT SURFACE

8-06.3(1)A EXTRUDED ASPHALT CONCRETE CURB

The asphalt pavement must be dry and cleansed of loose or deleterious material. Immediately after cleaning the pavement surface, a tack coat of CSS-1h must be applied only to the area of the pavement where the curb is to be placed at the rate of 0.08 to 0.20 gallons per 15 square feet of curb area contact surface with pavement, depending on the width of curb and age of pavement.

8-06.3(1)B EXTRUDED CEMENT CONCRETE CURB

The pavement must be dry and cleansed of loose or deleterious Materials before curb placement. At the Contractor's option, concrete curbs must be anchored to the existing pavement either by placing steel dowel bars 1 foot on each side of every joint or by using an adhesive. Dowel bars must comply with the dimensions shown on Standard Plans 411 and 412. The adhesive must comply with Section 9-26 for Type II epoxy resin.

8-06.3(2) EQUIPMENT FOR LAYING CURB

8-06.3(2)A EXTRUDED ASPHALT CONCRETE CURB

The machine for laying the curb must be of the self-propelled type, equipped with a Material hopper, distributing screw, and adjustable curb forming devices capable of laying and compacting the hot mix asphalt concrete to the lines, grades and cross-section shown on the Drawings and as shown on Standard Plan 412. Curbs must be placed in an even homogenous manner, free of honeycombs.

8-06.3(2)B EXTRUDED CEMENT CONCRETE CURB

Extruded cement concrete curb must be placed, shaped and compacted true to line and grade with an approved extrusion machine. The extrusion machine must be capable of shaping and thoroughly compacting the concrete to the required cross-section.

8-06.3(3) MIXING AND PLACING

8-06.3(3)A EXTRUDED ASPHALT CONCRETE CURB

The HMA asphalt concrete mixture must be homogeneously mixed to as specified in Section 5-04.3(7) and must be delivered to the hopper of the laying machine at a temperature no lower than 200 °F nor higher than 300 °F. Each hopper load of the asphalt concrete mix must be run through the curb laying machine, properly adjusted to form a well compacted asphalt concrete curb.

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8-06.3(3)B EXTRUDED CEMENT CONCRETE CURB

The cement concrete mixture must be homogeneously mixed to conform with Section 5-05 when delivered to the hopper of the curb machine. Each hopper load of cement concrete must be run through the curb laying machine, adjusted properly to form and compact the cement mix for the concrete curb.

8-06.3(4) JOINTS

8-06.3(4)A EXTRUDED ASPHALT CONCRETE CURB

Asphalt concrete curb construction at the specified temperature must be a continuous operation in one direction so as to eliminate curb joints. If joints are required and approved by the Engineer, the joints between successive Days work must be carefully made in such a manner as to ensure a continuous bond between the old and new sections of the curb. The contact surface of the previously constructed curb must be painted with a thin, uniform coat of tack coat or cutback emulsion immediately before placing the fresh asphalt concrete curb against it.

8-06.3(4)B EXTRUDED CEMENT CONCRETE CURB

Joints in the extruded cement concrete curb must be spaced at 15-foot intervals or must match existing transverse joints or cracks in existing pavement. Joints must be cut vertically. Do not place joints at location of curb dowels.

8-06.3(5) CURING EXTRUDED CEMENT CONCRETE CURB

Liquid membrane curing compound must be type 1D per Section 9-23.2 and applied to all exposed surfaces immediately after finishing. However, liquid curing compound as specified in Section 5-05 may be used with approval of the Engineer.

8-06.3(6) PROTECTION FROM TRAFFIC

The newly laid extruded asphalt concrete curb must be protected from traffic by barricades or other suitable means until the heat of the asphalt concrete mixture has been dissipated and the mixture has attained its proper degree of hardness.

The newly placed extruded cement concrete curb must be protected from traffic by barricades or other suitable means for at least 72 hours when it has attained its required strength of 2500 psi.

See Sections 1-07.23 and Section 1-10.

8-06.3(7) SUBSTITUTIONS

The Contractor may substitute extruded cement concrete curb for extruded asphalt concrete curb if approved by the Engineer, as specified in Section 1-05.3(6). Asphalt curb cannot be substituted for Portland cement concrete curb.

8-06.4 MEASUREMENT

Extruded concrete curb will be measured by the linear foot along the front face of the curb and returns.

8-06.5 PAYMENT

1. "**Extruded Curb**, **HMA (Class)**", per linear foot
2. "**Extruded Curb**, **Cement Concrete**", per linear foot
3. "**Extruded Curb**, **Cement Concrete, HES (Time)**", per linear foot

The Bid Item price for "Extruded Curb…" must include all costs for the work required to furnish and install the Material type extruded curb.

4. Other information

Extruded cement concrete curb substituted for extruded asphalt curb as specified in Section 8-06.3(7) must be at the Contractor's sole expense and at no additional or separate cost to the Owner.

SECTION 8-07 PRECAST TRAFFIC CURB AND BLOCK TRAFFIC CURB

8-07.1 DESCRIPTION

This Work consists of furnishing and installing precast cement concrete traffic curb and block traffic curb of the design and type, and at the locations, specified in the Contract. See Section 8-04.3(5) for traffic control circle.

8-07.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Materials	Section
Non-Roadway Cement Concrete, High Strength	Section 5-05
Non-Roadway Cement Concrete, High Strength, w/ 25% Pozzolans	Section 5-05
Grout	Section 9-04.3(2)B

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Materials	Section
Precast & Block Traffic Curb, Water Repellent Compound, Sodium Metasilicate	Section 9-18
Paint	Section 9-29

Unless otherwise approved by the Engineer, Cement Concrete must be Non-Roadway Cement Concrete, High Strength or Non-Roadway Cement Concrete, High Strength, W/ 25% Pozzolans as specified in Section 5-05.

Glass traffic beads must comply with Section 8-22.2.

8-07.3 CONSTRUCTION REQUIREMENTS

8-07.3(1) INSTALLING CURBS

See Section 8-04 for cement concrete curb and curb and gutter.

Precast traffic curb and block traffic must be secured to underlying pavement as indicated on Standard Plan 413a. 413C curb must be anchored to the underlying pavement every other 1-inch diameter hole with an 8-inch length of No. 4 rebar (1/2-inch reinforcing steel) fully grouted into the hole. The holes without rebar must be completely filled with grout. The remaining hole above the rebar must be a minimum 1 inch and must be filled with grout. All traffic curb in contact with pavement must have the entire contact area between the curb bottom and the pavement filled with a 1/2-inch thickness bed of grout. The anchor grooves along the bottom of the curb must also be completely filled with the grout.

Before the grout bed is laid, the pavement surface must be cleaned of all dirt or other deleterious material including but not limited to oil, grease, tar, other "oily" substance, and other material that may impair good bonding. The pavement surface must be flushed with water and cleaning agents as necessary using a stiff brush to produce a surface capable of bonding new curb to pavement with the grout.

Pavement surfaces covered with oil, grease, tar, or other oily substance must be cleaned as follows:

1. The pavement must be flushed with water.
2. While the pavement is still wet, sodium metasilicate must be evenly distributed over the pavement surface at a rate of 1 to 2 pounds per 100 square feet of pavement surface.
3. The sodium metasilicate must remain on the pavement for at least 15 minutes. Areas where patches of oil, tar, or grease occur must be scrubbed with a stiff brush or broom.
4. The pavement surface must then be thoroughly rinsed.
5. Steps 2 through 4 must be repeated until a surface is obtained that can provide an acceptable grout bond.

All joints between adjacent pieces of curb, except joints for expansion and/or drainage as described in the Standard Plans and in the Contract, must be filled with grout. The Contractor must provide the Engineer at least 1 Working Day advance notice of this grouting.

Joints between adjacent units of block traffic curb must not be filled with mortar.

The alignment and the top surface of adjoining sections of curb must be true and even with a maximum tolerance of 1/16 inch.

For traffic circles and median islands (radii greater than 10 feet), all 8-inch straight block curb (dual sloped) must have 1-inch diameter holes for anchoring the curb to the pavement as shown for precast curb on Standard Plan 413a.

Nosing pieces, connecting dividers, and radial sections as detailed on the Standard Plans and Drawings are required at the ends of the curb lines for all types traffic curbs at transitions from precast traffic curb to radial or block traffic curb and at radial traffic curb installation with radii less than 10 feet.

8-07.3(2) PAINTING OF CURBS

Concrete traffic curbs must be painted with 2 full coats of approved traffic paint as specified on the Drawings. The second coat must have glass traffic paint beads uniformly sprinkled in the wet paint at the rate of 12 pounds per 100 linear feet of curbing. The glass beads must be applied as specified in Section 8-22.3(3)G.

8-07.4 MEASUREMENT

Measurement for "Curb, Traffic, Precast" and "Curb, Traffic, Block (type faces)" will be by the linear foot along the top surface of the curb and return. The nosing pieces and dividers will be measured as traffic curb.

Measurement for painting curb will be by the linear foot of curb whether 1 face or more than 1 face.

8-07.5 PAYMENT

1. "**Curb**, **Traffic, Precast**", per linear foot
2. "**Curb**, **Traffic, Block, (type faces)**", per linear foot

The Bid Item prices for "Curb, Traffic, Precast" and for "Curb, Traffic, Block" must include all costs for the work required to furnish and install the specified type traffic curb.

3. **Other payment information**.

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Payment for painting precast curb will be as specified in Section 8-22.5

SECTION 8-08 PLASTIC LANE MARKERS AND TRAFFIC BUTTONS

8-08.1 DESCRIPTION

This Work consists of furnishing and installing plastic lane markers and traffic buttons with an epoxy adhesive as specified in these Specifications and the Standard Plans.

Color of Type 1, Type 2A, and Type 2B lane markers and traffic buttons must match the color of the pavement markings on which they are installed. Type 2A markers installed adjacent to fire hydrants, see Standard Plan 314a, must be blue. The color of applicable pavement markings are set forth in Section 8-22.

8-08.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Materials	Section
Lane Markers Type 1 & Type 2, and Plastic Traffic Buttons	Section 9-21
Adhesive	Section 9-26.2, 9-02.1(8)

8-08.3 CONSTRUCTION REQUIREMENTS

8-08.3(1) GENERAL

Location and spacing must be as indicated on the Drawings or designated by the Engineer. The Engineer will provide necessary control points. The Contractor is responsible for preliminary spotting of plastic buttons and lane markers from the control points before installation. Approval by the Engineer of the layout must be obtained before traffic button or markers are installed.

8-08.3(2) SURFACE PREPARATION

Traffic buttons and lane markers must be bonded to clean and dry pavement with an adhesive as specified here.

All sand, dirt and loose extraneous Material must be removed from the marker lane location.

Large areas of tar, grease or foreign Materials may require sand blasting, steam cleaning or power brooming to accomplish complete removal. Application of traffic buttons and lane markers must not proceed until the cleaned surface has been approved by the Engineer.

8-08.3(3) ADHESIVE PREPARATION

The Contractor may use an epoxy adhesive per Section 9-26.2, or a hot applied bituminous adhesive per Section 9-02.1(8).

For epoxy adhesive, at the time of use, the contents of Packages A and B specified in Section 9-26 must be thoroughly blended by mixing to produce a uniformly distributed mixture. One volume or weight of Package A must be mixed with one volume or weight of Package B until a uniform gray color is achieved without visible streaks of white or black. Formulation may be changed, if approved by the Engineer.

Catalyst must be added to the base just before use. Unused mixed adhesive must be discarded when catalytic action has caused stiffening and reduction of workability or a small ball of jelled resin has formed in the center of the container.

The adhesive must be maintained at a temperature between 60 °F and 85 °F before use and during application.

For hot applied bituminous adhesive, the adhesive must be indirectly heated in an applicator with continuous agitation or recurring circulation. Adhesive temperature must not exceed the maximum safe heating temperature stated by the manufacturer. The Contractor must provide the Engineer with manufacturers written instruction for application temperature and maximum safe heating temperature.

8-08.3(4) APPLICATION PROCEDURE

Do not apply traffic buttons and lane markers to pavement if the ambient air temperature is below 40 °F or if the pavement is moist.

The mixed adhesive must be applied to the base of the traffic button and lane marker with a quantity sufficient to overfill all voids between the base of the traffic button or lane marker and the pavement, such that as the traffic button and marker is worked into final position, the excess adhesive is forced out to form a bead rim around the entire perimeter of the traffic button or lane marker.

Traffic buttons and lane markers must be spaced and aligned as indicated on the Standard Plans unless otherwise indicated on the Drawings or designated by the Engineer. A displacement of not more than 1/2 inch left or right of the

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established guide line will be permitted. Improperly placed buttons must be removed and replaced at the Contractor's expense.

Bonding is considered acceptable when adhesive develops a minimum bond strength in tension of not less than 10 pounds per square inch for plastic traffic buttons, and not less than 2 pounds per square inch for lane markers Type 1, Type 2A and Type 2B. Traffic must be prevented from disturbing traffic buttons and lane markers until the minimum bonding strength has been achieved.

Where it is required that both paint striping and Lane Marker Type 1 are to be installed on the same alignment, the Contractor must install the lane markers before the application of the paint striping.

Do not place markers using bitumen adhesive when the pavement or air temperature is 50 °F or cooler.

Bitumen adhesive must be indirectly heated in an applicator with continuous agitation. The adhesive must be applied at a temperature between 400 °F and 425 °F. Markers must be placed immediately after application of the adhesive.

Do not place lane markers over any pavement joint.

8-08.4 MEASUREMENT

Bid Items of Work completed under the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs in this Section.

8-08.5 PAYMENT

1. "**Lane Marker**, **(Type)**", per each
2. "**Plastic Traffic Button**, **(Type)**", per each

The Bid Item prices for "Lane Marker, (Type)" and for "Plastic Traffic Button, (Type)" must include all costs for the work required to furnish and install the specified type traffic buttons and lane markers.

SECTION 8-09 RESERVED

SECTION 8-10 FLEXIBLE DELINEATOR POSTS

8-10.1 DESCRIPTION

This Work consists of furnishing and placing flexible delineator posts of the type specified on the Drawings per these Specifications and at the locations indicated on the Drawings or where designated by the Engineer.

8-10.2 MATERIALS

Flexible delineator posts, bases, and reflective sheeting must be made of approved Materials. Flexible delineator post must be able to reset to original position and orientation after impact. The flexible delineator posts may use a reactive spring or have material strength combined with a geometric shape to achieve the reset capability.

The color of the post and base must match the color of the longitudinal pavement marking lines the post is associated with.

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Material Characteristic	Spring-Driven Reset	Material Property Reset
Material Strength	Anti-Twist Spring	Under a tensile stress of 4000 psi experiences an axial strain of 400% or less
Post Details		
Width	2.375”	3”
Height	Approximately 28”, 48”, or 66”	Approximately 28”, 48”, or 66”
Colors	White, Yellow	White, Yellow
Post Top	Short 2” section squeezed together	Open Top
Internal Components	Reactive Spring with Cut Cable	None
Application to Base	Standard: Fixed with Hardware Alternative for Select Applications: Quick Release	Quick Release
Retroreflective Sheeting Bands		
Color	Match post color	Match post color
Sheeting Grade	Type V	Type V
Bands of Sheeting	Two	Two
Band Width	3”	3”
Application to Pavement		
Base Type	Surface Mount Base	Surface Mount Base
Asphalt Surface	2-Part Epoxy and Bolted (bolt type must match pavement type)	2-Part Epoxy and Bolted (bolt type must match pavement type)
Concrete Surface	Bolted (bolt type must match pavement type)	Bolted (bolt type must match pavement type)
Structures	2-Part Epoxy	2-Part Epoxy
Base Characteristics		
Geometry:	Standard: Fixed Base 7 7/8” x 7 7/8” square Approximately 1” height Flexible Curb*	Heavy Duty, 8” Diameter Truncated cone Approximately 2” height Alternative for Select Applications: Quick Release, Flexible Curb*
Color:	Matches post color	Matches post color
* Please submit product spec sheet for approval		

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8-10.3 CONSTRUCTION REQUIREMENTS

Flexible delineator posts must be installed plumb, using a surface mount base per the manufacturer’s recommendations. The Contractor must submit to the Engineer, the manufacturer’s recommended installation procedure at least 5 Working Days before installation. Use only one type of flexible delineator post on each project.

8-10.4 MEASUREMENT

Flexible delineator posts will be measured by each post furnished and installed.

8-10.5 PAYMENT

1. “**Flexible Delineator Post**”, per each

The Bid Item price for "Flexible Delineator Post" must include all costs for the work required to furnish and install the delineator post of the type specified, including reflectorizing, base, and surface mounting hardware and materials that may be required.

SECTION 8-11 GUARDRAIL

8-11.1 DESCRIPTION

Section 8-11 describes constructing, changing, removing and resetting guardrail and anchors of the kind and type specified in the Contract and in the WSDOT C Series Standard Plans, in conformity with the lines and grades shown on the Drawings.

8-11.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Materials	Section
Guardrail Elements, Posts, Blocks, Hardware, and Anchors	Section 9-16.4 and 9-16.8

8-11.3 CONSTRUCTION REQUIREMENTS

8-11.3(1) BEAM GUARDRAIL

8-11.3(1)A ERECTION OF POSTS

The posts must be set plumb and to the true line and grade of the roadway with spacing as indicated on the Drawings. When the Drawings require that the ends of a section of guardrail be curved outward or downward, the end posts must be set to accommodate the curve. End treatment must be per the appropriate WSDOT Standard Plans unless the Contract indicates otherwise.

The dimensions of posts to be installed must be as shown on the WSDOT C Series Standard Plans unless a detailed modified design is approved by the Engineer. The length of posts for beam guardrail Type 1 with long posts must be as shown on the Drawings.

Posts may be placed in dug or drilled holes. Ramming or driving the post will be permitted only if approved by the Engineer and if no damage to the pavement, shoulders, adjacent slopes, and the post results therefrom.

In broken rock embankments, the pre punching of holes will be permitted only before final shoulder or median compaction, surfacing, and paving.

The posts must be protected from traffic at all times by attaching the rail elements or by a method approved by the Engineer.

8-11.3(1)B ERECTION OF RAIL

All metal work must be fabricated in the shop. No punching, cutting, or welding must be done in the field, except that holes for special details in exceptional cases may be drilled in the field when approved by the Engineer. The rail must be erected so that the bolts at expansion joints are at the centers of the slotted holes.

Rail plates must be assembled with the splice joints lapping in the direction of the traffic.

Galvanized rail plates must be fastened to the posts with galvanized bolts, washers, and nuts of the size and kind shown on the Drawings. Weathering steel rail plates must be fastened to the posts with weathering steel bolts, washers, and nuts of the size and kind showing on the Drawings, and must not be galvanized.

All bolts, except where otherwise required at expansion joints, must be drawn tight. Bolts through expansion joints must be drawn up as tight as possible without being tight enough to prevent the rail elements from sliding past one another longitudinally. Bolts must be sufficiently long to extend at least 1/4 inch beyond the nuts. Except where required for adjustments, bolts must not extend more than 1/2 inch beyond the nuts.

After completing the installation of weathering steel beam guardrail, the Contractor must wash the rail with clean water under high pressure. If the rail is contaminated by oil or grease, sandblast as necessary to clean the rail.

8-11.3(1)C ANCHOR INSTALLATION

All excavation, backfilling and compaction required for installation of anchors must be performed as specified in Section 2-04, Section 2-10 and Section 2-11.

Bolts must be tightened to the tension specified. The anchor cable must be tightened sufficiently to eliminate all slack.

Where additional posts are required, field drilling of the rail will be permitted when approved by the Engineer.

Type 2 concrete anchors may either be pre cast or cast in place at the option of the Contractor.

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8-11.3(1)D GUARDRAIL SHOP DRAWINGS

At least 5 Working Days in advance, the Contractor must submit to the Engineer, additional detailed Shop Drawings of rail punchings, fittings, and assemblies to verify integrity and constructability.

8-11.3(2) GUARDRAIL CONSTRUCTION EXPOSED TO TRAFFIC

Any section of beam guardrail that is removed for modification must be put back in place within 5 Calendar Days of the date the guardrail was removed.

The Contractor's operations must be conducted in such a manner that fixed objects including beam guardrail posts must be protected from traffic at all times by attachment of the rail elements and all associated hardware or by a method approved by the Engineer.

At the end of each Day, guardrail sections having an exposed end toward oncoming traffic must have a Type G terminal end section bolted securely in place.

8-11.3(3) ACCESS CONTROL GATES

Access control gates must be placed to line and grade as shown on the Drawings or as established by the Engineer. After the posts have been set, the holes must be backfilled with suitable Material and Material thoroughly tamped.

8-11.3(4) RAISING GUARDRAIL

Guardrail must be raised to the height shown on the Drawings, measured from the top of the rail to the finished shoulder surface. The Material around each post must be tamped to prevent settlement of the raised rail.

8-11.4 MEASUREMENT

Measurement of beam guardrail and beam guardrail Type 1 long posts will be by the linear foot measured along the line of the completed guardrail, including expansion sections, and will also include the terminal section for Type F connections.

Measurement of beam guardrail transition sections will be per each for the type of transition section installed. Terminal sections, except Type F connections, will be considered part of the transition section and will be included in the measurement of the transition section.

Measurement of beam guardrail anchors of the type specified will be per each for the completed anchors, including their attachment to the guardrail.

Measurement of raising beam guardrail, and removing and resetting beam guardrail will be by the linear foot measured along the line of guardrail actually raised or removed and reset. This includes transition sections, expansion sections, and terminal sections.

8-11.5 PAYMENT

1. "**Beam Guardrail**, **(Type)**", per linear foot
2. "**Beam Guardrail**, **(Type)**, Long Post", per linear foot
3. "**Weathering Steel Beam Guardrail**, **(Type)**", per linear foot

The Bid Item prices for "Beam Guardrail, (Type)", for "Beam Guardrail, (Type), Long Post", and for "Weathering Steel Beam Guardrail, (Type)" must include all costs for the work required to furnish and install the beam guardrail, including all standard and CRT ("controlled releasing terminal") treated timber posts to which the guardrail is attached.

4. "**Beam Guardrail Anchor**, **(Type)**", per each

The Bid Item price for "Beam Guardrail Anchor, (Type)" must include all costs for the work required to furnish and install the specified type anchor, including excavation, backfilling, compaction, disposal of surplus excavated Material, and surface restoration. Where Type 2 anchors are required, the additional depth of post embedment must be included in the Bid Item price of the anchor. 10" x 10" treated timber posts (or steel alternate) will be paid separately as outlined here.

5. "**Beam Guardrail Transition Section**, **(Type)**", per each

The Bid Item price per each for "Beam Guardrail Transition Section, (Type)" must include all costs for the work required to furnish and install posts, terminal sections, and attaching the transition section to masonry Structures.

6. "**Access Control Gate**", per each

The Bid Item price for "Access Control Gate" must include all costs for the work required to furnish and install the access control gate as specified, including excavating, backfilling, compacting and surface restoration.

7. "**Removing and Resetting Beam Guardrail**", per linear foot

The Bid Item price for "Removing and Resetting Beam Guardrail" must include all costs for the work required to remove, relocate, and install the beam guardrail with posts.

8. "**Raising Existing Beam Guardrail**", per linear foot

The Bid Item price per linear foot for "Raising Existing Beam Guardrail" must include all costs for the work required to remove and reset or raise the guardrail and for backfilling and compacting holes.

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SECTION 8-12 CHAIN LINK FENCE AND WIRE FENCE

8-12.1 DESCRIPTION

This Work consists of furnishing and constructing chain link fence and wire fence of the types specified the Contract, in conformity with the Standard Plans 450a, 450b, and 450c; and at the locations, lines, and grades shown on Drawings or as established by the Engineer.

8-12.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Materials	Section
Cement Concrete Class 3000	Section 6-02
Chain Link Fence, Wire Fence, and Gates	Section 9-16

Chain link fence must be of diamond woven wire mesh mounted on steel posts. All fence and gate without barbed wire must have knuckled selvage at the top and bottom edges whether the edges are free, have tension wire, or have a rail. Unless the Contract specifies otherwise, all fence and gate with barbed wire must have twisted and barbed selvage at the top and bottom edges whether the edges are free, have tension wire, or have a rail.

Wire fence must be of barbed wire or barbed wire combined with wire mesh fastened to posts. Steel posts and steel braces, or wood posts and wood braces may be used, provided only one type must be selected for use in any Contract.

Gates must consist of a steel frame or frames covered with chain link or wire mesh.

8-12.3 CONSTRUCTION REQUIREMENTS

8-12.3(1) GENERAL

Clearing of the fence line may be required. Clearing must be as specified in Section 2-01.3(1).

For chain link type fences, the clearing width must be approximately 10 feet. For wire type fences, the clearing width must be approximately 3 feet. Grubbing will not be required except where short and abrupt changes in the ground contour require cuts or fills to properly grade the fence line. All stumps within the clearing limits must be removed or close cut.

Grading of the fence line sufficient to prevent short and abrupt breaks in the ground contour and to improve the aesthetic appearance of the top of the fencing when installed is required. It is expected that in the performance of this work, machine operations will be required for chain link fencing, and hand work will be required for wire fencing except where sufficient width exists for machine work.

The fence must be constructed close to and inside the Right of Way line unless otherwise specified in the Contract. Deviations in alignment to miss obstacles will be permitted only when approved by the Engineer and only when such deviation is not visible to the traveling public or adjacent property owners.

8-12.3(2) CHAIN LINK FENCE AND GATES

8-12.3(2)A POSTS

Posts must be placed in a vertical position and, except where otherwise specified in the Contract, must be spaced at 10-foot centers. Spacing must be measured parallel to the slope of the ground.

All posts, except line posts for Type 3 fence, must be set in concrete to the dimensions shown on Standard Plans 450a and 450c. All concrete footings must be crowned so as to shed water. Line posts on Type 3 fence must be set in undisturbed earth either by driving or drilling, except as specified. Driving must be accomplished in such a manner as not to damage the post. Voids around the post must be backfilled with suitable Material and thoroughly tamped.

Concrete footings must be constructed to embed the line posts on Type 3 fence at grade depressions where the Engineer determines tension on the fence may pull the post from the ground.

Where solid rock is encountered without an overburden of soil, line posts must be into the solid rock set a minimum depth of 14 inches, and end, corner, gate, brace, and pull posts a minimum of 20 inches. The holes must have a minimum width 1 inch greater than the largest dimension of the post section to be set. The posts must be cut before installation to lengths that provide the required length of post above ground, or if the Contractor so elects, an uncut length of post set at a greater depth into the solid rock.

After the post is set and plumbed, the hole must be filled with grout consisting of 1 part Portland cement and 3 parts clean, well graded sand. The grout must be thoroughly worked into the hole so as to leave no voids. The grout must be crowned to carry water from the post.

Where solid rock is covered by an overburden of soil or loose rock, the posts must be set to the full depth shown on the Standard Plans unless penetration into solid rock reaches the minimum depths specified above, in which case the depth of penetration may be ended. Concrete footings must be constructed from the solid rock to the top of the ground. Grouting will be required on the portion of the post in solid rock.

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Pull posts, as shown on Standard Plans 450a and 450c, must be braced to adjacent line posts and spaced at 1000-foot maximum intervals for Type 1, 3 and 6 fence and at 500-foot maximum intervals for Type 4 fence.

End, gate, corner, and pull posts must be braced to the adjacent brace posts in the manner shown on Standard Plans 450a and 450c. Changes in line amounting to 2-foot tangent offset or more between posts are considered as corners for all types of fence.

Steep slopes or abrupt topography may require changes in various elements of the fence. The Contractor is responsible for providing all posts of sufficient length to accommodate the chain link fabric and ornamental tops adapted to receive the top rail.

All posts for chain link fence Types 1 and 6 must be fitted with an approved top designed to fit securely over the post and carry the top rail. All round posts for chain link fence Types 3 and 4 must have approved tops fastened securely to the posts. The base of the top fitting for round posts must carry an apron around the outside of the posts.

8-12.3(2)B TOP RAIL

Top rails must pass through the ornamental tops of the line posts, forming a continuous brace from end to end of each stretch of fence. Lengths of tubular top rail must be joined by sleeve couplings. Top rails must be securely fastened to terminal posts by pressed steel fittings or other appropriate means.

8-12.3(2)C TENSION WIRE

Use one continuous length of tension wire between pull posts. Sufficient tension must be applied to avoid excess sag between the posts. Tension wires must be tied or otherwise fastened to end, gate, corner, or pull posts using approved methods.

8-12.3(2)D CHAIN LINK FABRIC

Chain link fabric on Type 1, 3, 4, and 6 fence must be placed on the face of the post as indicated on the Drawings.

Chain link fabric on Type 1, 3, 4, and 6 fences must be placed approximately 1 inch above the ground and on a straight grade between posts by excavating high points of ground. Filling of depressions will be permitted only upon approval of the Engineer.

The fabric must be stretched taut and securely fastened to the posts. Fastening to end, gate, corner, and pull posts must be with stretcher bars and fabric bands spaced at intervals of 15 inches or less or by weaving the fabric into the fastening loops of roll formed posts. Fastening to line posts must be with tie wire, metal bands, or other approved method attached at 14-inch intervals. The top and bottom edge of the fabric must be fastened with the wires spaced at 24-inch intervals to the top rail, or top and bottom tension wires as may be applicable.

Rolls of wire fabric must be joined by weaving a single strand into the ends of the rolls to form a continuous mesh.

8-12.3(2)E CHAIN LINK GATES

Chain link fabric must be fastened to the end bars of the gate frame by stretcher bars and fabric bands and to the top and bottom bars of the gate frames by tie wires in the same manner as specified for the chain link fence fabric, or by other standard methods if approved by the Engineer.

Welded connections on gate frames where the spelter coating has been burned must be thoroughly cleaned by wire brushing and all traces of the welding flux and loose or cracked spelter removed. The clean areas must then be painted with 2 coats of galvanizing repair paint, Formula A-9-73.

The drop bar locking device for the wire gates must be provided with a 12-inch round by 18-inch deep footing of Class 3000 concrete, crowned at the top and provided with a hole to receive the locking bar. The depth of the penetration of the locking bar into the footing must be as specified by the manufacturer of the locking device. A lock approved by the Engineer must be installed on all locking gates. 4 keys must be supplied with each lock.

8-12.3(3) WIRE FENCE AND GATES

8-12.3(3)A POSTS

Line posts must be spaced at intervals not to exceed 14 feet. All intervals must be measured center to center of posts. In general, in determining the spacing of posts, measurements will be made parallel to the slope of the existing ground, and all posts must be placed in a vertical position except where otherwise specified in Contract.

Line posts may be driven in place provided the method of driving does not damage the post. Steel corner, gate, and pull posts must be set in Class 3000 concrete footings to the dimensions shown on WSDOT Standard Plans and crowned at the top to shed water.

Class 3000 concrete footings must be constructed to embed the lower part of steel line posts, and wood anchors must be placed on wood posts at grade depressions wherever the Engineer determines tension on the line wires tend to pull the post from the ground. The concrete footings must be 3 feet deep by 12 inches in diameter and crowned at the top.

Where solid rock is encountered without an overburden of soil, line posts must be set into the solid rock a minimum depth of 14 inches, and end, corner, gate, and pull posts a minimum depth of 20 inches into the solid rock. The hole must have a minimum dimension 1 inch greater than the largest dimension of the post section to be set. The posts must be cut before

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installation to lengths which provide 4-1/2 feet of post above ground, or if the Contractor so elects, 6-foot posts set 18 inches into the solid rock may be used.

After the post is set and plumbed, the hole must be filled with grout consisting of 1 part Portland cement and 3 parts clean, well graded sand. The grout must be thoroughly worked into the hole so as to leave no voids. The grout must be crowned to carry water away from the post. Where posts are set in the above manner, anchor plates and concrete footings will not be required.

Where solid rock is covered by an overburden of soil or loose rock, the posts must be set to the full depth of 2-1/2 feet unless the penetration into solid rock reaches the minimum depths specified above, in which case the depth of penetration may be ended. When the depth of the overburden is greater than 12 inches, anchor plates will be required on the steel line posts, and concrete footings must be constructed from the solid rock to the top of the ground on steel end, gate, corner, and pull posts. When the depth of overburden is 12 inches or less, anchor plates and concrete footings will not be required. Grouting will be required on the portion of the post in solid rock.

Steel braces must be anchored to soil or loose rock with a Class 3000 concrete footing not less than 18 inches on any one side and set in solid rock to a minimum depth of 10 inches in the same manner as specified above for posts. The braces must be set on the diagonal as shown on Standard Plans 450a and 450c and connected to the post with an approved connection.

Wood braces must be dapped 1/4 inch into the posts and must be fastened to each post with three 20d galvanized nails.

Wire braces must consist of a 9-gage wire passed around the wood posts to form a double wire. The wire must be fastened to each post with 2 staples and fastened together to form a continuous wire. The wires must then be twisted together until the wire is in tension.

Where the new fence joins an existing fence, the 2 must be attached in an acceptable manner, end or corner posts being set as necessary.

Pull posts must be spaced not more than 1000 feet apart, but spacing must be such as to use standard rolls of wire mesh with a minimum of cutting and waste.

Changes in alignment of 30 degrees or more are considered as corners, and corner posts must be installed. Where the Engineer determines that a change in alignment of less than 30 degrees materially lessen the strength of the fence, the line post at the angle must be supported by the addition of braces or wires in an acceptable manner.

8-12.3(3)B BARBED WIRE AND WIRE MESH

After the pull posts have been placed and securely braced, the barbed wire and mesh must be pulled taut, with no slack, and each longitudinal wire must be cut and securely fastened to the pull post with devices customarily used for the purpose. Wire or mesh must not be carried past a pull post, but must be cut and fastened to the pull post independently for the adjacent spans.

After the tensioning of the wire or mesh between 2 pull posts, all longitudinal wires must be properly fastened at proper height to each intervening line post.

Wire mesh and barbed wire must be placed on the face of the post which is away from the highway, except that on horizontal curves, the mesh and wires must be fastened to the face on the outside of the curve.

Where unusual ground depressions occur between posts, the fence must be guyed to the ground by a 9-gage galvanized wire attached to a deadperson of approximately 100 pounds buried 2 feet in the ground. The guy wire must be securely attached to each strand of barbed wire and to the top and bottom wires of the wire mesh fabric as to maintain the entire fence in its normal shape. If necessary to guy the fence in solid rock, the guy wire must be anchored in a grouted hole 2 inches in a diameter and 10 inches deep. The operation of guying must leave the fence snug with the ground.

8-12.3(3)C VERTICAL CINCH STAYS

Vertical cinch stays must be installed midway between posts on both types of fence. The wire must be twisted in such a manner as to allow weaving into the horizontal fence wires to provide rigid spacing. All barbed wires and the top, middle, and bottom wire of the wire mesh must be woven into the stay.

8-12.3(3)D WIRE GATES

The wire mesh fabric must be taut and securely tied to the frame and stays per recognized standard practice for wire gate construction.

Welded connections on gate frames must be treated as specified for chain link fence gates.

The drop bar locking device for double wire gates must be provided with a footing of Class 3000 Concrete 12 inches in diameter and 12 inches deep, crowned on top and provided with a hole to receive the locking bar. The diameter and depth of the hole in the footing must be as specified by the manufacturer of the locking device.

8-12.4 MEASUREMENT

Chain link fence, and wire fence, will be measured by the linear foot of completed fence, along the groundline, exclusive of openings.

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8-12.5 PAYMENT

1. "**Chain Link Fence**, **(Type)**", per linear foot
2. "**Wire Fence, (Type)**", per linear foot

The Bid Item prices for "Chain Link Fence, (Type)" and for "Wire Fence, (Type)" must include all costs for the work required to furnish and install a complete fence including posts, fabric, tension wire, concrete footings, excavation, backfill and compaction, and all incidentals.

3. "**Chain Link Gate**, **Single 6 Ft. Wide**", per each
4. "**Chain Link Gate**, **Double 14 Ft. Wide**", per each
5. "**Chain Link Gate**, **Double 20 Ft. Wide**", per each
6. "**Wire Gate**, **Single, 14 Ft. Wide**", per each
7. "**Wire Gate**, **Double, 20 Ft. Wide**", per each

The Bid Item prices for chain link gate and wire gate of the size and type specified must include all costs for the work required to furnish and install a complete gate including posts, fabric, concrete footings, excavation, backfill and compaction, and all incidentals including locks and keys.

8. **Other payment information**

When there is no "Clearing", "Grubbing", or "Clearing and Grubbing" Bid Item included in the Bid Form, all costs for the required clearing and grubbing must be included in the applicable fence and gate Bid Item price.

SECTION 8-13 MONUMENT AND MONUMENT CASES

8-13.1 DESCRIPTION

This Work consists of furnishing and setting monuments, monument frame and cover castings, and removing and resetting monument castings which may be covered over, damaged, or otherwise rendered useless due to construction activities.

8-13.2 MATERIALS

Materials must comply with the requirements of the following Section:

Materials	Section
Monument Frame and Covers	Section 9-22

The Engineer may specify in the Contract a gray iron casting monument case and cover complying with Standard Plans 020a for residential streets or 020b for high traffic areas, per AASHTO M36, Class 35B. The cover and seat must be machined so as to have perfect contact around the entire circumference and full width of bearing surface. Dipping, painting, plugging, welding, or repairing defects are not permitted.

Monuments furnished by the Contractor must comply with Standard Plan 020c.

8-13.3 CONSTRUCTION REQUIREMENTS

8-13.3(1) REFERENCE POINTS – GENERAL

The Contractor must not remove or destruct any monument until the monument has been tied out. The Contractor must carefully protect all reference points to the monuments. The Contractor must provide advance notices as specified in Sections 1-07.16(1)A and 1-07.28 for notification information.

The survey monument must be as shown on Standard Plan 020a and must be set by the land surveyor.

The Contractor is responsible for furnishing and installing required castings and Materials as specified in the Contract.

8-13.3(2) FURNISH AND PLACE MONUMENT CASTINGS

Where indicated on the Drawings, the Contractor must furnish and install monument frame and cover per Standard Plan 020 when specified in the Contract, monument frames and covers to the lines and grades established by the Engineer.

Where the monument casting is located within the concrete pavement or within the rigid concrete pavement base, reinforcing in the concrete pavement slab must be installed as specified in Section 5-05.3(9) and per Standard Plan 406. Monument castings installed in concrete pavement or in rigid concrete pavement base may be integrated into the pavement with a thickened edge to meet the collar depth requirements as shown on Standard Plans 020a and 020b. Monument castings installed in non-rigid pavement must be embedded into a concrete collar, as shown on Standard Plan 020a.

8-13.3(3) ADJUST EXISTING MONUMENT CASTINGS TO GRADE

Existing monument castings must be adjusted to grades as specified in Section 7-20.3(3). Monument castings installed in concrete pavement or in rigid concrete pavement base must comply with Section 7-05.3(1)N.

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8-13.3(4) RESET OR RELOCATE MONUMENT CASTINGS

The Contractor must carefully remove monument castings as required during construction and must store the castings in a secure place.

Monument castings designated for removal and not reused on the project, must be carefully removed and salvaged as specified in Section 2-02.3(7).

The monument castings must be reset by the Contractor at street grade in locations designated by the Engineer. Monument castings installed in concrete pavement or in rigid concrete pavement base must comply with Section 7-05.3(1)N.

The Contractor must replace lost or damaged castings with new castings.

8-13.3(5) MISSING AND BROKEN CASTINGS, AND EXTRA WORK

The Contractor must notify the Engineer when a monument casting or monument appears to be missing, damaged, substandard, or, adversely impacted. The Engineer will make final determination of damaged, substandard, or adversely impacted monument castings, monuments, or both. If extra work is required by the Engineer it must be addressed as specified in Section 1-04.3.

Missing or damaged monument castings, monuments, or both, resulting from Contractor operations must be replaced and installed at no cost to the Owner as specified in Section 8-13.3(2).

Monument castings, monuments, or both, not identified on the Drawings but found during construction to be missing, damaged, or substandard must be replaced as specified in Section 8-13.3(2).

Monument castings, monuments, or both, not identified on the Drawings for relocate or reset which are adversely impacted by extra work or by specified work must be reset or relocated as specified in Section 8-13.3(4).

8-13.3(6) FURNISH AND PLACE SURVEY MONUMENTS

After installing the monument casting, the Contractor must excavate to the depth required to install the new survey monument, see Standard Plan 020c. Backfill and compact to a 3-inch base of Mineral Aggregate Type 1. Backfill with Mineral Aggregate Type 1G is not allowed.

The monument must be installed and set by or under the supervision of the Contractor's Professional Land Surveyor, licensed in the State of Washington. Once the monument is placed, backfill to the limits shown on Standard Plan 020c, hand-tamping for compaction in lifts to the satisfaction of the Land Surveyor.

The Land Surveyor must punch the survey cap, with the corner mark "X" or hole punch within 3/4-inch of disc center. All new monuments must be documented with a record of survey filed with the County. See Section 1-07.28, item 17.

8-13.4 MEASUREMENT

Bid Items of Work completed under the Contract will be measured as specified in Section 1-09.1 unless otherwise provided in this Section.

8-13.5 PAYMENT

1. "**Monument Frame and Cover**", per each

The Bid Item price for "Monument Frame and Cover" must include all costs for the work required to furnish and set the monument castings.

2. "**Reset Monument Frame and Cover**", per each

The Bid Item price for "Reset Monument Frame and Cover" must include all costs for the work required to remove, store, and reset the monument castings.

3. "**Relocate Monument Frame and Cover**", per each

The Bid Item price for "Relocate Monument Frame and Cover" must include all costs for the work required to remove, store and reset the monument casting in a new location.

4. "**Relocate or Reset Monument and Monument Frame and Cover**", per each

The Bid Item Price for "Relocate or Reset Monument and Monument Frame and Cover" must include all costs for the work required to furnish and survey in the new monument, and to furnish and install a new frame and cover at a location to be determined by the Engineer. Costs for this Bid Item must also include filing a DNR "Remove or Destroy a Survey Monument Permit" per Chapter 332-120 WAC and providing a copy of this permit to the Engineer.

5. "**Survey Monument**", per each

The Bid Item price for "Survey Monument" must include all costs for the work required to furnish, install, and survey in the new monument as specified in this Section, including excavation, backfill with Mineral Aggregate Type 1, compaction, disposal of excavated materials, final survey, and filing a DNR permit completion report with a copy of the permit to the Engineer.

6. **Other payment information**

Lost or damaged castings, and castings damaged during installation resulting from the Contractor's operations must be replaced, or replaced and reinstalled, respectively, by the Contractor with a new Type 020 casting at no cost to the Owner.

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SECTION 8-14 CEMENT CONCRETE SIDEWALK

8-14.1 DESCRIPTION

Section 8-14 describes cement concrete sidewalks, thickened edge for sidewalk, monolithic curb and sidewalk, curb ramps and detectable warnings, and bus shelter footings, including excavation and subgrade preparation.

8-14.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Materials	Section
Non-Roadway Cement Concrete	Section 5-05
Non-Roadway Cement Concrete, w/25% pozzolans	Section 5-05
Non-Roadway Cement Concrete, w/25% pozzolans, High Strength	Section 5-05
Patterned Cement Concrete Treatment	Section 5-05.3(20)
Colored Cement Concrete Treatment	Section 5-05.3(20)
Exposed Aggregate Cement Concrete Treatment	Section 5-05.3(21)
Premolded Joint Filler	Section 9-04.1(1)
Detectable Warning	Section 9-36

Cement Concrete Sidewalk monolithic with handrail must be Non-Roadway Cement Concrete, High Strength, see Section 8-18.2 and Standard Plans 442, 443a and 443b.

“Six Inch Sidewalk, Cement Concrete” must be Non-Roadway Cement Concrete, High Strength.

“Six Inch Sidewalk, Cement Concrete, W/25% pozzolans” must be Non-Roadway Cement Concrete, W/25% pozzolans, High Strength.

Except for “Six Inch Sidewalk,” all new concrete sidewalk and curb ramp must be with concrete Non-Roadway Cement Concrete or Non-Roadway Cement Concrete, W/25% pozzolans (when "W/25% pozzolans" is included in Bid Item description), and the slump of all concrete mixes must not exceed 3-1/2 inches.

Patterned cement concrete is defined as additional work necessary to imprint cement concrete with a pattern, and is referenced by "Patterned" and “Running Bond Used Brick” or (other pattern) in the Bid Item description.

Colored cement concrete is defined as additional work necessary to color cement concrete with a color, and is referenced by "Colored" and a Federal Standard 595B "F (color code)" in the Bid Item description.

8-14.3 CONSTRUCTION REQUIREMENTS

8-14.3(1) GENERAL

The curb and gutter section must be placed before the placement of the sidewalk section. Where sidewalk construction is in an area with exposed tree roots 2 inches or greater in diameter, the Contractor must comply with Sections 1-07.16(2), Section 8-01 and Section 8-02.

Tree grates for tree pits installed in the sidewalk must have a concrete collar as specified in Section 8-02.3(21).

8-14.3(2) EXCAVATION AND SUBGRADE

Excavation for sidewalks must be as described in Section 2-04. Unsuitable material in the subgrade must be removed to a depth determined by the Engineer and then backfilled with suitable Material.

Embankments must be constructed per Section 2-10 and compacted by Method B as specified in Section 2-11.

Before the forms are set, the subgrade must be graded to within 1 inch of established grade and the area between the sidewalk and the adjacent private property line must be shaped to line, grade, and section shown on the Drawings and in accordance with Section 1-05.5.

Compaction of the subgrade must be to 95 percent as determined by Section 2-11.

If the Drawings call for sidewalk drains or the Engineer directs sidewalk drains to be installed, they must be installed before forms are placed. Sidewalk drains must be installed according to Section 7-01 and Standard Plan 241b.

8-14.3(3) FORMS AND FINE GRADING

Forms must conform to requirements specified in Section 5-05.3. Wood forms must be 2” x 4” (nominal) in lengths of not less than 10 feet. Steel forms may be used upon approval of the Engineer. Forms must be staked to a true line and grade. A subgrade template must then be set on the forms and the fine grading completed so that the compacted subgrade must be a minimum of 3-1/2 inches below the top of the forms. The subgrade must be thoroughly dampened before the time the concrete is placed.

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Forms must be provided around all street name sign posts and traffic sign posts that are placed in concrete areas. Forms used for this purpose must provide a 1-foot square or 1-foot diameter blockout, as approved by the Engineer.

Forms for the curb section of monolithic curb and sidewalk must be as specified in Section 8-04.3(1)A.

8-14.3(4) PLACING AND FINISHING CONCRETE

8-14.3(4)A PLACING CONCRETE

The concrete must be spread uniformly between the forms and thoroughly consolidated to a minimum thickness of 3-1/2 inches. Through joints and contraction joints must be located and constructed as specified in Section 8-14.3(6). In construction of through joints, the premolded joint filler must be adequately supported straight and vertical until the concrete is placed on both sides of the joint.

Whenever castings are located in the sidewalk area, joints must be installed at the casting location to control cracking of the sidewalk. Concrete sidewalk placed around fire hydrant must be placed around the reinforced concrete shear block with 3/8-inch premolded joint filler as detailed on Standard Plans 310a or 311a. Place a 3-inch deep by 3/8-inch thick premolded joint filler between concrete sidewalk and shear block. Concrete sidewalk placed to accommodate a tree pit with a tree grate must include a concrete collar with reinforcing steel and a joint with 3/8-inch premolded joint filler, or a concrete thickened edge, see Section 8-02.3(21). If spacing of joints or scoring is such that installation of premolded joint filler would be unsuitable, the Contractor must install rebar to strengthen the sidewalk section as required by Section 5-05.3(9) for castings in the pavement area.

Contraction joints must be formed by first cutting a groove in the concrete with a tee bar to a depth equal to, but not greater than the joint filler Material, and then working the premolded joint filler into the groove. Premolded joint filler for both through and contraction joints must be positioned in true alignment at right angles to the line of the sidewalk and be normal to and flush with the surface. Where the sidewalk is contiguous with the curb, it must be constructed with a thickened edge as shown on Standard Plan 420.

After the concrete has been thoroughly consolidated and leveled, it must be floated with floats and finished at the proper time with a metal float. Joints must be edged with a 1/4-inch radius edger and the sidewalk edges must be tooled with a 1/2-inch radius edger.

Additional requirements for placing concrete in cold weather must be as specified in Section 5-05.3(14).

Placing concrete for the curb section of the monolithic curb and sidewalk must be as specified in Section 8-04.3(1)B.

Temperature and time requirements for batching and placement must be as specified in Section 5-05.

8-14.3(4)B FINISHING CONCRETE

The surface must be brushed with a fiber hair brush of an approved type in a transverse direction except that at driveway and alley crossings it must be brushed in a longitudinal direction. The placing and finishing of all sidewalks must be performed as acceptable to the Engineer, and the tools used must be acceptable to the Engineer. After brush finish, the edges of the sidewalk and all joints must be lightly edged again with an edging tool to give it a finished appearance.

Sidewalk 120 feet in length or less must be scored to match the pattern of existing sidewalk to which new sidewalk joins unless otherwise specified in Contract. All other sidewalk must be divided into panels by scoring 1/4-inch deep "V grooves" in the manner indicated on Standard Plan 420. Unless existing pattern differs, all “V” grooves and joints must have a 2-inch wide troweled perimeter as shown on typical sidewalk detail on Standard Plan 420; this includes Business District 2’ x 2’ pattern.

Soil cell supported sidewalk must be brushed and scored to distinguish it from on-grade supported sidewalk. The surface must be brushed in a diagonal direction and scored with a 1-foot by 2-foot pattern with the 1-foot grooves in the transverse direction and 2-foot grooves in the longitudinal direction, matching the pattern of the existing adjacent sidewalk.

Additional requirements for finishing concrete in cold weather must be as specified in Section 5-05.3(14).

8-14.3(5) CURING AND PROTECTION

The curing Materials and procedures must be as specified in Section 5-05; however with Liquid membrane curing compound must be type 1D per Section 9-23.2 or must be manufactured specifically for colored concrete, unless otherwise approved by the Engineer. Curing compound must be applied to all exposed surfaces immediately after brushing and must be maintained for a period of 5 Days.

The Contractor must have readily available sufficient protective covering, such as waterproof paper or plastic membrane, to securely cover the sidewalk pour of an entire Day in event of rain or other unsuitable weather.

The sidewalk must be protected against damage or defacement of any kind until it has been accepted by the Owner.

Additional requirements for curing in hot weather must be as specified in Section 5-05.3(13)C. Additional requirements for curing in cold weather must be as specified in Section 5-05.3(14).

Curing for the curb section of the monolithic curb and sidewalk must be as specified in Section 8-04.3(1)E.

8-14.3(6) THROUGH AND CONTRACTION JOINTS

Standard locations for through joints for sidewalks are:

1. At street margins produced and at 30-foot or 28-foot intervals.

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2. To separate concrete driveways, stairways, curb ramps and their landings from sidewalks.
3. Around the vertical barrel of fire hydrants, around utility poles and large diameter underground utility cover castings when located in the sidewalk area.
4. Longitudinally between concrete walks, curbs, paved planting strips and solid masonry or concrete walls where they abut.
5. To match as nearly as possible the through joints in the adjacent pavement and curb when sidewalk abuts curb.

Transverse contraction joints must be constructed with 3/8-inch premolded joint filler 2 inches in depth, and set at intervals of 15 feet or less. Where obstacles or shortened sidewalk lengths or non-regular shaped sidewalks are encountered, the location of joints must be as specified in Contract. At no time must joint spacing exceed 15 feet.

Through joints as shown on the Standard Plans must be 3/8-inch thick premolded joint filler. The joint filler width must be cut to a width equal to the full depth of the concrete sidewalk plus 1/2 inch. When installed, the premolded joint filler must be placed with top edge 1/8 inch below the finished surface of the concrete in a plane perpendicular to the surface and with the bottom edge embedded in the subgrade. All joints must be in straight alignment, except where placed in curved locations as required by the Drawings.

Construction joints for sidewalks must conform to the applicable requirements for through joints. Construction joints formed by placing a header board transversely across the subgrade must be made at the end of each Day's paving or when placing of concrete is discontinued for more than 45 minutes. The header board must be located to conform to the spacing for the joints and must be left in place until the placing is resumed. The header must have a strip of premolded joint filler imbedded against the hardened concrete when paving is resumed.

8-14.3(7) CURB RAMP

Curb ramp alignment must be as indicated on the Drawings, or as directed in the field. The Contractor must notify the Engineer 2 Working Days in advance of placing concrete for each curb ramp to allow the Engineer the opportunity to inspect the curb ramp layout. If the curb ramp cannot be built per the Drawings, the Contractor must immediately notify the Engineer and allow 2 Working Days to resolve the problem. The Contractor must not place concrete for a curb ramp until the Engineer has either inspected and accepted the layout or waived the layout inspection.

Curb passing through the curb ramp must be monolithic with the curb ramp unless the curb ramp is built within a curb and gutter section. Curb ramps, including landings and shared landings, must be constructed separately from the sidewalk with a through joint per Section 8-14.3(6). Bond-breaking material such as polyethylene film, roofing paper, or other material as approved by the Engineer must be installed between the pavement and curb and gutter.

Concrete for curb ramps must not be overlaid or topped. The adjacent sidewalk "V" groove scoring pattern must not extend into the ramp or flared side surfaces. The subgrade for curb ramps must be graded and formed to provide a minimum concrete depth of 6 inches adjacent to the curb and tapering to a minimum depth of 3 1/2 inches at the back terminus. Curb ramp surfaces and surfaces of curb ramp landing areas must have straight and consistent line and grade. Surfaces must not vary more than ¼-inch from a 4-foot straight edge placed on the surface. All curb ramp surfaces, not including landing and shared landings, must be a heavy broom brushed finish as shown on the Standard Plans.

Side curbs are curbs that are adjacent to curb ramps but are not adjacent to street paving. Unless otherwise shown on the Drawings, side curbs must have a width of 6 inches. Depth of side curb below the ramp surface must be 6 inches. Height of side curb above the ramp surface must vary from flush to 6 inches. Side curbs must be doweled or constructed monolithically with the ramp.

Where existing sidewalk or existing curb ramp are replaced with new curb ramp and a detectable warning plate, construction of the new curb ramp must be complete and connected to the existing pedestrian routes within 5 Calendar Days of the removal of the existing curb ramp. In no case may this work extend into or through a Non-Working Day without approval of the Engineer. The only exception to the 5 Day requirement is when the product specified requires a length of time longer than 5 Days for acceptable performance. This time extension must be approved by the Engineer.

All curb ramp and curb ramp retrofit must have a detectable warning plate or detectable warning retrofit plate installed per the manufacturer's written instructions. The Contractor must ensure the concrete supporting the detectable warning plate is a plane and that the concrete base is completely bonded to and fully supporting of the detectable warning. Voids, pockets, and other irregularities in the supporting concrete base are unacceptable.

The detectable warning plate must be oriented as shown on Standard Plan series 422.

8-14.3(7)A SUBMITTAL

The Contractor must submit to the Engineer, per Section 1-05.3, the following detectable warning plate information for approval before starting curb ramp and curb ramp retrofit Work:

1. A description of the detectable warning plate proposed including the manufacturer's name, address, phone number, and web-site addresses as available. (Note – acceptable Materials are specified in Sections 9-36.2 and 9-36.3).
2. For "or equal" products other than acceptable Materials specified see Section 9-36.4 for additional submittal requirements; See Section 9-36.1 for detectable warning material and performance requirements.
3. Shop Drawings showing fabrication details, dimension details, composite structural system, joint and edge detail; preparation of the concrete surface to receive the plate; Supplies used for installation, support, and bonding; and

installation instructions for placement with new curb ramp concrete and for curb ramp retrofit as the Work requires. Where a curb ramp construction or curb ramp retrofit requires more than 3 Days to complete, provide written instruction from the manufacturer stating in detail the reasons for more than 3 Days.

4. Manufacturer's certificate of compliance indicating the product complies with these Specifications including material test reports from a testing laboratory accredited by a recognized designated standards organization such as ASTM.
5. Manufacturer's warranty against breakage, fading, and deformation (minimum 1 year).

8-14.3(7)B WASTE ACCESS RAMP

Waste access ramps must be as shown on the Drawings and Standard Plan 433. Waste access ramps must adhere to the construction requirements for curb ramps except detectable warning plate will not be installed. Tactile directional indicator must be installed at top of ramp as indicated.

8-14.3(7)C RESERVED

8-14.3(7)D DETECTABLE WARNING PLATE RETROFIT

Where specified in the Contract, existing curb ramp without a detectable warning plate must be retrofitted with a detectable warning plate. Detectable warning plates used for retrofits may also be used in through cuts of traffic islands, or on edges of platforms. Curb ramps detectable warning plate retrofits must be located as shown on the Standard Plans. Other installations must be applied at locations and dimensions detailed in the Drawings. Detectable warning plate retrofits must be a surface applied detectable warning plate system as defined in Section 9-36.3.

The Contractor must submit to the Engineer for approval, see Section 1-05.3, information on the detectable warning retrofit plate as follows:

1. Complete description of the Material including Shop Drawings showing fabrication details, composite structural system, and Supplies used for installing the plate. If not one piece, a complete description of the jointing, spacing of joints, joint details and how the plate will satisfy the ADA requirements;
2. Complete description of preparation of the surface to receive the retrofitted plate including detailed instruction on the installation and bonding procedure. Also include any curing and time to cure requirements;
3. Manufacturer's certificate of compliance indicating Material testing and performance complies with Sections 8-14.3(7) and 9-36.3, and additional testing indicating performance of the bond between the plate and existing curb ramp material over a period of time. Also include information on the test laboratory providing the test information, including a letter of certification from a designated recognized testing standards organization stating the test laboratory is accredited; and,
4. Manufacturer's warranty (minimum 1 year) against breakage, fading, deformation, and loss of bonding strength.

8-14.3(7)E FINAL INSPECTION AND AS-BUILTS

The Contractor must notify the Engineer within 1 Working Day of when the curb ramp, landing, and adjoining sidewalk has cured. The Contractor must also submit as-built Drawings indicating the constructed slopes and dimensions of the curb ramp to the Engineer with 5 Working Days of when the curb ramp, landing, and adjoining sidewalk has cured. If curb ramp slopes and dimensions depicted in the as built Drawing do not conform to the Drawings, and changes were not approved or directed by the Engineer, the curb ramp may be deemed defective and subject to removal and replacement as specified in Section 1-05.7.

All equipment for the measurement of curb ramp slopes for as built purposes must be submitted and approved by the Engineer prior to use. Slope measuring devices must be digital or electronic levels 24-inches in length, be calibrated before each use according to the manufacturer's instructions, and be in good working condition as specified in Section 1-05.9. Measurements and curb ramps measured with non-working, uncalibrated, or unapproved equipment will not be accepted.

Submittals for as built drawings and equipment must be as specified in Sections 1-05.3.

8-14.3(8) PATTERNED, COLORED, AND EXPOSED AGGREGATE TREATMENTS

The following 3 treatments may be used in areas paid as cement concrete sidewalk. Patterned and Colored can be combined for artistic sidewalks as long as the patterns to not conflict with ADA accessibility, Patterned and Colored or Exposed Aggregate and Colored may be combined for architectural landscaping in roadway traffic islands and in non-pedestrian areas. Payment for the extra effort required to create these 3 treatments will be per Section 8-14.5.

1. Patterned Cement Concrete Surface Treatment: Patterned cement concrete is defined as additional work necessary to imprint cement concrete with a pattern, and is referenced by "Patterned" and "Running Bond Used Brick" or (other pattern) in the Bid Item description and call-outs for locations on the Drawings. Other patterns may be shown on the Drawings or on Drawing Details in the Appendix of the Contract. This extra work is described in Section 5-05.3(20).
2. Colored Cement Concrete Treatment: Colored cement concrete is defined as additional work necessary to color cement concrete with a color, and is referenced by "Colored" and a Federal Standard 595B "F (color code)" in the Bid Item description and call-outs for locations on the Drawings. This extra work is described in Section 5-05.3(20).

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3. Exposed Aggregate Cement Concrete Surface Treatment: Exposed aggregate cement concrete is defined as additional work necessary to expose aggregate on the surface of cement concrete. This extra work is described in Sections 5-05.3(21).

Exposed aggregate is an architectural finish on concrete surfaces, and must not be used on new sidewalks, walkways, or any pedestrian access unless approved by SDOT. It may be used for repair of existing exposed aggregate concrete sidewalks only. It may be used for vertical or sloped features and within architectural landscaping such as within traffic inlands.

8-14.3(9) BUS SHELTER FOOTING

The Contractor must construct a bus shelter footing according to the details shown on the Drawings. Before construction, the Contractor must notify KCM at least 10 Working Days in advance so that coordinating the installation of the bus shelter by KCM forces is accommodated, see Section 1-07.28 or contact information.

8-14.3(10) STRIPPING FORMS AND FINISHING – MONOLITHIC CURB AND SIDEWALK

Stripping forms and finishing for the curb section of the monolithic curb and sidewalk must be as specified in Section 8-04.3(1)D.

Unless otherwise accepted by the Engineer, the concrete must be cured for at least 72 hours by one of the methods specified in Section 5-05.3(13)B.

8-14.4 MEASUREMENT

Measurement for “Sidewalk, Cement Concrete…”, “Six Inch Sidewalk …” and “Bus Shelter Footings…”, per square yard will be by the square yard for the surface of concrete placed. Deductions will be made for blocked out areas, castings, or other discontinuities in the sidewalk 9 square feet or larger.

Measurement for “Sidewalk, Thickened Edge” will be by the linear foot along the face of the thickened edge for the length constructed. Measurement of thickened edge will not be made through curb ramps, driveways, or alley access ramps.

Measurement for Mineral Aggregate of the Type specified will be as specified in Section 4-01.4.

Measurement for monolithic curb and sidewalk will be considered as 3 component sections as follows:

1. The first component, “Sidewalk, Cement Concrete” will be that portion of the combined section not including the area within 6 inches of the curb face and will be the square yards of actual sidewalk constructed.
2. The second component, “Curb, Cement Concrete”, will be that portion of the combined section beginning at back of curb and extending to the face of the curb, and will be the actual linear feet of curb constructed, as measured along the front curb face.
3. The third component, “Sidewalk, Thickened Edge”, will be the triangular cross-sectional portion of the combined section below the bottom of sidewalk and butting against the back of the curb section. The thickened edge will be the actual linear feet of thickened edge constructed, as measured along the face of the thickened edge.

Measurement for “Curb Ramp” will be per square yard and include the areas of monolithic curb, side curb, and back curb, as shown by the pay limits depicted in the Standard Plans.

Measurement for “Detectable Warning Plate” will be by the square foot area of detectable warning plate installed in new curb ramps and cut through islands.

Measurement for “Detectable Warning Plate Retrofit” will be by the square foot area of detectable warning plate installed in existing curb ramps.

Measurement for “Tactile Directional Indicator” will be by the linear foot.

Measurement for "Patterned Cement Concrete Treatment, Sidewalk, (pattern)" will be by the square yard of area where imprinting tools is applied.

Measurement for "Colored Cement Concrete Treatment, Sidewalk, (color), F(color code)", will be by the square yard of area of color cement concrete.

Measurement for "Exposed Aggregate Cement Concrete Treatment, Sidewalk", will be by the square yard of area of exposed aggregate cement concrete.

8-14.5 PAYMENT

1. “**Sidewalk**, **Cement Concrete**”, per square yard
2. “**Sidewalk**, **Cement Concrete, W/25% pozzolans**”, per square yard

The Bid Item price for “Sidewalk, Cement Concrete” and “Sidewalk, Cement Concrete, W/25% pozzolans” includes all costs for the work required to construct the sidewalk as specified including the earth work required to excavate Material from the top surface of the sidewalk to the sidewalk subgrade, subgrade preparation, and furnishing and installing all Materials.

Payment for the volume of earth work involved in excavating Material above the top surface of the sidewalk will be made as specified in Section 2-04.5 and 2-05.5

3. “**Sidewalk**, **Thickened Edge**”, per linear foot
4. “**Sidewalk**, **Thickened Edge, W/25% pozzolans**”, per linear foot

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The Bid Item price for “Sidewalk, Thickened Edge” and "Sidewalk, Thickened Edge, W/25% pozzolans" must include all costs for the work required to construct the thickened edge where required.

5. “**Curb Ramp**”, per square yard

6. “**Curb Ramp, W/25% pozzolans**”, per square yard

The Bid Item price for “Curb Ramp” and “Curb Ramp, W/25% pozzolans” must include all costs for the work required to construct the curb ramp and side wings complete and in place, including excavation, sidewalk thickened edge, monolithic curb, side curb, back curb, and brushed or coursed textural surface finish as shown on the Standard Plans.

Payment for the removal of existing concrete walk, curb, or curb and gutter must be made separately as specified in Section 2-02.

Unless otherwise specified, no separate payment for new curb, side curb, thickened edge, or back curb within the payment limits shown on the Standard Plans for curb ramps will be made.

Payment for detectable warning plate will be made separately as specified in this Section.

7. ”**Detectable Warning Plate**” per square foot

The Bid Item price for “Detectable Warning Plate” must include all costs for the work required to furnish and install the detectable warning plate.

8. “**Detectable Warning Plate Retrofit**”, per square foot

The Bid Item price for “Detectable Warning Plate Retrofit” must include all costs for the work required to prepare the existing curb ramp surface (or specified surface), and to furnish and install the detectable warning retrofit plate.

9. “**Tactile Directional Indicator, (Type)**”, per linear foot

The Bid Item price for “Tactile Directional Indicator, (Type)” must include all costs for the work required to furnish and install the tactile directional indicator.

10. “**Bus Shelter Footing**”, per square yard.

11. “**Bus Shelter Footing**, **W/25% pozzolans**”, per square yard

The Bid Item price for “Bus Shelter Footing” and “Bus Shelter Footing, W/25% pozzolans” must include all costs for the work required to construct the bus shelter footing.

12. "**Patterned Cement Concrete Treatment**, **Sidewalk, (pattern)**", per square yard.

The Bid Item price for “Patterned Cement Concrete” must include all costs for additional work as described in Section 5-05.3(20) and necessary to imprint cement concrete with a pattern referenced in the Bid Item description.

13. "**Colored Cement Concrete Treatment**, **Sidewalk, (color), F(color code)**", per square yard

The Bid Item price for “Colored Cement Concrete” must include all costs for additional work as described in Section 5-05.3(20) and necessary to color cement concrete with a color referenced in the Bid Item description.

14. "**Exposed Aggregate Cement Concrete Treatment**, **Sidewalk**", per square yard

The Bid Item price for “Exposed Aggregate Cement Concrete” must include all costs for additional work as described in Section 5-05.3(21) and necessary to expose aggregate of cement concrete per the Contract.

15. “**Six -Inch Sidewalk**, **Cement Concrete**”, per square yard

16. “**Six -Inch Sidewalk**, **Cement Concrete, W/25% pozzolans**”, per square yard

The Bid Item price for “Six Inch Sidewalk, Cement Concrete” and “Six Inch Sidewalk, Cement Concrete, W/25% pozzolans” must include all costs for the work required to construct the sidewalk as specified including the earth work required to excavate Material from the top surface of the sidewalk to the sidewalk subgrade, subgrade preparation, and furnishing and installing all Materials.

Payment for the volume of earth work involved in excavating Material above the top surface of the sidewalk will be made as specified in Section 2-04.

All costs for reinforcing bars constructed around castings must be included in the Bid Item price for “Six Inch Sidewalk, Cement Concrete” and “Six Inch Sidewalk, Cement Concrete, W/25% pozzolans.”

17. **Other payment information**.

Payment for imported Mineral Aggregate of the Type specified for sidewalk fill will be made as specified in Section 4-01.5.

Payment for sidewalk drains will be made as specified in Section 7-01.5.

Payment for monolithic curb and sidewalk or monolithic curb, gutter and sidewalk will be made for the Bid Item measurements as described in Section 8-14.4.

Payment for relocations of signs will be made as specified in Section 8-21.5.

Costs for finishes, edging, joints, premolded joint filler, and other minor work incidental to Section 8-14 constructions must be included in the applicable Bid Item prices.

Payment for thicken edge for the concrete collar around tree grate will be paid as “Sidewalk, Thickened Edge.”

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Payment for furnishing and installing the removable concrete panels for tree pits will be paid under applicable Bid Items as cement concrete sidewalk.

Payment for waste access ramps will be paid as “Curb Ramp” per square yard.

SECTION 8-15 RIPRAP

8-15.1 DESCRIPTION

This Work must consist of furnishing and placing riprap protection, including the furnishing and placing of geotextile and filter blanket protection of the type specified at the locations and to lines and dimensions shown on the Drawings or established by the Engineer. Riprap will be classified as heavy loose, light loose, hand placed, sack, and concrete slab riprap.

8-15.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Materials	Section
Cement Concrete Class 3000	Section 6-02
Mineral Aggregates	Section 9-03
Riprap and Quarry Spall	Section 9-13
Geotextile	Section 9-37

Filter Material must comply with the gradation requirements for Mineral Aggregate Type 13, shoulder ballast.

The geotextile must be as specified in Section 9-37, Permanent Erosion Control, High Survivability. The filtration Class of the geotextile will be specified in the Contract.

Concrete for fire hydrant concrete slab and wall applications must be Class 3000 (see Standard Plan 313).

8-15.3 CONSTRUCTION REQUIREMENTS

8-15.3(1) GENERAL

The foundation for riprap must be excavated below probable scour or to the elevation shown on the Drawings. Do not lay stones or place concrete until the foundation is approved by the Engineer. Excavation below the level of the intersection of the slope to be riprapped and the adjacent original ground, or the channel floor, or the slope, is classified as ditch excavation as defined in Section 2-05. Before placing riprap, the slopes must be dressed to the lines and grades as indicated on the Drawings or as established by the Engineer.

Where specified in Contract, the slope or the area to be protected must first be covered with a geotextile. A filter blanket is required for hand placed riprap, sack riprap and concrete slab riprap. A filter blanket is a layer of selected aggregate, or a Mineral Aggregate Type, of specified thickness placed over the geotextile as a cushioning medium on which the riprap is placed.

8-15.3(2) LOOSE RIPRAP

Loose riprap must be placed in such a manner that all relatively large stones must be essentially in contact with each other, and all voids filled with the finer Materials to provide a well graded compact mass. Dump the stone on the slope in a manner that ensures the riprap attains its specified thickness in 1 operation. Use care when dumping or placing, to avoid disturbing the underlying Material. Placing in layers parallel to the slope is not permitted. A 12-inch tolerance for loose riprap is allowed from slope plane and grade line in the finished surface.

8-15.3(3) HAND PLACED RIPRAP

The stones must be laid by hand on prepared slopes to such thickness as may be directed by the Engineer. The riprap must be started at the toe of the embankment by digging a trench and placing a course of the largest stones therein. Each stone must be placed so that it must rest on the slope of the embankment and not wholly on the stone below, and it must be thoroughly tamped or driven into place. The exposed face of all hand placed riprap must be made as smooth as the shape and size of the stones allow and must not vary more than 3 inches from a plane surface on the required slope.

8-15.3(4) SACK RIPRAP

Sack riprap that complies with Section 9-13.4 must be deposited in the trench and on the slope of the embankment to be protected as shown on the Drawings.

The concrete must be placed in the sacks to a uniform volume leaving sufficient room for effectively tying the sacks. The sacks must then be placed in longitudinal rows in the trench and on the slope to lie parallel with the slope. In placing the sacks on the slope, their outside faces must be laid against a heavy timber header or screed so that each layer is true to line and grade. The tied end of the sack must be turned under and the sack firmly pressed into place against the header or screed. Each sack must rest equally on 2 sacks below it such that vertical joints must be staggered in succeeding horizontal rows. Do

not place sack riprap in freezing weather, and work damaged by frost must be removed and replaced by the Contractor at no additional cost to the Owner.

8-15.3(5) CONCRETE SLAB RIPRAP

Concrete slab riprap except Standard Plan 313 applications must consist of concrete placed in slabs 4 inches thick unless otherwise specified in the Contract.

A trench of the dimensions shown on the Drawings or as established by the Engineer must be dug at the toe of the slope. The forms must be of the depth of the concrete to be placed.

The panel length must be 10 feet unless otherwise shown on the Drawings, and the concrete panels must be placed in layers. The joints between panels in one layer must alternate with the joints in progressive layers to present a staggered and regular joint pattern among all layers. Care must be taken not to injure the concrete in place when constructing the fill in panels. Expansion joint Material will not be required at the joints.

The concrete must be placed and rodded true to the plane of the embankment and must be finished smooth by troweling or other methods approved by the Engineer. The edges must be tooled to a 1/2-inch radius.

The riprap must be protected from flood waters and tides during the hardening of the concrete.

Weep holes must be constructed every 10 feet. All Material placed in back of the riprap and within 18 inches of weep holes must be gravel backfill for drains.

8-15.3(5)A RESERVED

8-15.3(6) QUARRY SPALLS

Quarry spalls must be placed in ditches and channels, and on slopes to be protected as specified in the Contract. After placement, the quarry spalls must be compacted by tracked equipment making a minimum of 3 passes. On steep slopes, the Contractor must compact the quarry spall as approved by the Engineer.

8-15.3(7) FILTER BLANKET

When required, a filter blanket must be placed on the prepared slope or area to the thickness specified on the Drawings using methods which do not cause segregation of particle sizes within the bedding. The surface of the finished layer must be even and free from mounds or windrows. Additional layers of filter Material, when required, must be placed using methods which do not cause mixing of the Materials in the different layers.

8-15.4 MEASUREMENT

Loose riprap will be measured by the ton of riprap actually placed.

Hand placed riprap and filter Material will be measured by the cubic yard actually placed.

Sack riprap will be measured by the cubic yard. The number of cubic yards of sack riprap placed must be computed from the number of sacks of cement actually used in the concrete mix and the yield per batch of concrete as determined from actual measurement.

Concrete slab riprap will be measured by the cubic yard based on the dimension of all slabs in-place as a whole.

Quarry spall and Mineral Aggregate will be measured by the ton actually placed.

Weepholes will not be measured.

Geotextile will be measured by the square yard as specified in Section 2-15.4.

8-15.5 PAYMENT

1. "**Heavy Loose Riprap**", per ton
2. "**Light Loose Riprap**", per ton
3. "**Hand Placed Riprap**", per cubic yard
4. "**Sack Riprap**", per cubic yard
5. "**Concrete Slab Riprap**", per cubic yard

The Bid Item prices for "Heavy Loose Riprap", for "Light Loose Riprap", for "Hand Placed Riprap", for "Sack Riprap", and for "Concrete Slab Riprap" must include all costs for the work required to furnish and install the riprap of the type specified including all excavation and backfill above the level of the intersection of the slope to be riprapped and the adjacent original ground or the channel floor or channel slope as specified in Section 8-15.3(1). When it is necessary to dump and sort individual loads, payment will be made only for that portion accepted by the Engineer.

6. "**Quarry Spalls**", per ton

The Bid Item price for "Quarry Spalls" must include all costs for the work required furnish and install quarry spall.

7. **Other payment information**

Payment for ditch excavation as defined in Section 8-15.3(1) will be made as specified in Section 2-05.5.

Payment for "Geotextile" will be made as specified in Section 2-15.5.

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Payment for Mineral Aggregate will be as specified in Section 4-01.5.

All cost for weep holes must be included in the appropriate Bid Item prices

SECTION 8-16 CONCRETE SLOPE PROTECTION

8-16.1 DESCRIPTION

Section 8-16 describes constructing concrete slope protection, in conformity with and at the locations, lines, and grades, as shown on Drawings and as established by the Engineer.

8-16.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Materials	Section
Concrete Class 3000	Section 6-02
Wire Mesh	Section 9-07.7
Concrete Slope Protection	Section 9-13

8-16.3 CONSTRUCTION REQUIREMENTS

8-16.3(1) FOOTING AND PREPARATION OF SLOPE

The footing for the slope protection must be constructed as specified in Section 2-04 and Section 6-02.

The surface on which application is to be made must be thoroughly compacted and neatly trimmed to line and grade as necessary to conform to the detail on the Drawings.

8-16.3(2) PLACING SEMI OPEN CONCRETE MASONRY UNITS

The concrete masonry units must be placed in a uniform plane, as indicated on the Drawings, in such a manner that they rest firmly and evenly against the slope with no rocking. The concrete masonry units must be placed in horizontal parallel courses, and successive courses must break joints with the preceding course to form a running bond.

8-16.3(3) CAST IN PLACE CEMENT CONCRETE

The wire mesh must lap a minimum of 1 mesh spacing, and laps must be securely fastened at the ends. During the placement of the concrete, the reinforcement must be supported in place so as to provide a minimum of 1-1/4 inches of cover.

Where Class 3000 cement concrete is to be placed on the slope, the method of depositing and compacting must result in a compact, dense, and impervious concrete which shows a uniformly plane surface.

The newly constructed concrete must be finished by a wood float and must be striated with a rustication joint as shown on the Drawings.

Curing must be performed as specified in Section 6-02.

8-16.3(4) PNEUMATICALLY PLACED CONCRETE

Workers: Only workers experienced in pneumatically placed concrete must be used; and acceptable evidence of such experience must be submitted when requested by the Engineer.

Equipment: The Contractor must submit to the Engineer 2 copies of the manufacturer's specifications and operating instructions for the equipment used. Before placement of any portion of the slope protection, the type of equipment and method of operation must be approved by the Engineer.

Proportions of Materials: The sand/cement ratio must be 4-1/2 parts sand to 1 part cement based on loose dry volume.

Water must be maintained at a constant pressure which must be at least 15 psi above atmospheric pressure at the nozzle. For lengths of hose up to 100 feet, pneumatic pressure at the gun must be 45 psi or greater. Pressure must be increased 5 psi for each additional 5-foot increment over 100 feet of hose required. A steady pressure must be maintained.

Method of Application: Portland cement and sand must be mixed dry, passed through a cement gun and conveyed by air through a flexible tube, hydrated at a nozzle at the end of the flexible tube, and deposited in place by air pressure.

All surfaces must be wetted, but application must not be made on any surface on which free water exists.

Reinforcement: The wire mesh must lap a minimum of one mesh spacing, and laps must be securely fastened at the ends. During the placement of the concrete, the reinforcement must be held so as to provide a minimum of 1-3/4 inches of cover at the recess.

Finishing: The newly constructed concrete must be finished by a wood float and must be striated with a rustication joint as shown on the Drawings.

Curing: Curing must be as specified in Section 6-02.

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Protection of Facilities: During the construction, the Contractor must protect all retaining walls, columns and Structures from concrete splash or overspray. Suitable covering must be provided if the Engineer determines such protection is necessary.

Test Cylinders: 2 test cylinders must be made for each full Day's operation. The Contractor must furnish the cylinders 6 inches in diameter and 12 inches high made of 3/4-inch mesh hardware cloth. The test cylinder must be filled with concrete by utilizing the same pneumatic application described above. Contact the SPU Materials Laboratory at (206) 386-1236 for coordinating pick up of the test cylinders and for testing requirements.

The cylinders will be tested for the minimum compressive strength for Class 3000 at the age of 28 Days (see Section 6-02.3) unless another Class of concrete is specified in the Contract.

8-16.4 MEASUREMENT

Measurement for concrete slope protection will be by the square yard and will include the actual area of the slope protection face covered except the footings. Footings will be measured by the cubic yard within neat lines indicated on the Drawings, see Section 2-04.4.

8-16.5 PAYMENT

1. "**Concrete Slope Protection**", per square yard

The Bid Item price for "Concrete Slope Protection" must include all costs for the work required to construct the slope protection including the work required to construct the footing.

SECTION 8-17 CURB WALL AND SUPPORT WALL

8-17.1 DESCRIPTION

Section 8-17 describes constructing Portland cement or hydraulic cement concrete support walls and curb walls at locations and in conformity with the lines and grades, shown on the Drawings.

8-17.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Materials	Section
Class 4000 Cement Concrete	Section 6-02
Mineral Aggregate	Section 9-03
Reinforcing Steel	Section 9-07.2
Geotextile	Section 9-37

8-17.3 CONSTRUCTION REQUIREMENTS

8-17.3(1) GENERAL

Where shown on the Drawings, the Contractor must construct curb wall and support wall as shown on Standard Plan 800 and 801.

After removal of forms, all lips and edgings must be removed. Bolts or concrete ties must be removed and the holes filled with 1:2 mortar and floated to an even uniform surface. If in the opinion of the Engineer an acceptable surface has been obtained, no further finishing must be done. If, however, the surface is unacceptable, these surfaces must be thoroughly washed with water and a 1:1 mortar applied with brush and completely worked into the small air holes and other crevices. After initial set, the surface must be rubbed with a damp sack.

8-17.3(2) CURB WALL

Curb wall must be constructed as indicated on Standard Plan 801.

8-17.3(3) SUPPORT WALL

Support wall must be constructed as indicated on Standard Plan 800.

8-17.4 MEASUREMENT

Measurement for support wall and curb wall will be per cubic yard of concrete based on neat lines indicated on Standard Plans 800, and 801.

8-17.5 PAYMENT

1. "**Wall, Cement Concrete, Support**, **Type 800**", per cubic yard

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The Bid Item price for "Wall, Cement Concrete, Support, Type 800" must include all costs for the work required to construct the wall as shown on Standard Plan 800. Payment for excavation, for disposal of materials, backfill, geotextile, and for reinforcing steel (including steel extending into pavement slab) for the support wall must be considered included in the Bid Item price.

2. "**Wall, Cement Concrete, Curb**, **Type 801**", per cubic yard

The Bid Item price for "Wall, Cement Concrete, Curb, Type 801" (including reinforcing steel extending into pavement slab) must include all costs for the work required to construct the wall as shown on Standard Plan 801. Payment for excavation, for disposal of materials, backfill, geotextile, and for reinforcing steel for curb wall is considered included in the Bid Item price.

SECTION 8-18 CEMENT CONCRETE STAIRWAYS, LANDINGS, AND STEPS

8-18.1 DESCRIPTION

This Work consists of constructing, on a prepared compacted subgrade, cement concrete stairways, landings, steps, and handrails, and bike path handrails, and such subsidiary work as may be necessary, per these Specifications and in conformity with the lines, grades, and cross-sections indicated on the Drawings. See Standard Plans 440a, 440b, 440c, 440d, 441, 442, and 443.

8-18.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Materials	Section
Cement Concrete	Section 6-02
Non-Roadway Cement Concrete, High Strength	Section 5-05
Aggregates	Section 9-03
Joint & Crack Sealing Materials, and Non-Shrink Grout	Section 9-04
Concrete Curing Materials and Admixtures	Section 9-23

The concrete mix must be Class 3000 for steps, stairways, and landings unless shown otherwise on the Drawings. Cement Concrete Sidewalk monolithic with handrail must be Non-Roadway Cement Concrete, High Strength, see Section 8-14. For minor sidewalk segments constructed adjacent to stairway landings, cement concrete Class 3000 may be used with approval of the Engineer.

Galvanized steel pipe railing must be fabricated from standard weight steel pipe per ASTM A 53. After fabrication, the railings must be hot dipped galvanized per ASTM A 123. Gripping handrail must be standard steel pipe per ASTM A 53 and must be 1 inch nominal diameter (1.315 inch outside diameter) as specified in the American Institute of Steel Construction Manual.

Aluminum paint for handrails must be Formula D-1-57 aluminum paint.

Wood for railings must be as indicated on the Drawings.

Reinforcing Steel must be ASTM A 615, Grade 60.

8-18.3 CONSTRUCTION REQUIREMENTS

8-18.3(1) SITE PREPARATION AND GRADING

At locations where cement concrete stairways, landings, or steps are to be constructed, the area must be cleared, grubbed, excavated, graded, and prepared as specified in Division 2, to the limits indicated on the Drawings or established by the Engineer.

8-18.3(2) SUBGRADE PREPARATION AND FORMS

The necessary subgrade preparation and compaction required in the construction of cement concrete stairways, landings, and steps must comply with the requirements for pavement subgrade preparation set forth in Section 2-09.

Forms must be as specified in Section 5-05.3(7)B except that wood side forms must be not less than 2 inches nominal in thickness and must be straight and true.

8-18.3(3) REINFORCING STEEL

Reinforcing steel for cement concrete stairways must be placed as shown on Standard Plans 440a through 443. The reinforcing steel must be assembled and securely tied with annealed wire of not less than No. 16 gauge at each bar lap or crossing and be rigidly supported above the subgrade during the concrete placement.

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8-18.3(4) HANDRAIL

Handrails must be of welded steel pipe construction, fabricated and installed as indicated on Standard Plans 440a, 440b, 440c, 440d, 442, and 443 unless the Contract specifies otherwise. Welds must be made by certified welders and each weld must be ground and buffed to a smooth surface. Rails must be hot dip galvanized according to ASTM A 123 after fabrication. Damaged or uncoated areas of hot dip galvanized coating must be repaired according to ASTM A780. If field welds are required, they must be coated with a zinc alloy solder to a minimum thickness of 2.0 mils per ASTM A 780.

Either the railing must be placed completely assembled at the time when stairway concrete is placed, or recesses must be provided in the concrete for grouting the railing posts after the concrete has been placed, finished, and cured. The installed railing must be in true alignment, on proper grade, and with posts plumb.

8-18.3(5) PLACING, FINISHING, AND CURING CONCRETE

Placing, finishing and curing concrete must conform to the applicable requirements in Section 5-05.3.

Front and side edging of concrete stair treads must be to a radius of 1/2 inch.

Landings for stairways must be scored as specified for concrete sidewalks in Section 8-14 except that transverse and longitudinal scoring must be modified as necessary to result in uniform size of squares in each landing. Where gutters are along the side of the stairways, the gutter portion of stairway landing must be smooth finished without markings to conform with the stairway gutter.

8-18.3(6) GUTTER

Where Type 440 stairway is called for in the Contract, or where a stairway gutter is called for in the Contract, the concrete gutter must be constructed as specified in the detail on Standard Plan 440b. The gutter must be constructed along and outside the stairway, adjacent to the concrete walk or landing that joins flights of stairs connecting the stairway gutters, and must be sloped for continuous flow.

8-18.3(7) STEPS

Steps must be constructed as shown on Standard Plan 441.

Treads must range from a maximum 12 inches to a minimum 11 inches. Risers must range from a maximum 7 inches to a minimum 5 inches. Within any single flight of stairs, the difference in the largest and shortest tread run, and the difference in the highest and lowest riser height, must not exceed 3/8 inch respectively.

8-18.3(8) BIKE RUNNELS

Where Type 440 stairway with bike runnels is called for in the Contract, the concrete bike runnels must be constructed as shown on Standard Plan 440c or 440d, and as shown on the Drawings. The runnel must be constructed along and outside the stairway, adjacent to the concrete walk or landing that joins flights of stairs connecting the runnel path, and must be sloped for continuous flow to drain surface runoff.

8-18.4 MEASUREMENT

Excavation for stairways, landings, gutters, and bike runnels will be measured by the cubic yard of common excavation as specified in Section 2-04.

Measurement of “Steps, Cement Concrete”, “Steps, Cement Concrete w/25% Pozzolans”, “Stairway, Cement Concrete, (Type)” and “Stairway, Cement Concrete, (Type) w/25% Pozzolans,” will be by the square foot of tread surface installed.

Handrail of the type specified will be measured by the linear foot of actual handrail installed measured along the top of the top rail from end post to end post including the posts.

Concrete landings or walkways outside the stairway measurement limits will be measured as “Sidewalk, Cement Concrete” by the square yard as specified in Section 8-14.4.

Asphalt walks will be measured as specified in Section 5-04.4.

Gutter will be measured by the linear foot along the gutter end to end including stairway slope, landing, and concrete walk.

Measurement for “Bike Runnel, Cement Concrete” and “Bike Runnel, Cement Concrete w/25% Pozzolans” will be by the linear foot for the horizontal distance from end to end of the runnel, including the stairway slope, landings, and concrete walk to the edge of the runnel lip or “walk bike” stamp.

8-18.5 PAYMENT

1. “**Stairway, Cement Concrete, (Type)**”, per square foot.
2. “**Stairway, Cement Concrete, (Type) w/25% Pozzolans**”, per square foot.

The Bid Item price for “Stairway, Cement Concrete, (Type) and “Stairway, Cement Concrete, (Type) w/25% Pozzolans” must include all costs for the work required to construct the concrete stairway to the width described in the Standard Plans. Where stairways are shown in the Drawings with details or dimensions not matching the standard plans, the Type designation will be “Special.”

3. “**Handrail, (Type)**”, per linear foot.

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The Bid Item price for "Handrail, (Type)" of the type specified must include the costs for the work required to furnish, fabricate and install the handrail along the stairway or sidewalk.

4. "**Steps, Cement Concrete**", per square foot.
5. "**Steps, Cement Concrete w/25% Pozzolans**", per square foot.

The Bid Item price for "Steps, Cement Concrete" and "Steps, Cement Concrete w/25% Pozzolans" must include all costs for the work required to construct concrete steps.

6. "**Gutter, Cement Concrete, Type 440**", per linear foot.

The Bid Item price for "Gutter, Cement Concrete, Type 440" must include all costs for the work required to construct a gutter section along the edge of stairways and landings.

7. "**Bike Runnel, Cement Concrete**", per linear foot.
8. "**Bike Runnel, Cement Concrete w/25% Pozzolans**", per linear foot.

The Bid item price for "Bike Runnel, Cement Concrete" and "Bike Runnel, Cement Concrete w/25% Pozzolans" must include all costs for the work required to construct the concrete bike runnel, including "walk bike" stamp or painted text and anti-skate devices, as applicable.

9. **Other payment information**

Payment for excavation required for stairways, landings, gutter, and bike runnel sections will be paid as "Common Excavation" as specified in Section 2-04.

Payment for concrete landings and walkways will be made as "Sidewalk, Cement Concrete" as specified in Section 8-14.

Reinforcing steel is considered as incidental to the Bid Item price for the appropriate Bid Item.

SECTION 8-19 CEMENT CONCRETE DRIVEWAY AND ALLEY

8-19.1 DESCRIPTION

This Work consists of constructing cement concrete driveway and alley as shown on the Drawings and on Standard Plans 403, 430 and 431.

Driveways and alleys for commercial access must be 8-inch minimum depth.

8-19.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Materials	Section
Non-Roadway Cement Concrete, HES, High Strength	Section 5-05
Non-Roadway Cement Concrete, High Strength	Section 5-05
Non-Roadway Cement Concrete, High Strength W/25% pozzolans	Section 5-05
Mineral Aggregates	Section 9-03
Premolded Joint Filler	Section 9-04.1(1)

The cement concrete mix class must be:

1. Non-Roadway Cement Concrete, High Strength for "Driveway, Cement Concrete, (Thickness)",
2. Non-Roadway Cement Concrete, HES, High Strength for "Driveway, Cement Concrete, HES, (Thickness)",
3. Non-Roadway Cement Concrete, High Strength W/25% pozzolans for "Driveway, Cement Concrete, or (Thickness) w/25% Pozzolans".

8-19.3 CONSTRUCTION REQUIREMENTS

8-19.3(1) EXCAVATION AND SUBGRADE

Subgrade preparation for driveways and the required compaction must conform to the applicable requirements in Section 2-09 to provide a firm, unyielding subgrade, acceptable to the Engineer. Where driveway construction is in an area with exposed tree roots 2 inches or greater in diameter, the Contractor must comply with Section 1-07.16(2). Driveways for accessing alleys and for commercial traffic must be excavated to accommodate an 8-inch minimum thickness concrete driveway and 6-inch minimum base course of Mineral Aggregate Type 2. Driveways for residential access must be excavated to accommodate a 6-inch minimum thickness concrete driveway and 6-inch minimum base course of Mineral Aggregate Type 2.

Subgrade must be compacted to 95 percent relative density per Section 2-11 for a 12-inch minimum depth.

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8-19.3(2) FORMS AND FINE GRADING

Forms must have a height of not less than the specified depth of concrete to be placed and must be of ample strength to resist deformation. All forms must be securely staked and braced plumb and true to line and grade.

A template must be set on the forms, and the subgrade must be fine graded and compacted to conform to the required section. Before the placement of concrete, the subgrade must be thoroughly dampened.

8-19.3(3) PLACING AND FINISHING CEMENT CONCRETE DRIVEWAY AND ALLEY

The concrete must be spread uniformly and consolidated between the forms, see Section 5-05. Through joints and contraction joints must be located as shown on Standard Plans 403, 430 and 431. The concrete driveway and alley must be brush finished. The sidewalk portion of the driveway must be scored as shown on the Standard Plans and as specified in Section 8-14, cement concrete sidewalks.

Through joints as shown on the Standard Plans must be 3/8-inch thick premolded joint filler. The joint filter width must be cut to a width equal to the full depth of the concrete sidewalk plus 1/2 inch. When installed, the premolded joint filler must be placed with top edge 1/8 inch below the finished surface of the concrete in a plane perpendicular to the surface and with the bottom edge embedded in the subgrade. All joints must be in straight alignment

In the construction of through joints, the premolded joint filler must be adequately supported until the concrete is placed on both sides of the joint.

Contraction joints must be formed with a tee bar by first cutting a groove in the concrete to a depth equal to, but not greater than the premolded joint filler. The premolded joint filler must then be worked into the groove. Premolded joint filler for both through joints and dummy joints must be positioned in true alignment and at right angles to the center line of the driveway or alley crossings.

After the concrete has been thoroughly compacted and leveled, it must be floated with wood floats and finished at the proper time with a metal float. Joints must be edged with 1/4-inch radius edger and the driveway or alley return edges must be tooled with 1/2-inch radius edger. Curbs must be tooled with a 1-inch radius edger.

The surface must be brushed in a transverse direction in relation to the center line of the driveway or alley return with a fiber hair brush of approved type.

Unless otherwise approved, driveways and alley crossings must not be constructed at the same time the pavement is placed.

8-19.3(4) CURING AND PROTECTION

The curing Materials and procedures must be as specified in Section 5-05; however Liquid membrane curing compound must be type 1D per Section 9-23.2 unless otherwise approved by the Engineer. Curing compound must be applied to all exposed surfaces immediately after brushing and must be maintained for a period of 5 Days

8-19.4 MEASUREMENT

Measurement for cement concrete driveway will be by the square yard for the class and thickness of driveway actually placed, measured from the back of the sidewalk to the back of the curb and gutter, or to the face of the curb if poured monolithically.

Measurement for alley will be by the square yard for the class and thickness of concrete actually placed per Standard Plan 403 and will be measured as “cement concrete driveway”.

8-19.5 PAYMENT

1. “**Driveway, Cement Concrete**, **(Thickness)**”, per square yard
2. “**Driveway, Cement Concrete**, **HES (time), (Thickness)**”, per square yard
3. “**Driveway, Cement Concrete (Thickness) w/25% Pozzolans**” per square yard

The Bid Item prices for “Driveway, Cement Concrete…” must include all costs for the work required to construct the driveway including excavation, subgrade preparation, and the curb if monolithic.

Payment for the removal of existing concrete walk, concrete driveway, curb, or curb and gutter must be made separately as specified in Section 2-02.

4. **Alley payment information**

Payment for alley will be made as “Driveway, Cement Concrete…” as shown on the Drawings.

5. **Other payment information**

Payment for excavation below the prepared subgrade and additional selected Materials will be made as “Common Excavation” per Section 2-04.5 and as “Mineral Aggregate, (Type)” per Section 4-01.5.

No separate or additional payment will be made for common excavation associated with the work described in this Section.

No separate or additional payment will be made for driveway or alley concrete thickness greater than the thickness specified in the Contract.

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SECTION 8-20 RESERVED

SECTION 8-21 PERMANENT SIGNING AND POSTS

8-21.1 DESCRIPTION

Section 8-21 describes transporting, furnishing, installing and relocating signs, posts, and hardware specified in the Contract, as shown on the Drawings, these Specifications, and Standard Plans 601b through 630.

8-21.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Materials	Section
Non-Shrink Cement Sand Grout	Section 9-04.3(2)
Signing & Post Materials, and Jet Set Cement	Section 9-28

Traffic sign post Material must be Qwik Punch Telespar or approved equal as shown on Standard Plan 625.

Unless otherwise specified, all hardware and Material must be commercial quality.

8-21.3 CONSTRUCTION REQUIREMENTS

8-21.3(1) GENERAL

For temporary signage associated with temporary traffic control, see Section 1-10.

The removal of signs must be as specified in Sections 2-02.3(3)F and 2-02.3(3)K.

Unless the Contract specifies otherwise, bus zone signs will be relocated by KCM, see Section 1-07.28 for coordination information.

General guidance:

1. Where the Bid Item for signs includes “Owner furnished”, the sign will be furnished by the Owner.
2. When indicated on the Drawings “by others”, or when no Bid Items exist for relocation or installation, the Owner or sign owner will install and relocate signs and posts.
3. The Contractor must install and relocate all traffic signs and posts, street designation signs and posts, and other signs and posts as specified in the Contract.
4. The Contractor must install signs on new or existing posts, poles, span wires, or mast arms as specified in the Contract, where indicated on the Drawings or where directed by the Engineer.

When indicated “Owner furnished” in the Bid Item, SDOT will provide and make available traffic signs, street name signs, and street designation signs. To order these signs, see Section 1-07.28 for contact and notification requirements. Unless otherwise specified, other signs must be Contractor provided. Signs must be fabricated as shown on the Drawings as specified in Section 9-28.1.

All Sign locations must be verified by SDOT Traffic. The Contractor must coordinate sign locations with SDOT Traffic and the Engineer. Advanced notification is required, see Section 1-07.28.

Signs must be located as not to obstruct pedestrian traffic flow or ADA accessible routes. Where practical, a pedestrian traffic flow width of the greater of 5 feet or 80 percent of the sidewalk, walkway, or path flow must be maintained. Traffic flow is the normal or least obstructed path. If Contract sign locations seem to obstruct pedestrian traffic flow, or if the signs locations seem to obstruct other traffic signal or signs, or if the signs seem to not be visible, field adjustments may be necessary. The Contractor must coordinate sign locations with SDOT Traffic and the Engineer for field adjustments or location direction verification. All signs must be mounted level and face in the direction specified in the Contract or as designated by the Engineer.

8-21.3(1)A SIGNS

8-21.3(1)A1 TRAFFIC SIGN

Unless the Contract specifies otherwise, the Contractor must install and relocate all traffic signs and posts as specified in the Contract.

8-21.3(1)A2 STREET DESIGNATION SIGNS

Unless the Contract specifies otherwise, the Contractor must install and relocate street designation signs as specified in the Contract.

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8-21.3(1)A3 STREET NAME SIGNS

When indicated on the Drawings "by others", or when no Bid Items exist for relocation or installation, SDOT will install and relocate all street name signs and posts. If the Contract requires removal or relocation before scheduled work, the Contractor must notify SDOT as specified in Section 1-07.28.

Otherwise, the Contractor must install and relocate all street name signs and posts.

8-21.3(1)A4 BUS ZONE SIGNS, NUMBERED BASE PLATES AND SIGNS ASSOCIATED WITH PARKING PAY STATIONS, AND OTHER SIGNS

Unless the Contract specifies otherwise, the SDOT will install and relocate all parking pay station, and D-22 signs (includes Pay L, Pay R, Pay H, and Pay LR signs) and numbered base plates. If the Contract requires removal or relocation before scheduled work, the Contractor must notify SDOT as specified in Section 1-07.28.

Unless the Contract specifies otherwise, KCM will install and relocate all bus zone signs and posts. If the Contract requires removal or relocation before scheduled work, the Contractor must notify KCM as specified in Section 1-07.28.

Unless the Contract specifies otherwise, all other signs not addressed in this Section, will be installed and relocated by the sign owner. Should the Contract require removal or relocation before scheduled work, the Contractor must notify the sign owner as specified in the Contract.

8-21.3(1)B MOUNTING SIGNS

8-21.3(1)B1 GENERAL

Unless the Contract specifies otherwise, the Contractor must provide all hardware required to mount signs as shown on the Drawings, as specified in Section 9-28.1(8), and shown on Standard Plans 601a through 630, as applicable.

The Contractor must not weld on steel or aluminum poles. The Contractor must not drill or tap steel, aluminum, or concrete poles, unless otherwise specified in the Contract. All traffic signs less than 2'-6" wide x 3'-6" in height must be attached using Steel Straps; see Standard Plan 616 for details.

8-21.3(1)B2 MOUNTED TO WOOD POST

When mounting a sign on an existing wood pole, use 5/16" x 3-1/4" galvanized or cadmium plated lags screws with 1/8" thick by 1" O.D. nylon washers. For details, see Standard Plan 620.

8-21.3(1)B3 MOUNTED TO STEEL, ALUMINUM, OR CONCRETE POLE

Unless otherwise specified, when mounting a sign on existing steel, aluminum, or concrete pole, use hardware as shown on Standard Plans. For details see Standard Plans 601c, 610, 615, and 616. All sign installations must be by brackets or bands unless otherwise approved by the Engineer. The Contractor is solely responsible for field repair of galvanized surfaces due to damage during installation or drill holes due to sign removal or relocation. Field repairs must use galvanized repair paint per Federal Specification MIL-P-21035 (Ships) paint, high zinc dust content, galvanizing repair.

For steel pole mounted or mast arm mounted Street Designation Sign (SDS), use CAN-BRAC Universal Sign Bracket Assembly from Traffic Hardware + Design, AS-0144 or AB-0635 Astro Sign-Brac cable mount from Pelco Inc., or approved equal.

8-21.3(1)B4 RESERVED

8-21.3(1)B5 MOUNTED TO SPAN WIRE OR MAST ARMS

Unless otherwise specified, signs mounted on span wire or mast arms must be mounted as indicated on the Drawings and in the signing details shown on Standard Plans 601b and 601c. Sag in the span must be maintained between 5 percent and 7 percent of the span length. Clearance between the bottom of the sign and the roadway centerline must be maintained between a minimum 17 feet and a maximum 19 feet. Use standard signal mounting hardware & span wire assemblies as specified in Section 8-31. All sign installations on mast arms must be by brackets or bands unless otherwise approved by the Engineer.

8-21.3(1)B6 MOUNTED TO TELESPAR QWIK-PUNCH SIGN POST

Signs mounted to Qwik Punch Telespar posts must be attached by punching out the appropriate holes on the Telespar post, then fastening the sign to the post using a 3/8-inch drive rivet as indicated on Standard Plan 621a.

8-21.3(1)B7 MOUNTING STREET NAME SIGN TO POST

When mounting a sign on street name sign post, use hardware as shown on Standard Plans. For details see Standard Plans 615, 622, and 623.

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8-21.3(2) POST INSTALLATION

8-21.3(2)A SIGN POST INSTALLATION

8-21.3(2)A1 GENERAL

The area disturbed during sign post installation must be surfaced to match the surrounding surfaces. Where a sign post is to be installed in an existing paved concrete area, a neat 12" x 12" cut out must be provided by saw cutting, or an 8-inch diameter hole must be provided by core drilling.

Where the Drawings or the Engineer directs a street name or traffic sign post to be located within the area of new sidewalk, the Contractor must provide a 12-inch square or a 12-inch diameter blockout, with depth to match the thickness of the proposed paving.

After a post is installed, and backfilled and compacted with selected Material, the cutout or blockout must be filled with Material matching surrounding Material and capped with additional Material from 3/4 inch above surrounding finished grade to finished grade, to shed water away from the post. Where concrete is the surrounding Material, a 3/4-inch preformed joint Material must be placed in the joint. See Standard Plan 624 for details.

All posts must be plumb.

Post must be as specified in Section 9-28.2 and Standard Plans 620 through 630.

8-21.3(2)A2 STREET NAME SIGN POST INSTALLATION

Street name sign posts must be installed on a heavy duty anchor, and must be backfilled with dry-pack concrete as described in Standard Plans 621b, 622, and 630. Dry-pack concrete must be bagged premix concrete containing well graded aggregate, sand, and cement, mixed with approximately 1 quart of water per 60 pound bag, or any concrete as specified in Section 5-05 may be substituted with the Engineer's approval.

8-21.3(2)A3 TELESPAR QWIK-PUNCH POST INSTALLATION

Excavations for Qwik Punch Telespar post installation must be of sufficient size to allow placement of backfill Material completely around the posts; for details see Standard Plan 621b. Suitable backfill Material must be placed and compacted as specified in Section 2-10 and Section 2-11.

Qwik punch Telespar posts must be mounted and fastened to anchor posts as indicated on Standard Plan 621b.

A reflective sleeve must be attached to the steel sign posts with four steel self-tapping screws, #10 by 1/2 inch, with zinc plated hex washer head. The four screws must be located at each corner of the shield at least 1 inch from the top and bottom of the sleeve. The reflective sleeve must be "U" shaped with an open side. The reflective sleeve must be installed so that the open side is on the right side of the sign face on the post, except at locations where the cross street is a one-way street and traffic can only turn left. At those locations, the reflective sleeve must be installed so that the open side is on the left side of the sign face on the post. The reflective sleeve must be installed at least 1 foot above the top of the anchor.

8-21.3(3) SIGN COVERING

As specified in the Contract, the Contractor is required to provide a temporary covering to hide or remove from view select signs for public convenience until such time they are applicable. Existing signs covering is incidental and included in the Bid Items related to traffic control. The covering must consist of 4 mil minimum thickness black polyethylene sheeting or other approved Material, of sufficient size to cover the entire face or both faces of the sign as applicable, must extend over the edges of the sign, and must be securely fastened to the sign and post. The Contractor must not use any type of Material which may permanently adhere to or damage the face of the sign and post. The covering Material, and method of fastening the covering to the sign, is subject to the acceptance of the Engineer.

8-21.3(4) SIGN RELOCATION

Existing traffic signs, street name signs, street designation signs, and other signs as specified in the Contract, and their posts, must be relocated to new locations shown on the Drawings or when designated by the Engineer. Temporarily stockpiled signs and posts must be protected against loss or damage. Removal of signs and posts required for "sign relocation" must conform to Section 2-02.3(3)K.

Reinstalling posts must comply with Section 8-21.3(2).

8-21.3(5) SIGN CLEANING

Signs must be thoroughly cleaned after relocation or installation, and before Physical Completion when directed by the Engineer. The Contractor must not use cleaning solvents that harm the sign finish.

8-21.4 MEASUREMENT

Measurement for: "Install Sign, (type), Owner Furnished, (mounting)", "Sign, (type), (mounting)", "Post, (type)", and "Relocate Sign, (type)", will be per each. "Sign, (type), (mounting)", per square feet (SF) will be measure by the square feet (SF) of the face of the sign.

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8-21.5 PAYMENT

1. "**Install Sign**, **(type), Owner Furnished, (mounting)**", per each

The Bid Item prices for "Install Sign, (type), Owner Furnished, (mounting)", must include all costs for the work required to pick up the sign, and furnish the mounting hardware, and install the sign.

2. "**Sign**, **(type), (mounting)**", per each

The Bid Item prices for "Sign, (type), (mounting)", must include all costs for the work required to furnish the sign and mounting hardware, and install the sign.

3. "**Sign**, **(type), (mounting)**", per square foot

The Bid Item prices for "Sign, (type), (mounting)", must include all costs for the work required to furnish the sign and mounting hardware, and install the sign.

4. "**Post**, **(type)**", per each

The Bid Item prices for "Post (type)" must include all costs for the work required to furnish and install the specified post including foundation, selected backfill, surface restoration, and reflective sleeve. Telespar may be abbreviated as "TS" followed by a length, for example "-12". If length unit is not provided, the length is in feet. If length is not provided, it is determined per city and WSDOT adopted MUTCD standards.

5. "**Relocate Sign, (type)**", per each

The Bid Item prices for "Relocate Sign, (type)" must include all costs for the work required to remove and relocate the sign, including posts, foundations, disposal, and cleaning as specified. If a new post is installed on the new location, the post will be paid for separately. New posts will be shown on the Drawing or when directed by the Engineer.

Payment for the removal and replacement of surrounding improvements is per the Bid Items in the Bid Form. If this work is not specified in the Bid Form, replacement of improvements is incidental and included, and to applicable Specifications or in-kind to the satisfaction of the Engineer.

If no location is specified in the Bid Item, the sign must be mounted to post, pole, mast arm, or span wires at the location specified in the Contract.

Sign covering and cleaning is considered incidental to other Bid Items.

6. **Other payment information**

Payment for signing work related to the maintenance and protection of traffic control will be as specified in Section 1-10.5.

SECTION 8-22 PAVEMENT MARKING

8-22.1 DESCRIPTION

8-22.1(1) GENERAL

This Work consists of furnishing and installing pavement markings on the roadway surface at locations shown on the Drawings, or where designated by the Engineer, as specified and shown on the 700 series Standard Plans. Pavement markings are for channelization, warnings, instructions, or curb usages.

8-22.1(2) PAVEMENT MARKING DESIGNATIONS

Pavement marking designations are defined by the marking type, the marking material, and the item designation. Marking types, marking materials, and item designations are defined in this Section.

8-22.1(2)A MARKING TYPES

Marking types are grouped into line markings to indicate lanes, transverse lines, and marked barrier areas; symbol and legend markings; and curb markings. Marking types are designated with the following abbreviations in pavement marking callouts:

Marking Type	Description	Examples
L	Line Markings	Center lines, lane lines, bike lane lines, stop lines, crosswalk lines etc.
S	Symbols and Legends	Arrows, bike lane legends, only legends, etc.
C	Curb Markings	Bus zones, commercial load zones, passenger load zones, etc.

8-22.1(2)B MARKING MATERIALS WITH LINE SUFACES

Pavement marking materials and their line surfaces, as specified in Section 8-22.3(3)C, are designated with the following abbreviations in pavement marking callouts:

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Marking Material with Line Surface	Description
MP	Profiled methyl methacrylate (MMA)
M	MMA with flat surface
T	Thermoplastic with flat surface
P	Paint with flat surface

8-22.1(2)C ITEM DESIGNATIONS

Line markings consist of long lines and crosshatching, and line types vary for different lane uses. Line type callouts, as they appear in item designations, are as follows:

Callout	Line Type
2	Dotted lines with 2-foot stripes and 4-foot skips
3	Dotted lines with 3-foot stripes and 6-foot skips
B	Broken/Dashed lines with 10-foot stripes and 20-foot skips
D	Double parallel solid lines
O	Two-way left-turn lane line (or centerline with passing in one direction only) consisting of a solid line parallel to broken lines with 10-foot stripes and 20-foot skips
S	Single solid line

Long lane lines that are double parallel solid lines or broken lines include Type 2A lane markers/raised pavement markers (RPMs) that match the color of the marking, see Section 8-08.1 and Standard Plan 700. See the Standard Plans for details on RPM placement in various channelization layouts.

The width of line, color of line, and line type are included in the item designation for longitudinal markings. Item designations for longitudinal markings appear in pavement marking callouts as follows:

Item Designation	Description	Usage
4YD	Two parallel 4” yellow solid stripes with 4” gap between stripes and a Type 2A RPM every 30’ on center	Double centerline Median line
4YB	4” yellow 10’ stripes with 20’ skips and Type 2A RPMs centered in skips	Broken/Dashed centerline
4Y2	4” yellow 2’ stripes with 4’ skips	Intersection guideline for centerlines
4Y3	4” yellow 3’ stripes with 6’ skips	Bike facility centerline (Passing OK)
4YO	4” yellow solid stripe with parallel 4” yellow 10’ stripes (with 4” gap between the two stripes) with 20’ skips and Type 2A RPMs centered in skips	One side of two-way left-turn lane, Passing Permitted from One Direction Only
4YS	4” yellow solid stripe	Bike Facility No Passing Centerline
8YS	8” yellow solid stripe	Median Diagonal Crosshatching
4WD	Two parallel 4” white solid stripes with 4” gap between stripes and a Type 2A RPM every 30’ on center	Do Not Cross Line (for parallel same direction travel lanes)
4WB	4” white 10’ stripes with 20’ skips and Type 2A RPMs centered in skips	Broken/Dashed Lane line
4W2	4” white 2’ stripes with 4’ skips	Intersection Guideline, extending solid approach line through taper
4WS	4” white solid stripe	Approach line for opt-in lanes, edge line, guide line, parking stall line

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Item Designation	Description	Usage
6WS	6” white solid stripe	Bus or HOV lanes, Bike lanes & bike buffers, Drop/Trap lane approach line
6W2	6” white 2’ stripes with 4’ skips	Intersection guideline, etc.
6W3	6” white 3’ stripes with 6’ skips	Drop lane notification
8WS	8” white solid stripe	Barrier line, and crosshatch
XWK	Pairs of longitudinal 8” white bars with an 8” gap between, repeated in a pattern avoiding wheel paths pedestrian path	Ladder Style Crosswalk
XWK2	Two 8” white lines forming a pedestrian path	Two Transverse Lines Style Crosswalk
SL16	16” white stripe	Stop bar at stop sign
SL24	24” white stripe	Stop bar at signal or beacon

For symbols and legends and colored pavement marking areas, MMA or pre-formed thermoplastic markings with flat surfaces must be applied unless the intent of the marking is to create a profile in a wheel path. Item designations for symbols and legends appear in pavement marking callouts as follows:

(Marking Type)-(Material Type)(Standard plan detail number) (optional color designation)

The color for symbols and legends must be white unless otherwise noted.

Item designations for curbs appear in pavement marking callouts as follows:

Item Designation	Description	Usage
W	white curb stripe (mark full width of top surface of curb)	Various zones (e.g., passenger load zone, etc.)
R	red curb stripe (mark full width of top of curb)	Tow away zone
Y	curb yellow stripe (mark full width of top of curb)	Various zones (e.g., commercial load zone, etc.)
BUS	combination curb stripe on top and face of curb (3’ red – 4’ yellow – 3’ red)	Bus zone
BUSB	combination curb stripe of top and face of curb (3’ red – 4’ yellow – 3’ red, skip for up to 10’)	Bus zone in non-paid parking areas

8-22.1(2)D PAVEMENT MARKING CALLOUT EXAMPLES

Line and curb markings called out on the Drawings and Standard Plans are in the format of “[Marking Type]-[Material Type with Line Surface]/[Item Designation].”

Symbol and Legend markings called out on the Drawings are in the format of “S-(Material)(Standard plan detail number)

Example callouts are shown below:

Callout Example	Description
L-MP/4YD	Profiled MMA 4” Yellow Double Line with Type 2A RPMs 30 feet on center
L-T/XWK	Thermoplastic Crosswalk
C-P/Y	Painted Yellow Curb
S-T720c	Right Arrow per standard plan 720 detail 720c

8-22.2 MATERIALS

Materials must comply with the requirements of the following Sections:

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Materials	Section
Pavement Marking Materials	Section 9-29

Material for pavement marking will be specified in the Contract.

All thermoplastic legends and symbols must be pre-formed Type B installations.

8-22.3 CONSTRUCTION REQUIREMENTS

8-22.3(1) PRELIMINARY SPOTTING

The Contractor must provide the preliminary layout as shown on the Drawings for permanent pavement marking alignment following paving operations. Preliminary layout is required for all permanent pavement markings. Legend and symbols must be placed in accordance with the 700 series Standard Plans at locations shown on the Drawings.

Notify the Engineer at least 5 Working Days before applying the preliminary layout.

Do not apply permanent pavement markings before receiving the Engineer's approval. Permanent pavement markings must be installed within 5 Working Days, if permitted by the weather, after preliminary layout has been approved by the Engineer.

Temporary pavement marking tape for centerline, lane lines, or other pavement markings, if required by the Engineer, must be installed in accordance with Section 5-04.3(13). Temporary pavement marking tape must meet the requirements of Section 9-29.4.

8-22.3(2) PREPARATION OF SURFACES

Surface dirt and all contaminants within the areas to receive pavement markings must be removed. Large areas of tar, grease or foreign Materials may require sandblasting, steam cleaning, power brooming, or chemical stripping to accomplish complete removal. Grass obstructing curb painting must be trimmed to the back edge of the curb and the curbs cleaned of foreign Material before painting.

Existing pavement markings must be completely removed. Cleaning and removal methods used must not damage the pavement surface to a depth or width greater than that required to provide adequate bond between the pavement and the pavement marking Material. The pavement surface must be approved by the Engineer before application of the markings.

Apply Materials to new HMA that is sufficiently cured according to the manufacturer's recommendations. Typically, Type D Material applied to new HMA pavement requires a pavement cure period of 21 days. This cure period may be reduced if the manufacturer performs a successful bond test and approves the reduction of the pavement cure period.

For new Portland cement concrete surfaces, remove curing compounds and laitance by an approved mechanical means. Air blast the pavement with a high-pressure system to remove extraneous or loose material. Apply Materials to concrete that has reached a minimum compressive strength of 2,500 psi and that is sufficiently cured according to the manufacturer's recommendations. Typically, Type D Material applied to Portland cement concrete pavement requires a pavement cure period of 28 days. This cure period may be reduced if the manufacturer performs a successful bond test and approves the reduction of the pavement cure period.

After the pavement surface is clean and dry, apply primer as recommended by the manufacturer to the area receiving the pavement markings. Apply the primer in a continuous, solid film according to the recommendations of the primer manufacturer and the pavement markings manufacturer.

8-22.3(3) MARKING APPLICATION

8-22.3(3)A MARKING COLORS

Lane line and right edge line must be white in color. Centerline and left edge line must be yellow in color. Transverse markings must be white, except as otherwise noted in the Standard Plans.

8-22.3(3)B RESERVED

8-22.3(3)C LINE SURFACES

Flat Lines: Pavement marking lines with a flat surface.

Profiled Marking: A profiled pavement marking is a marking that consists of a base line thickness and a profiled thickness, which is a portion of the pavement marking line that is applied at a greater thickness than the base line thickness. Profiles must be applied using the extruded method in the same application as the base line. The profiles may be slightly rounded provided the minimum profile thickness is the same throughout the length of the profile. See WSDOT Standard Plan M-20.20-02 for profiled MMA details.

8-22.3(3)D LINE APPLICATIONS

Surface Line: A line constructed by applying pavement marking Material directly to the pavement surface or existing pavement marking.

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Grooved Line: A line constructed by grinding or saw cutting a groove into the pavement surface and spraying, extruding, or gluing pavement marking Material into the groove. Groove depth is measured vertically from the bottom of a 2-foot or longer straight edge placed on the roadway surface to the ground surface. The groove depth is dependent on the material used, the pavement surface, and the location. Do not construct grooved line pavement marking on bridge decks or on bridge approach slabs.

8-22.3(3)E INSTALLATION

Apply pavement marking Materials to clean, dry pavement surfaces and according to the following:

1. Place Material according to the manufacture's recommendations.
2. Place parallel double lines in 1 pass.
3. The top of pavement marking must be smooth and uniform.
4. Line ends must be square and clean.
5. Place pavement marking lines parallel and true to line.
6. Place markings in proper alignment with existing markings.

When applying paint, Type A or Type C Material, ensure that both the pavement surface and the air temperature during application are not less than 50°F and rising. When applying Type B or Type D Material, ensure that both the pavement surface and the air temperature during application are not less than 40°F and rising.

Ensure that the Type A thermoplastic Material meets the manufacturer's temperature specifications when it contacts the pavement surface.

Two applications of paint will be required to complete all paint markings. The second application of paint must be squarely on top of the first pass. The time period between paint applications will vary depending on the type of pavement and paint (low VOC waterborne or low VOC solvent) as follows:

Pavement Type	Paint Type	Time Period
Bituminous Surface Treatment	Low VOC Waterborne	4 hrs minimum, 48 hrs maximum
Hot Mix Asphalt Pavement	Low VOC Waterborne	4 hrs minimum, 30 days maximum
Cement Concrete Pavement	Low VOC Waterborne	4 hrs minimum, 30 days maximum
Bituminous Surface Treatment	Low VOC Solvent	40 min minimum, 48 hrs maximum
Hot Mix Asphalt Pavement	Low VOC Solvent	40 min minimum, 30 days maximum
Cement Concrete Pavement	Low VOC Solvent	40 min minimum, 30 days maximum

Centerlines on two-lane Highways with broken line patterns, paint, or plastic must be applied in the increasing milepost direction so they are in cycle with existing broken line patterns at the beginning of the project. Broken line patterns applied to multilane or divided Roadways must be applied in cycle in the direction of travel.

Where paint is applied on centerline on two-way roads with bituminous surface treatment or centerline rumble strips, the second paint application must be applied in the opposite (decreasing milepost) direction as the first application (increasing milepost) direction. This will require minor broken line pattern corrections for curves on the second application.

On painted ladder type crosswalks, pedestrian and bicyclist symbols (including arrows), white sharp sand must be spread over fresh paint at a rate of approximately 1 pound per 20 square feet.

Type B thermoplastic Material may be supplied complete with a precoated, factory applied adhesive, or may be furnished with separate adhesive, as recommended by the manufacturer. Whether precoated or supplied separately, the adhesive must be such as to allow the thermoplastic Material to be repositioned on the pavement surface before permanently fixing it in its final position with a downward pressure.

If the required pavement marking width is 12 inches or more, it may be fabricated from 12-inch or 6-inch wide Material. Longitudinal splices will be permitted, provided the gap at any splice does not exceed 1/16 inch.

Excess thermoplastic Material left on the pavement must be removed before continuation of the operation.

8-22.3(3)F APPLICATION THICKNESS

Pavement markings must be applied at the following base line thickness measured above the pavement surface or above the groove bottom for grooved markings in thousandths of an inch (mils):

Marking Material Application		HMA	PCC	BST	Groove Depth
Paint – first coat	spray	10	10	10	
Paint – second coat	spray	15	15	15	
Type A – flat/transverse & symbols	extruded	125	125	125	

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Marking Material Application		HMA	PCC	BST	Groove Depth
Type A – flat/long line & symbols	spray	90	90	120	
Type A – with profiles	extruded	90	90	120	
Type A – embossed	extruded	160	160	160	
Type A – embossed with profiles	extruded	160	160	160	
Type A – grooved/flat/long line	extruded	230	230	230	250
Type B – flat/transverse & symbols	heat fused	125	125	125	
Type C-2 – flat/transverse & symbols	adhesive	90	90	NA	
Type C-1 & 2 – flat/long line	adhesive	60	60	NA	
Type C-1 – grooved/flat/long line	adhesive	60	60	NA	100
Type D – flat/transverse & symbols	spray	120	120	120	
Type D – flat/transverse & symbols	extruded	120	120	120	
Type D – flat/long line	spray	90	90	120	
Type D – flat/long line	extruded	90	90	120	
Type D – profiled/long line	extruded	90	90	120	
Type D – grooved/flat/long line	extruded	230	230	230	250

Liquid pavement marking Material yield per gallon depending on thickness must not exceed the following:

Mm thickness	Feet of 4" line/gallon	Square feet/gallon
10	483	161
15	322	108
18	268	89
20	242	80
22	220	73
24	202	67
30	161	54
40	122	41
45	107	36
60	81	27
90	54	18
90 with profiles	30	10
120	40	13
120 with profiles	26	9
230	21	7

Solid pavement marking Material (Type A) yield per 50-pound bag must not exceed the following:

Mm thickness	Feet of 4" line/50 lb bag	Square feet/50 lb bag
30 – flat	358	120
45 – flat	240	80
60 – flat	179	60
90 – flat	120	40
90 – flat with profiles	67	23
120 – flat	90	30
120 – flat with profiles	58	20
125 – embossed	86	29
125 – embossed with profiles	58	20

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Mm thickness	Feet of 4″ line/50 lb bag	Square feet/50 lb bag
230 – flat grooved	47	15

All grooved lines must be applied into a groove cut or ground into the pavement. For Type A or Type D Material, the groove must be cut or ground with equipment to produce a smooth square groove 4 inches wide. For Type C-1 Material, the groove must be cut with equipment to produce a smooth bottom square groove with a width per the material manufacturer's recommendation. After grinding, clean the groove by shot-blasting or a method approved by Engineer. Immediately before placing the marking Material, clean the groove with high-pressure air.

8-22.3(3)G GLASS BEADS

Top dress glass beads must be applied to all spray and extruded pavement marking Material. Glass beads must be applied by a bead dispenser immediately following the pavement marking Material application. Glass bead dispensers must apply the glass beads as such that the beads appear uniform on the entire pavement marking surface with 50 to 60 percent embedment. Hand casting of beads will not be allowed.

Glass beads must be applied to 10 or 15 mil thick paint at a minimum application rate of 7 pounds per gallon of paint. For plastic pavement markings, glass bead type and application rate must be as recommended by the marking Material manufacturer.

When 2 or more spray applications are required to comply with thickness requirements for Type A and Type D Materials, top dressing with glass beads is only allowed on the last application. The cure period between successive applications must be per the manufacturer's recommendations. Any loose beads, dirt or other debris must be swept or blown off the line before application of each successive application. Successive applications must be applied squarely on top of the preceding application.

8-22.3(4) TOLERANCES FOR LINES

Allowable tolerances for lines are as follows:

1. Length of Line: The longitudinal accumulative error within a 40-foot length of broken line must not exceed ± 1 inch. The broken line segment must be at least 10 feet.
2. Width of Line: The width of the line must not be less than the specified line width or greater than the specified line width plus 1/4 inch.
3. Lane Width: The lane width, which is defined as the lateral width from the edge of pavement to the center of the lane line or between the centers of successive lane lines, must not vary from the widths shown on the Contract by more than ± 4 inches.
4. Thickness: A thickness tolerance not exceeding plus 10 percent will be allowed for thickness or yield in paint and plastic material application.
5. Parallel Lines: The gap tolerance between parallel lines is ± 1/2 inch.

8-22.3(5) INSTALLATION INSTRUCTIONS

8-22.3(5)A PLASTIC MARKINGS

Installation instructions for plastic markings must be provided for the Engineer. The instructions must include equipment requirements, approved work methods and procedures, material application temperature range, air and pavement surface temperature requirements, weather limitations, precautions, and all other requirements for successful application and material performance. Do not use materials with incomplete or missing instructions. All materials including glass beads must be installed according to the manufacturer's recommendations. A manufacturer's technical representative must be present at the initial installation of plastic material to approve the installation procedure or the material manufacturer must certify that the Contractor will install the plastic material per their recommended procedure.

8-22.3(5)B PRESSURE SENSITIVE TAPE PAVEMENT MARKING

Application procedures for pressure sensitive tape must be as recommended by the tape manufacturer. The Contractor must submit these recommendations to the Engineer at least 2 Working Days in advance of usage.

8-22.3(6) REMOVAL OF PAVEMENT MARKING

Removal of pavement marking must be as specified in Section 2-02.3(3)J.

Grinding to remove painted markings is not allowed. Grinding to remove plastic marking is allowed to a depth just above the pavement surface, then water blasting or shot blasting is required to remove the remaining markings.

8-22.3(7) TEMPORARY PAVEMENT MARKING

See Sections 1-07.23(1) and 1-10.3(3)L.

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8-22.3(8) LOCATING BICYCLE DETECTOR LOOP SYMBOL

Contractor must record the exact location of loop wire according to Section 1-05.3(13). Contractor must refer to both the Drawings and Standard Plan 725 for placement of the bike loop detector symbol.

8-22.3(9) COLORED PAVEMENT MARKING AREAS

Colored pavement marking areas must be installed where shown in the Drawings and per Standard plans. The product used must have a durable, color stable, skid resistant surface meeting the material requirements of MMA or pre-formed thermoplastic.

The product used must integrate an aggregate that enables the surface to have a Skid resistance greater than 60 units per ASTM E303.

The color for MMA and Thermoplastic must be per Section 9-29.3(2). Install per the manufacturer's recommendations.

8-22.4 MEASUREMENT

Measurement for "Pavement Marking, Paint, (Width) Stripe" will be by the linear foot of stripe, except dashed center lines and dashed lane lines will be measured as continuous lines with no deduction for the unpainted area caused by the skip pattern specified.

Measurement for "Pavement Marking, Paint, Legend/Symbol" will be per each legend or symbol.

Measurement for "Pavement Marking, Thermoplastic, 8-inch stripe" will be by the linear foot of 8-inch stripe actually placed and will not include unmarked space.

Measurement for "Pavement Marking, Thermoplastic, Legend/Symbol" will be per each legend or symbol.

Measurement for "Pavement Marking, MMA, (Width) Stripe" will be by the linear foot of stripe. No deduction will be made for the unmarked area when the marking includes a broken or skip pattern specified.

Measurement for "Pavement Marking, MMA, Legend/Symbol" will be per each legend or symbol.

The legends "ONLY" and "OK" together will be measured as 1 unit each.

The symbol "Bicyclist" with "Arrows" together will be measured as 1 unit each.

Stop lines, 16 or 24 inches wide and comprised of multiple 8-inch wide stripes, will be measured by the linear foot of 8-inch width stripe.

Measurement for "Pavement Marking, Pressure Sensitive Tape" will be by the linear foot of tape actually placed and will not include unmarked space. Measurement for "Pavement Marking Area, (Material), (Color)" will be per square foot of material actually placed.

8-22.5 PAYMENT

1. "**Pavement Marking**, **Paint, (Width) Stripe**", per linear foot
2. "**Pavement Marking**, **Paint, Legend/Symbol**", per each
3. "**Pavement Marking**, **Thermoplastic, 8 inch Stripe**", per linear foot
4. "**Pavement Marking**, **Thermoplastic, Legend/Symbol**", per each
5. "**Pavement Marking, MMA, (Width) Stripe"**, per linear foot.
6. **"Pavement Marking, MMA, Legend/Symbol",** per each.
7. "**Pavement Marking**, **Pressure Sensitive Tape**", per linear foot.
8. "**Pavement Marking Area, (Material), (Color)**", per square foot.

The Bid Item prices for the above listed Bid Items must include all costs for the work required to furnish and install the specified types of pavement marking.

Costs for the Work required for preliminary layout of permanent pavement markings are incidental to the various pavement marking Bid Items, and no separate payment will be made.

No additional payment will be made for the required second application of paint. No additional payment will be made for additional applications required to meet thickness requirements for plastic markings.

Sharrows to be installed as shown on the Drawings will be measured and paid as "Pavement Marking, Thermoplastic, Legend/Symbol", per each.

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SECTION 8-23 RESERVED

SECTION 8-24 RESERVED

SECTION 8-25 RESERVED

SECTION 8-26 RESERVED

SECTION 8-27 PROJECT IDENTIFICATION SIGN

8-27.1 DESCRIPTION

Section 8-27 describes furnishing and installing project identification signs at the Project Site as specified in the Contract, or installing Owner furnished project identification signs.

The quality of Contractor provided signs and supports must be such that they present a workmanlike appearance with the paint remaining in good condition for the duration of the project.

The Work also includes removing and disposing of the signs and supports after construction is completed or when directed by the Engineer.

8-27.2 MATERIALS AND FABRICATION

8-27.2(1) GENERAL

Project identification signs must be constructed with Medium Density Overlay plywood, or will be Owner provided. Descriptions of Owner furnished signs will be specified in the Contract.

8-27.2(2) PLYWOOD

Plywood signs must be made of Medium Density Overlay plywood meeting the requirements of “Products Standard PS 1-83 for Softwood Plywood, Construction and Industrial” grade, published by the Products Standards Section of the U.S. Department of Commerce. The plywood must be free of contaminants which would adversely affect the application and life of the paint. Face veneers must be Grade B or better.

Core and crossband veneers must be solid. Core veneers must be jointed. Core gaps must not exceed 1/8 inch in width. The entire area of each contacting veneer surface must be bonded with a waterproof adhesive that meets the requirements of the U.S. Department of Commerce for exterior type plywood.

The overlay must be high density type. It must have a minimum weight of 60 pounds per thousand square feet and must be at least 0.012 inches thick before pressing. The overlay must have a sufficient resin content to bond itself to the plywood, a content equal to 45 percent of the dry weight of the impregnated fiber.

The sign dimensions must be as shown on the Drawings. The thickness of the single panel plywood sign must be 1/2 inch.

8-27.2(3) SIGN BORDERS

Every project identification sign must have a border frame of 2” x 4” as specified in the Contract.

8-27.2(4) LETTERING AND SPACING FORMULA

Letters and symbols must be of the type, size, and color specified in the Contract.

Letters and symbols must be of Material compatible with the sign surface Material recommended by the sign surface manufacturer.

The Contractor must submit 1 sample of a finished project identification sign for the Engineer’s approval before fabricating the remaining signs required under this Contract.

8-27.2(5) SIGN SUPPORTS

Posts and wood supports must be 4” x 4” as specified in Section 9-09.2. Preservative treatment for posts and wood supports must be as required in Section 9-09.3. Project identification signs must be securely mounted either to the posts, or to the wood supports and supporting framework. Posts must be of a length capable of installing in the ground to a minimum depth of 3 feet below grade. The signs must be mounted to be level and in a vertical plane. Backfill around the posts must be reasonably compacted to provide adequate lateral support to prevent movement caused by moderate wind conditions. The wood supports and framework must be sturdy and must be installed to provide the needed stability to prevent movement caused by moderate wind conditions.

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8-27.3 CONSTRUCTION REQUIREMENTS

8-27.3(1) LOCATION OF SIGNS

The Contractor must install project identification signs at locations shown on the Drawings or at locations directed by the Engineer. Signs facing in each direction of traffic must be placed at all Project Sites before construction. Signs must be placed so as to convey their message effectively without restricting lateral clearances or sight distance. When the Engineer requires the Contractor to relocate signs, sign support must be as specified in Section 8-27.2(5).

8-27.3(2) SIGN REMOVAL

The Contractor must remove all project identification signs, posts, and supports from the Project Site when Work is completed at that location or when required by the Engineer. When the Engineer directs a sign to be relocated, removal of the sign, posts, and wood supports and supporting frame must be done in such a manner as to prevent disturbance or damage to the sign, wood support and supporting frame. If the sign, post, or wood support is disturbed or damaged, the Contractor must restore the sign to an acceptable condition, or provide an identical sign or post or support, as necessary, at no cost to the Owner. The Engineer will determine if new posts, or new wood supports and framework, are required to accommodate a reasonably different Job Site terrain where signs are to be relocated.

All removed Materials become the property of the Contractor and must be removed from the Project Site.

The area must be restored to pre-existing or better condition immediately after removal.

8-27.4 MEASUREMENT

Measurement for “Sign, Project Identification” and for "Sign, Project Identification, Owner Furnished" will be per each sign actually used on the Project Site.

Measurement for "Relocate Project Sign" will be per each.

Measurement for posts, and for wood supports and supporting framework, will be per each sign.

8-27.5 PAYMENT

1. “**Sign**, **Project Identification**”, per each

The Bid Item price for “Sign, Project Identification” must include all costs for the work required to fabricate, paint, install, remove and dispose of signs, and restore all areas after project completion.

2. "**Sign**, **Project Identification, Owner Furnished**", per each

The Bid Item price for “Sign, Project Identification, Owner Furnished” must include all costs for the work required to pick up and deliver, install, remove and dispose of signs, and restore the areas after project completion.

3. "**Posts**, **Project Sign**", per each sign

The Bid Item price for "Posts, Project Sign" must include all costs for the work required to furnish, fabricate, install, maintain, relocate, and remove the posts, or wood supports and supporting frame, for each project sign.

4. "**Relocate Project Sign**", per each

The Bid Item price for "Relocate Project Sign" must include all costs for the work required to relocate a project sign and posts or wood supports and support frame as specified.

5. **Other payment information**

No additional payment will be made for signs requiring restoration or replacement if disturbed or damaged by Contractor operations.

No additional payment will be made for posts or wood supports and support frames if disturbed or damaged by Contractor operations.

Relocation of a project sign to a different site where a significant change in the original post, or wood support and supporting frame, is necessary to accommodate different terrain or other conditions, will be paid as "Posts, Project Sign".

SECTION 8-28 RESERVED

SECTION 8-29 WIRE MESH SLOPE PROTECTION

8-29.1 DESCRIPTION

Section 8-29 describes constructing wire mesh slope protection as shown on the Drawings.

8-29.2 MATERIALS

Materials must comply with the requirements of the following Sections:

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Materials	Section
Wire Mesh Slope Protection	Section 9-16.4

8-29.3 CONSTRUCTION REQUIREMENTS

8-29.3(1) ANCHORS

The Contractor must install anchors of the type shown on conformance to the layout shown on the Drawings. The spacing and number of the anchors and cables as shown on the Drawings are approximate only, and the Engineer will arrange the spacing in such a manner as to hold the wire mesh against the slope. Backfill Material must be thoroughly compacted.

8-29.3(2) CABLE ASSEMBLY

The cable assembly must be in place before the wire mesh is attached. Do not tension the bottom cable. No cable splicing is allowed.

8-29.3(3) WIRE MESH

The wire mesh must be fastened to the completed cable assembly as shown on the Drawings. Hog rings on the vertical lap splices must be placed in a single row centered on the splice. Horizontal splices joining 2 rolls of mesh must be made by removing a horizontal end wire and reweaving through the ends of the fabric to form a continuous mesh. All top and bottom laps must be made by folding the mesh to the outside, away from the slope, to avoid the possibility of falling material hanging up in the folds. The bottom of the mesh must be located so that material dislodged under the mesh can drain freely from the bottom, yet does not flow or bounce onto the roadway. The ends of all tie wires must be secured to the mesh with a minimum of 1-1/2 turns.

The wire mesh must not be tensioned in any direction but must remain loose so as to increase its dampening effect on rolling rocks. The Contractor must not damage the wire mesh and cable during handling and installation. Any mesh or cable damaged due to the Contractor's operations must be replaced by the Contractor at no additional cost to the Owner.

8-29.4 MEASUREMENT

Measurement of anchors will be per each for the completed anchor. Anchor types will not be differentiated.

Galvanized wire mesh will be measured by the square foot of the completed area.

Galvanized wire rope will be measured by the linear foot of wire rope actually used for the slope protection work.

8-29.5 PAYMENT

1. "**Wire Mesh Slope Protection Anchor**", per each

The Bid Item price for "Wire Mesh Slope Protection Anchor" must include all costs for the work required to furnish and install the anchors of the type required including removing obstructions, excavating, drilling, backfilling and grouting.

2. "**Galvanized Wire Mesh**", per square foot
3. "**Galvanized Wire Cable**", per linear foot

The Bid Item price for "Galvanized Wire Mesh" and for "Galvanized Wire Cable" must include all costs for the work required to furnish and install the wire mesh and the cable, including all rings, U bolts, thimbles, wire rope, clips, hog rings, and tie wire necessary to complete the wire mesh slope protection.

SECTION 8-30 ILLUMINATION AND ELECTRICAL SYSTEMS

8-30.1 DESCRIPTION

8-30.1(1) GENERAL

Section 8-30 describes furnishing and installing a complete and functional illumination and electrical system as specified in the Contract and as shown on the Standard Plans.

All existing service disconnections, temporary and final service connections and energizing of illumination and electrical street lighting systems to overhead secondary or to secondaries in vaults or handholes will be made by Seattle City Light. The Contractor must provide the Engineer at least 10 Working Days advance notice unless otherwise arranged with the Engineer.

Do not use illumination and electrical street lighting systems to serve other electrical services.

Required permits for electrical work except street lighting and signals, and except irrigation, see Sections 8-03.1 and 8-03.3(1), must be obtained as specified in Section 1-07.6.

The Contractor must become thoroughly familiar with the electrical environment within the Project Site and with the relevant Work.

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8-30.1(2) APPLICABLE ELECTRICAL CODES AND STANDARDS

In addition to the safety rules and standards specified in Section 1-07.1(2), electrical work must be performed per the current applicable provisions of the following codes:

1. The SCL Material Standards, SCL Construction Standards, and Requirements for Electrical Service Connection documents, as published at the time of Bid Opening
2. State of Washington Electrical Workers Safety Rules, Chapter 296-45 WAC
3. National Electrical Safety Codes
4. National Electrical Code (NEC)
5. City of Seattle Electrical Code Supplement
6. Edison Electric Institute (EEI)

8-30.1(3) ELECTRICAL SHOP DRAWINGS

The Contractor must submit Shop Drawings to the Engineer of the following items as specified in Section 1-05.3:

1. Luminaires (include photometrics and socket position)
   a. Fixture
   b. Photoelectric Cells
2. Wiring
   a. Wire
   b. Wire Connectors
   c. Fuseholders
   d. Fuses
   e. Splice Kits
3. Grounding
   a. Ground Rods
   b. Ground Clamps
4. Receptacle (Festoon Outlet)

8-30.1(4) ELECTRICAL AND ELECTRONIC WORDS AND PHRASES

See Section 1-01.3.

8-30.2 MATERIALS

Materials must comply with the requirements of the following Sections:

Materials	Section
Illumination and Electrical Materials, Luminaires, Ground Rods & Clamps	Section 9-31

All welds on tubular steel must comply with ANSI/AWS D1.1 Section 10 Tubular Structures.

8-30.3 CONSTRUCTION REQUIREMENTS

8-30.3(1) GENERAL

To maintain safe traffic conditions, existing luminaires must remain in service until cut over to new luminaires can be accomplished. Roadways must not be opened to traffic before all of the required lighting system or approved temporary lighting system is tested, commissioned, and accepted as specified in this Section.

Temporary lighting plans are required unless provided in the Drawings. Temporary lighting must be provided at the cost of the Contractor unless plans are provided in the Drawings. When temporary lighting plans are provided in the Drawings a Bid Item for Temporary Lighting will be provided.

8-30.3(2) LUMINAIRES

The luminaire glassware, reflector and lamp must be thoroughly cleaned before installation on the tenon on the bracket arm. For LED luminaires, the LED array must be cleaned with a soft cloth. The luminaire must be secured and adjusted according to the manufacturer's recommendations. The luminaire refractor or LED array must be level in the transverse roadway axis and parallel to the roadway grade in the longitudinal roadway axis after the pole has been plumbed with all loads added, according to SCL Construction Guidelines D12 9/NSL 30.

Date of installation must be marked on the bottom of the photoelectric cell with an indelible ink. The luminaire must have the installation date marked inside the metal base adjacent to the photo cell.

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The photoelectric cell receptacle must be adjusted such that the photoelectric cell faces north.

8-30.3(3) HANDHOLE, MAINTENANCE HOLE AND VAULT ACCESS REQUIREMENTS

Access to handholes, maintenance holes, and vaults must be provided at all times. Temporary storage of any material on top of or within 2 feet of any handhole, maintenance hole, or vault is not allowed.

8-30.3(4) RELOCATING EQUIPMENT

When equipment and associated Material is to be relocated, the Contractor must furnish and install all equipment and material, including additional new material as necessary, required to complete the installation. All material and equipment must comply with these Specifications.

8-30.3(5) WIRING, FUSING, AND SPLICING

Underground streetlight systems must be installed per SCL Construction Standard 1714.50. Luminaire fusing must be sized appropriately per SCL Construction Standard 1730.00. Individual luminaire fuses for roadway and pedestrian luminaires must be located in the adjacent handhole.

Festoon outlets must be fused at 15 amps.

The Contractor must provide wiring from luminaire terminal boards to in line fuseholders and to the source of secondary service.

The Contractor must coil a minimum 8 feet of wire at the source of secondary service to allow for connections by Seattle City Light. The Contractor must coil 3 feet of excess conductor in each type handhole.

Each “hot” conductor must have an in line fuseholder and insulating boots located as indicated on the Drawings.

Multiple connectors must also be used as required by the Drawings. Grounding and bonding for all streetlights must conform to requirements outlined in SCL Construction Standard 1714.50 and 1810.05.

Ground wire attached to the face of a wood pole, not enclosed in conduit, must be covered with plastic molding meeting SCL Material Standards 5820.50.

Caution must be exercised in working near and within Seattle City Light vaults and the electrical distribution system. Voltages in vaults can be 26,000 volts or higher. Vault wiring will not be de energized while the qualified Contractor is working. The Contractor must arrange for scheduling a Seattle City Light Electrical Safety Observer when work is required in a Seattle City Light vault or near an electrical distribution facility as specified in Section 1-05.2(2).

When cables or single conductors are being installed, use care to not exceed tension limitations recommended by the manufacturer. Conductors may be pulled directly by hand; however, conductors pulled by mechanical means must use a dynamometer with drop needle hand on every pull. On mechanical pulls, either the insulation must be stripped off each conductor and conductors formed into a pulling eye and firmly taped before pulling, or a cable grip must be used. Apply the pulling force must directly to the conductor.

Secondary insulator racks required for new construction must be per SCL Material Standards and installed per SCL Construction Guidelines.

Where new cable will be installed in occupied existing conduits, the Contractor must protect existing wiring from damage. Use a cable pulling compound to minimize cable pulling tensions and adverse effects on existing wire insulation, jacket, and shield. Use care in pulling cable into poles and pedestals, as sharp metal edges may be present.

Aluminum wire and connectors must be prepared and coated with an oxide inhibiting compound.

Where triplex wire is installed overhead to feed only 1 street light, the 2 hot conductors must be tied together at each pole.

Wire insulation must be removed by a method that does not “ring” or nick the wire. “Ringing” will be cause for rejection of the splice.

Wire splices must be made mechanically and electrically secure. Each individual splice or termination of extra leads must be insulated and made waterproof.

All cables must be marked with a permanent stainless steel tag in handholes or access points with feed point circuit number per SCL Construction Standard 1714.10. Racking of cables is required.

For above ground splices, the connector must be torqued to the manufacturer’s recommended level. The splice and termination of extra leads must be covered with rubber base insulating and waterproofing tape as specified in SCL Material Standards. This tape must be worked around the wire insulation to insure a water tight assembly. The splice assembly must be protected with 2 layers of electrician tape.

For below ground splices, connectors must be tightened or crimped per the manufacturer’s specifications. Use only manufacturer’s approved crimping tools to compress crimp splices. Center the metal splice in the enclosure. The encapsulant must be mixed and installed per manufacturer’s recommendation. The encapsulant must completely fill the enclosure and be free of voids and impurities.

Where festoon outlets are installed on poles a separate circuit must be provided.

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8-30.3(6) LUMINAIRES RELAMPING

Re-lamping must be completed without power disconnection. The Contractor personnel servicing streetlights must be Washington State Certified Electricians licensed to work on electrical low voltage up to 600 Volts AC.

Before starting work on conductive structures, the Contractor must perform touch potential testing. Conductive structures include, but are not limited to, any structure capable of carrying current. The Contractor must test structures using an electric voltage detector to test touch potential voltage. Electric voltage detector must detect voltages 5 V or greater. If a voltage above 5 V is not detected, the test is complete and Contractor must proceed with luminaire replacement.

If a voltage above 5 V is detected, the Contractor must test structures using a voltmeter equipped with a 3000-ohm shunt. Adequate ground points to reference all measurements must be used. All ground points must first be checked for voltage. Fire hydrants, Storm Drains or other grounded structures must be sought for ground points.

If touch potential is detected, all conductive structures within a 40-foot radius must be tested for voltage. If less than 30 volts has been detected, the area must be taped and coned off to prevent incidental contact and reported to the Engineer.

If a structure is found to be energized at 30 volts or more, the immediate area must be secured and the Engineer must be notified immediately.

Removal of the existing luminaire must be done per Section 2-02.3(3)L. Installation of new luminaire must be done per Section 8-30.3(2).

After completing work on conductive structures, Contractor must perform touch potential testing to confirm Contractor's activities have not created touch potential on the structures as identified above.

8-30.3(7) GROUNDING AND BONDING

Grounding and bonding for all streetlights must conform to requirements outlined in SCL Construction Standard 1714.50.

All conductive appurtenances containing electrical conductors, including cabinets, metallic conduit, metal poles, pedestals, and junction boxes, must be made mechanically and electrically secure to form a continuous system which must be effectively grounded. Each streetlight circuit must only have 1 Service Bond.

Where conduit (including steel conduit) systems are used, all metallic appurtenances must be electrically bonded by a separate insulated ground conductor. Conduit risers must be bonded to the grounding conductor.

Where parallel electrical circuits exist in an electrical conduit, the equipment grounding conductor must be sized as determined by the rating of the largest overcurrent device serving any circuit contained in the conduit. Except the 1-3/C pole and bracket cable, the minimum size for the grounding conductor must be #6 AWG copper. Only 1 equipment grounding conductor is required in any conduit, raceway, junction box, handhole, or pole.

All conduit runs with phase conductors (with the exception of the run from the riser to the first handhole) must have the grounding conductor installed in the conduit unless noted otherwise on the Drawings.

The grounding conductor must connect all ground rods in each circuit. The grounding conductor must be installed in one continuous length without a splice or joint. If necessary, splices or connections must be made by irreversible compression-type connector listed for direct-buried use. Exothermic weld is acceptable.

Metal conduit, grounding conductor and the service neutral must be bonded and grounded at the service entrance point as required in SCL Construction Standard 1714.50, under the NEC and the City of Seattle Electrical Code.

Only 1 wire must be installed under any ground clamp.

Ground rods must be installed in firm undisturbed earth. In areas with loose or soft soil conditions, extensions must be coupled until the rod cannot be removed by hand. Minimum spacing between ground rods must be 8 feet per Seattle Electrical Code.

Grounding performance must be based on both the NESC and NEC. If installed system does not measure below 25 ohms resistance to Earth, the Engineer must make the determination if the overcurrent protection is adequate for acceptance or if additional grounding is required.

8-30.3(8) REMOVAL AND SALVAGE OF EXISTING EQUIPMENT

Refer to Sections 2-02.3(3)G, 2-02.3(3)L, and 2-02.3(7)C.

8-30.3(9) FIELD TESTING

Before completion of the Work, the Contractor must provide the Engineer 3 Working Days advance notice. The Engineer must coordinate with the Contractor to determine a hold-open timeframe. Parties must make the following tests on all electrical circuits:

1. During open trench, test for grounds in each circuit by physically examining the installation to ensure that all required ground jumpers, devices and appurtenances are in place, that they are mechanically and electrically firm, and that they comply with Seattle City Light requirements.
2. The insulation test must be performed after all field connections have been made. All readings must be recorded and made available when requested by the Engineer.

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3. A functional test in which it is demonstrated that each and every part of the system functions as specified or intended. The functional test must be performed after all field connections are completed. If applicable, streetlight contactor function must be tested as part of the complete functional test as follows:
   a. No current on the load side of contactor when in the OFF position or in the AUTO position when the PE cell is open; and
   b. Correct current to the load side of the contactor when in the ON position or in the AUTO position when the PE cell is closed.

8-30.3(10) AS-BUILT RECORDS SUBMITTALS

See Section 1-05.3(13).

Before service connection, the Contractor must submit to the Engineer for approval, as built wiring drawings indicating field wiring, conduit route and sizes, handhole location and sizes, and pole locations.

8-30.3(11) FINAL INSPECTION

See Section 1-05.11.

The Contractor must coordinate with the Engineer for all inspections. The Contractor must provide 10 Days notice before inspection.

8-30.3(12) COMMISSIONING

All projects are subject to commissioning to ensure proper operations and installation of the system. The Contractor must coordinate with the Engineer to ensure completion of all commissioning requirements.

Components in this process must include controls operation verification and adjustments, system stress testing (operation under full load), light level verification, power quality, and consumption verification.

Findings in this process that do not comply with Construction, Material, and Design Standards must be flagged and remedied during this process. The Contractor must be on site and provide traffic control for the duration of the commissioning process.

8-30.3(13) ACCEPTANCE

Upon completion of punch list and remedy of flagged items, an acceptance document must be signed by the Contractor, Engineer, and SCL, and then the system is accepted by SCL.

Upon acceptance, final connection of the lighting must occur after a service application is made to Seattle City Light and the as-built Drawings are received, confirmed, and approved.

The illuminations system will not be approved and wiring Bid Items will not be paid until the Contractor meets all requirements made in Sections 8-30.3(11), 8-30.3(12), and 8-30.3(13).

8-30.4 MEASUREMENT

Bid Items of Work completed under the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs in this Section.

8-30.5 PAYMENT

1. "**Luminaire**, **(Light Source Type), (Description)**", per each

The Bid Item price for "Luminaire, (Light Source Type), (Wattage or Number of LEDs), (Description)" must include all costs for the work required to furnish and install a complete luminaire including the fuse, hardware, photoelectric control and wiring to the fuseholder at the secondary source or at the base of the pole.

2. "**Relocate (Item)**", per each

The Bid Item price for "Relocate (Item)" must include all costs for the work required to remove the item and reinstall the item complete at the new location, including furnishing new hardware if necessary, and cleaning and re-lamping (which includes a new lamp and photoelectric cell) relocated luminaires.

3. "**Wiring**, **Street Lighting**", per lump sum

The Bid Item price for "Wiring, Street Lighting" must include all costs for the work required to furnish and install wiring for the street light system from the service point to the luminaire fuseholder, including taps, splices, tape, fuseholder, excess wire for connections, and any other Material necessary for a complete illumination and electrical system.

4. "**Relamp Luminaire**, **(Light Source Type), (Description)**", per each

The Bid Item price for "Relamp Luminaire, (Light Source Type), (Description)" must include all costs for the work required to completely remove and salvage the existing luminaire and furnish and install a complete luminaire including hardware and photoelectric control.

5. "**Bond Existing Handhole**", per each
6. "**Bond Existing Pole**", per each

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The Bid Item price for "Ground Existing Handhole" and "Ground Existing Pole" must include all costs for the work required to bond handholes or poles to grounding electrode conductor and ground rods including furnishing and installing wire, taps, splices, tape, clamps, lugs and any other Material necessary for a complete ground system.

7. "**Install Ground Rod**", per each

The Bid Item price for "Install Ground Rod" must include all costs for the work required to furnish and install ground rods including wire, taps, splices, tape, clamps, lugs, couplers, locating underground utilities and Structures, and any other Material necessary to complete a grounded system.

8. "**Inspect Grounding and Bonding**", per each

The Bid Item price for "Inspect Grounding and Bonding" must include all costs for the work required to inspect the grounding and bonding system for each existing service point location from the furthest downstream metal appurtenance to the service point.

9. "**Remove (Item)**", per each

The Bid Item price for "Remove (Item)" must include all costs for the work required to remove and salvage as required.

10. **Other payment information**

All existing service disconnections, temporary and final service connections of the illumination and electrical street lighting systems to overhead secondaries, or to secondaries in vaults or handholes will be made by Seattle City Light at the Owner's expense.

All costs for furnishing and installing hardware not specifically called out, but required to complete the construction in Section 8-30 must be included in the applicable Bid Item prices and no separate or additional payment will be made.

Existing materials proposed to be relocated per approved drawings and documents and found to be in need of repair or replacement during the time of construction by the Engineer must be replaced by new material and will be addressed as extra work per Section 1-04.3.

Costs for Electrical Safety Observer must be as specified in Section 1-05.2(2).

SECTION 8-31 TRAFFIC SIGNAL SYSTEM

8-31.1 DESCRIPTION

8-31.1(1) GENERAL

This Work consists of furnishing and installing a complete and functional traffic control system consisting of controller assembly, signals, miscellaneous traffic devices, and appurtenances as specified in the Contract.

The Contractor must become thoroughly familiar with the electrical environment within the Project Site and with the relevant Work.

All final signal system service connections to secondary overhead / underground will be made by Seattle City Light.

If, for any reason, vehicular or pedestrian signals fail to function properly, the Contractor must immediately call for an off-duty Uniformed Peace Officer to control the intersection. The Contractor must also immediately notify the Engineer and the Owner's Signal Maintenance Office (206) 386-1206 of the nature of the malfunction. The Contractor must immediately undertake the necessary repairs. The Engineer may require the work to be done by Owner forces.

8-31.1(2) ELECTRICAL AND ELECTRONIC WORDS AND PHRASES

See Section 1-01.3.

8-31.1(3) APPLICABLE ELECTRICAL CODES

See Section 8-30.1(2).

8-31.1(4) SUBMITTALS AND REFERENCE MATERIALS

8-31.1(4)A SIGNAL SHOP DRAWINGS

The Contractor must submit Shop Drawings including catalog cuts as specified in Section 1-05.3 for the following:

1. Signal Heads and Mounting Assemblies
2. Cable and Wire
   a. Wire Connections
   b. Fuse Kits
   c. Splice Kits
3. Pole Line Hardware
4. Interior Illuminated Signs and Blank Out Signs
5. ITS Equipment
   a. CCTV Cameras

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b. Detection Cameras
c. License Plate Readers
d. Wireless Detectors
e. Dynamic Message Signs
f. Communication Devices

6. Miscellaneous
   a. Aerial Terminal Compartments
   b. Pedestrian Push Button
   c. Ground Rods
   d. Emergency Vehicle Preemption Detector
   e. Cabinet
7. Detector Loops
   a. Loop Sealant
   b. Wire
8. Rapid Flashing Beacon System
   a. Light Bar
   b. Controller Cabinet
   c. Flash Controller
   d. Universal Switching Power Supply
   e. Solar Panel
   f. Wireless Communication Components
   g. Pushbutton

The Contractor must submit redline as-built wiring diagrams to the Engineer for each signalized intersection at least 3 Working Days before requesting the Engineer's approval for turn on or cut over.

8-31.1(4)B SAMPLES

The Contractor must submit a sample to the Engineer for approval of the type of electronic component to be used. Approved samples will be retained for future comparison for the remaining equipment to be installed.

8-31.1(5) CONTROLLER ASSEMBLY TESTING REQUIREMENTS

8-31.1(5)A FIELD TESTING

The Contractor must make the following tests on all new electrical circuits. Test equipment must be calibrated as recommended by the test equipment manufacturer.

1. Test for continuity of each circuit.
2. Test for grounds in each circuit which consists of the physical examination of the installation to ensure that all required ground jumpers, devices and appurtenances do exist and are mechanically firm, meeting the requirements of Article 250 of the National Electrical Code.
3. A megger test on each circuit between the conductor and ground with all switchboards, panel boards, fuse holders, switches, receptacles and over current devices in place and all readings recorded. The megger test must be performed with all wiring installed but connections not made to controller, conflict monitor, load switches, or other plug connected accessories. The Contractor must submit 3 copies of the test results identifying observed readings with their respective circuits at least 3 Working Days before any checkout of the installation is turned on or cut over. 1 copy must be filed in the controller cabinet.

   The insulation resistance on all electrical circuits whose nominal voltage is between 115 volts and 600 volts, except direct burial cable, must not be less than 6 megohms between the conductor and ground on circuits with total single conductor lengths of more than 2,500 feet, nor less than 8 megohms between the conductor and ground for circuits with single conductor length 2,500 feet or less.

   For circuits below 115 volts nominal and all direct burial circuits, the insulation resistance must not be less than 2 megohms to ground, and for loop wire not less than 10 megohms.

   Any change in the above stated minimum readings requires written approval by the Engineer. Only those factors based on dielectric properties of items such as but not limited to conductor insulation, splicing insulations, and terminal strips will be cause for consideration of variance.
4. A functional test (intersection check out) in which it is demonstrated that each and every part of the system functions as specified here. The functional test will be performed after all field connections to the controller cabinet have been made.

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Any fault in any Material or in any part of the installation revealed by these tests requires Material replacement or repair by the Contractor as approved by the Engineer, and the same test must be repeated until the system is approved by the Engineer.

8-31.1(6) GUARANTEE

See Section 1-05.10.

8-31.2 MATERIALS

Materials must be as specified in Section 9-32.

8-31.3 CONSTRUCTION REQUIREMENTS

8-31.3(1) CLEARANCE REQUIREMENTS AND INTERSECTION CHECK OUT AND TURN ON PROCEDURES

8-31.3(1)A TRAFFIC CONTROL

The Contractor must provide an off-duty Uniformed Peace Officer at any time a signalized intersection is dark or inoperative, such as during controller change out, cable installation, signal turn on or cut over, or similar circumstances. The Contractor must have all traffic controls (i.e. pavement markings, channelization, and signage) in place before requesting Engineer's approval for turn on or cut over.

To maintain safe traffic conditions, existing signals must remain in operation until a simultaneous cut over to new signals can be accomplished.

At the time of turn on of new signals, temporary advanced warning signs must be installed on all approaches. These signs must remain in place for not less than 7 Calendar Days nor more than 21 Calendar Days. All signs must be highly visible and be placed in convenient and secure locations. Installation and removal of signs is the Contractor's responsibility and incidental to sign work.

At the time of cut over of revised signals having phasing which is different from the old signal operation (including but not limited to an added phase or split phase) temporary signal revision signs must be placed upstream on all approaches. These signs must remain in place for not less than 7 nor more than 14 Calendar Days. At a cut over of revised signals having phasing which is the same as the old signal operation, no temporary signing is necessary. All signs must be highly visible and placed in convenient and secure locations. See Sections 8-31.3(16), 1-07.23, and Section 1-10 for traffic safety and traffic control. The Contractor is responsible for installation and removal of signs incidental to signal work.

8-31.3(1)B TRAFFIC SIGNAL CONTROLLER CABINET AND HANDHOLE ACCESS REQUIREMENTS

Access to traffic signal controller cabinets and handholes must be provided at all times. Storage of any item on, against, or within 3 feet of any traffic signal controller cabinet will not be allowed. Traffic signal controller cabinets must always have at least 3 feet clear on all sides. Clear and uncluttered access between the traffic signal controller cabinet and accompanying handhole must be provided at all times with a minimum access width of 3 feet. Temporary storage of any material on top of or within 2 feet of any handhole will not be allowed.

8-31.3(1)C TRAFFIC SIGNAL CONTROLLER ASSEMBLY REPLACEMENT

At each location which requires that an existing traffic signal controller assembly be replaced by a new one using the existing foundation, the work must proceed as follows:

The Contractor must check and tag all field circuits, and must provide the Engineer 10 Working Days advance notice for de-energizing.

After field circuits have been tagged, the Engineer will de energize the traffic signal controller assembly, and disconnect and remove existing traffic signal controller and auxiliary equipment from the cabinet. The Contractor must then remove the field wiring, remove the existing traffic signal controller cabinet, install the new traffic signal controller cabinet, and connect the field wiring.

At each location selected for modification work that requires removal or rebuilding of the existing traffic signal controller cabinet foundation, the Engineer will de energize the traffic signal controller cabinet and remove electronic equipment while the Contractor temporarily relocates the existing cabinet as approved by the Engineer. The cabinet must be temporarily relocated in such a manner that the intersection operates in its present mode during foundation reconstruction or modification. The Contractor must protect the traffic signal controller assembly within the Work area, as approved by the Engineer.

Following foundation reconstruction, the new traffic signal controller assembly must be installed on the new or modified foundation.

8-31.3(2) TRAFFIC SIGNAL CONTROLLER ASSEMBLY

8-31.3(2)A GENERAL

The Contractor must install the traffic signal controller cabinet. The Engineer will install the traffic signal controller and associated electronic equipment. The Contractor must terminate all field wiring on the terminal strip in the traffic signal controller cabinet.

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Auxiliary equipment added to existing traffic signal controller cabinets must be installed as indicated on the Drawings and as specified here.

Any field modification requires the Contractor to submit to the Engineer for approval a modification plan 3 weeks before scheduling the Work. The submittal must include equipment layout and wiring diagrams detailing the work to be done, as well as the portion of the critical path schedule to be followed. A description of how the Work affects traffic and signal operation must also be submitted, along with information on measures to be taken to minimize adverse impacts on traffic.

The Engineer must be notified 2 Working Days in advance of energizing the unit.

The Contractor must coordinate with SDOT Signal Operations at the preconstruction meeting for traffic signal controller cabinet pick up schedule. The Contractor must pick up the traffic signal controller cabinet at the Traffic Signal Shop for installation. The Traffic Signal Shop is at 4200 Airport Way South, or (206) 386-1517.

For installation of all traffic signal controller cabinet, the Contractor is required to have power service at the cabinet location and to be hooked up to keep the electronics warm and dry until energizing the traffic signal.

8-31.3(2)B TEMPORARY CONTROLLER CABINET FRAMING APPARATUS

Where relocation of the controller cabinet is required for locations where a new foundation is being poured in the same location as the existing foundation, the Contractor must furnish a temporary controller cabinet framing apparatus to support the controller cabinet over the control box handhole.

The framing apparatus must be sized to match the base of the controller cabinet and completely cover the control box handhole. It must also have a means to securely tie the controller cabinet to the framing apparatus.

The framing apparatus must be constructed from wood and treated to withstand the rain while in the field.

The temporary controller cabinet framing apparatus must be installed at the same orientation as the existing traffic signal cabinet, unless otherwise directed by the Engineer.

8-31.3(2)C AUXILIARY CABINETS

The Contractor must supply 336a cabinets installed in the location for Auxiliary Cabinets as shown on the Drawings and as specified in this Section. The cabinet must not be supplied with a “police panel.” All hardware in the 336a cabinet will be furnished by the City of Seattle unless otherwise specified. The installation must consist of the following:

1. Inspect cabinet before installation to ensure that the cabinet is free of damage.
2. Install cabinet on concrete foundation per the Drawings.
3. Mount cabinet to foundation per manufacturer’s instructions.
4. Seal cabinet at base and seal all conduits into cabinet with a waterproof sealant following installation.
5. Ground cabinet to comply with National Electric Code (NEC) standards.

The Contractor must store each cabinet in a secured location before installation. This storage area may be an outdoor secure facility.

Any field modification requires the Contractor to submit to the Engineer for approval a modification plan 3 weeks before scheduling the Work. The submittal must include equipment layout and wiring diagrams detailing the work to be done.

8-31.3(2)D TERMINAL CABINET

Terminal cabinets must be field installed on all signal poles as shown on the Drawings. All terminal cabinets must have two 18-position terminal strips. Use terminal cabinets for all vehicular and pedestrian signal heads attached to or spanned from signal poles. Install terminal cabinets at the mounting height shown on Standard Plan 562a and above pedestrian signal heads. Terminal cabinets must be locked. The Contractor must supply police lock with 2 master keys. The keys must be delivered to the Engineer. Terminal cabinets must be wired per the field termination diagram shown on the Drawings. If no field termination diagram is provided in the Drawings, the Contractor must submit a proposed termination diagram for review by the Engineer before installation.

8-31.3(3) SIGNAL HEADS, VEHICLE AND PEDESTRIAN

8-31.3(3)A GENERAL

Do not install signal heads at any intersection earlier than 10 Working Days before turn on or cut over.

Mounting must be bracket, mast arm, post top, span wire, or clamshell as indicated on the Drawings. Signals mounted on post tops must use standard 4-inch slipfitters. Bracket mounted signal heads must use the signal bracket assembly and type of mounting indicated on the Drawings. The bracket assembly must be installed in line with the pole center line.

Attachments such as visors, backplates or adapters must conform and readily fasten to existing mounting surfaces without affecting the weatherproofing and light integrity of the signal.

Electrical service must be neatly formed to the supporting structure with only sufficient slack for wind effect when span wire mounted.

All new vehicular and pedestrian signals must be temporarily, securely, and completely covered with a 6 mil minimum thickness black, or blue, polyethylene sheeting until the time of turn on or cut over.

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Alignment of vehicular and pedestrian signal heads and the overall readiness of other traffic control devices and channelization will be approved by the Engineer before activating signal locations.

8-31.3(3)B VEHICLE SIGNAL HEADS

The bottom of vehicle signals mounted over roadways, excluding backplates, must have a range of clearance between 17 feet to 19 feet above roadway grade at the grade of the roadway. On designated truck and overhead trolley routes, the range of clearance must be 18 feet to 19 feet. The top of the vehicle signal face cannot be more than 25.6 feet above roadway grade. Vehicle signals mounted on poles or pedestals must be 12 to 15 feet above sidewalk grade. Vehicular signals mounted to aluminum pedestal poles must be installed with a supplemental pole base collar. The pole base collar is not required for vehicular steel pedestal poles. Pole plates used for bracket mounted installations must be of the type that must fit flush against the pole surface without altering the pole or pole plate.

The signal must be mounted with standard 1-1/2 inch fittings as a single section or as a multiple section head. The signal section must be provided with an adjustable connection that permits incremental tilting from zero to at least 10 degrees above or below the horizontal while maintaining a common vertical axis through couplers and mounting. Terminal connection must allow external adjustment about the mounting axis in 5 degree increments. The signal must be mountable with ordinary tools and capable of being lamped without tools.

Signal heads located over the roadway must not be in physical or visual conflict with trolley wires, span wires, electrical wires, or any other hardware existing or proposed for the location. Maintain a 4-foot edge-to-edge clearance between signal heads and trolley wires. Span wires and tether lines within 4 feet of trolley lines must be properly insulated. If it becomes evident that a conflict exists, the Contractor must immediately notify the Engineer and allow 5 Working Days to resolve the problem.

Do not install balance adjusters when the approach grade is less than 10 percent.

When balance adjusters are required, the vehicular heads must be adjusted in the field such that persons standing on the pavement, 4 times the speed limit in feet back from the stop bar, must see the brightest image of the red section. Heads must be plumbed as viewed from the direction in which they face.

Vehicle signal heads must be attached to the mast arm either with a signal coupling unit or bracket mounted as detailed on Standard Plan 510A and 562b. Signal head attachment type is shown on the Drawings. Coupling mounts must include elevator straight plumbizer units between the red and yellow signal sections, or 90 degree plumbizers. Bracket mounts must include a cable mount kit and a clamp kit.

Vehicle signal heads must be attached to the span wire by a hanger clamp, balance adjuster, and suspension fittings as shown on the Standard Plans. The sag in the span wire after loading must be within the range of 5 percent to 7 percent of the total span. Span wires must be attached to the poles such that the signal head mounted at the lowest point on the span does not require a signal height adjuster. The top (red) section of all heads hanging on the same span must be approximately level when viewed from the approach direction.

For signal heads that include a visual restrictor, referred to as optically programmed or geometrically programmed signals, where specified to be span wire mounted, a tether cable must be installed. The tether cable must be complete with connections and hardware as recommended by the signal head manufacturer to provide and maintain proper optical visibility of all indications. The tether cable clamps used must be designed to release under severe wind loads and impact. The tether cable must be ¼" and be installed a minimum 18 feet above roadway grade. Where in proximity to existing or planned trolley wires, span wires or electrical wires tether cable must be insulated. Optically programmed and geometrically programmed traffic signal heads must be programmed before traffic signal system turn on. Programming must be performed in the presence of the Engineer by allowing 2 Working Days advance notice.

Optically programmed type traffic signal heads must be programmed before traffic signal system turn on. Programming must be performed in the presence of the Engineer by giving 2 Working Days advance notice.

8-31.3(3)C PEDESTRIAN SIGNAL HEADS

Pedestrian signal heads must be aligned to focus on the center of the far end of the crosswalk which it is associated with and at a point 5 feet above the opposing sidewalk.

Multiple pedestrian signal heads mounted on a pedestal must be stagger mounted so that the distance to the bottom of the lower housing is 8 feet above the sidewalk, and the distance to the bottom of the upper housing is 9'-6" above the sidewalk.

The Contractor must use a "Clamshell" type mounting assembly for pedestrian signals.

Pedestrian signal heads mounted on the same pole (not pedestal) must be installed so that the bottom of the housing of each head is a minimum 8 feet to a maximum 9'-6" above sidewalk grade. On poles where the signal housings interfere with each other, stagger mounting is required as indicated on the Standard Plans.

8-31.3(4) PUSHBUTTON ASSEMBLIES

8-31.3(4)A ACCESSIBLE PEDESTRIAN SIGNAL PUSHBUTTON ASSEMBLY

The complete Accessible Pedestrian Signal (APS) system must be furnished and installed by the Contractor and must be designed as shown on the Drawings. The mounting height of the pushbutton must be 3'-6" above the sidewalk as indicated on Standard Plans 521 and 522a. The APS system must consist of audible tones/message capabilities from the pushbutton

housing, pedestrian pushbutton (with a raised tactile directional arrow and latching mode as described in Standard Specification 9-32.3), MUTCD sign, frame which provides an integral pushbutton mount and sign platform (with sign mounted above the pedestrian pushbutton), central control unit in the traffic control unit, and all associated cables and mounting hardware. The Contractor must use the cable type and mounting assembly as recommended by the pushbutton manufacturer.

The pushbutton assembly must be located on the side of the pole as shown on the Drawings.

8-31.3(4)B BICYCLE PUSHBUTTON ASSEMBLY

The complete bicycle pushbutton assembly must be furnished and installed by the Contractor and must be designed as shown on the Drawings. The mounting height of the pushbutton must be 3'-6" above the sidewalk as indicated on Standard Plans 521 and 522b. The system must consist of pedestrian pushbutton (with a raised tactile directional arrow and latching mode as described in Standard Specification 9-32.3), MUTCD sign, frame which provides an integral pushbutton mount and sign platform (with sign mounted above the pedestrian pushbutton), central control unit in the traffic control unit, and all associated cables and mounting hardware. The Contractor must use the cable type and mounting assembly as recommended by the pushbutton manufacturer.

The pushbutton assembly must be located on the side of the pole as shown on the Drawings.

8-31.3(5) VEHICLE DETECTION

8-31.3(5)A INDUCTIVE DETECTOR LOOPS

Vehicle loop detectors indicated on the Drawings are located schematically and actual loop detector locations will be verified by the Engineer before sawcut or installation. The Contractor must mark out proposed detector loops on the roadway at least 3 Working Days before any sawcut or installation occurs. The location of stop bar pavement marking must be obtained by the Contractor before sawcut or loop detector installation. In general, locate loop locations behind existing or proposed stop bar pavement marking, and do not locate where pavement dowel or tie bars or metal supports within the pavement are located. Loops located within or beyond the stop bar pavement marking are allowed. Do not start sawcutting pavement until loop locations have been approved by the Engineer. When parallel to a pavement joint or edge, the sawcut must be at least 1 foot away from the edge or joint. All saw cuts must be cleaned of all debris.

Traffic loops must be sawcut into the concrete base or HMA sublayer after planing and before placement of final wearing course. The Contractor must sawcut the existing base to a depth that provides a minimum of 1 inch of cover between the top of the loop wire and the top of the existing pavement base.

Use one single continuous length of loop wire to form a loop with 4 turns. The wire must be placed by tamping it into the saw cut with a blunt wooden stick, taking care not to damage the insulation. To reduce abrasion of the insulation, the Contractor must sawcut all corners at least once to reduce the corner angle. This corner angle must then be filed or smoothed acceptably free of sharp edges.

The sawcut in concrete must be filled with a quick drying high strength highway concrete patching Material. The Contractor must submit to the Engineer at least 3 Working Days in advance, a catalog cut describing the patch Material properties including strength and time to develop strength characteristics.

For polyurethane detector sealant, remove all dust, water or other debris from the wire loop prior to installation. After installing detector wire, apply sealant to seal detector wires and fill slot to approximately 1/8" below the roadway surface. Roadway may be reopened as long as sealant is not filled to surface. All additional manufacturer installation instructions must be followed.

For hot-applied asphaltic sealant, sealants must be melted in jacketed double boiler melters with effective agitation that meet Appendix X1.1 of ASTM D6690. The melter must be capable of safely heating the product to 420F. Product must be applied to clean, dry pavement at a temperature greater than 40F. Sealant should be installed flush with the pavement surface in a neat manner which fills the sawcut. All additional manufacturer installation instructions must be followed.

Loop wire, from the loop to the lead in splice, must be twisted a minimum of 3 turns per foot. Care must be taken so that the twists are uniform.

A minimum of 60 inches of loop wire must be brought into the handhole and spliced to the lead in cable with a crimped soldered, waterproof splice.

Before Turn-on/Cut-over, the Contractor must provide the Engineer as-built Drawings diagramming the complete loop detector system. After Turn-on/Cut-over has been accepted by the Engineer, a dated as-built Drawing, provided by the Contractor, of the complete loop system indicating their size, direction, lane location, inductance reading and identifying number assigned must be installed in the controller cabinet. Also see Sections 1-05.3(11), 8-31.3(5)C, 8-31.3(5)E, and 8-31.3(16).

Before splicing the loop wire to the loop lead in cable, an inductance test must be performed by the Engineer to ensure the inductance is within the acceptable range of ± 15 percent of the calculated inductance. If the inductance does not fall within the acceptable range, the Contractor must take necessary corrective measures until the desired readings are obtained or as approved by the Engineer. Before cut-in/turn-over, the completed loop and lead in configuration after splicing must be checked for continuity by the Contractor, using a tester that does not exceed the voltage rating of the lead in and loop wires.

The Contractor must also perform a Megger test on the loop and lead in configuration to make certain that the resistance to ground is 10 megohms or greater. If resistance to ground before placing the sealant is less than 10 megohms, all splices and wires must be checked for insulation damage. Corrective measures must be taken until an acceptable resistance is

obtained. After the slot has been sealed, the Contractor must perform the resistance and continuity tests again. If the continuity and resistance tests do not comply with the above mentioned requirements, the Contractor must take corrective measures until readings acceptable to the Engineer are obtained.

After loop wire and lead in cable splices have been made, and the continuity test has been completed, the Engineer will test the inductance of the loop and loop lead in cable at the controller cabinet. The inductance must be within the acceptable range of ± 15 percent of the calculated inductance. If the inductance does not fall within the acceptable range, the Contractor must take corrective measures until acceptable readings are obtained.

8-31.3(5)B PREFORMED DETECTOR LOOP

The Specifications of Section 8-31.3(5), except Section 8-31.3(5)A, apply to preformed detector loops except as follows:

Catalog cuts must be submitted as specified in Section 8-31.1(4)A. No more than 4 different lengths of lead-in can be submitted.

The Contractor must mark out proposed loop detector locations for the Engineer's approval at least 3 Working Days before the concrete placement. Follow the loop detector location coordination specifications in Section 8-31.3(5)A.

Preformed loop detectors must be placed per plan above the concrete reinforcing steel, when present, and just above the neutral axis of the panel. Detectors located in panels without rebar must be secured onto poly insert tees as shown on details at 2-foot spacing to hold the preformed loop with a minimum of 3-inch clearance from the top and bottom surface of the concrete. A minimum of 6-foot of lead-in slack must be placed in a neat coil in the handhole. If the loop is not to be spliced as part of this contract, the ends must be taped and the wire marked with the loop number per the plan using permanent waterproof tags.

Preformed loop detectors must be installed and tested before the pavement being placed. Before the paving operation begins, the Engineer will conduct an inductance test per Section 8-31.3(5)A. The test will be performed again after the pavement has been placed, and before turn-on or cut-over. The Contractor must perform the test as specified in Section 8-31.3(5)A, in the presence of the Engineer, if the preformed detector loop is connected to the controller cabinet. The pavement must be poured making certain not to disturb the loop cable. The lead-in cable must be protected during construction. If the preformed loop or lead-in cable is not functional during the final test or is damaged during construction the Contractor must provide a fully functional equivalent wireless detector system, equal to the Contract plans, with 1 wireless detector replacing each upstream preformed detector and 2 wireless detectors at the stop bar as approved by the Engineer and at the Contractor's sole expense.

Before Turn-on/Cut-over, the Contractor must provide the Engineer as-built Drawings diagramming the complete loop detector system. After Turn-on/Cut-over has been accepted by the Engineer, a dated as-built Drawing, provided by the Contractor, of the complete loop system indicating their size, direction, lane location, inductance reading and identifying number assigned must be installed in the controller cabinet. Also see Sections 1-05.3(11), 8-31.3(5)E, and 8-31.3(16). Before splicing the loop wire to the loop lead in cable, the Engineer will perform an inductance test to ensure the inductance is within the acceptable range of ± 15 percent of the calculated inductance. If the inductance does not fall within the acceptable range, the Contractor must take necessary corrective measures until the desired readings are obtained or as approved by the Engineer. Before cut-in/turn-over, the Contractor must check the completed loop and lead in configuration after splicing for continuity, using a tester that does not exceed the voltage rating of the lead in and loop wires.

The Contractor must also perform a Megger test on the loop and lead in configuration to make certain that the resistance to ground is 10 megohms or greater. If resistance to ground before placing the sealant is less than 10 megohms, all splices and wires must be checked for insulation damage. Corrective measures must be taken until an acceptable resistance is obtained. After the slot has been sealed, the Contractor must perform the resistance and continuity tests again. If the continuity and resistance tests do not comply with the above mentioned requirements, the Contractor must take corrective measures until readings acceptable to the Engineer are obtained.

After loop wire and lead in cable splices have been made, and the continuity test has been completed, the Engineer will test the inductance of the loop and loop lead in cable at the controller cabinet. The inductance must be within the acceptable range of ± 15 percent of the calculated inductance. If the inductance does not fall within the acceptable range, the Contractor must take corrective measures until acceptable readings are obtained.

8-31.3(5)C VIDEO DETECTION CAMERA

Video cameras must be installed for vehicle detection in locations shown on Drawings. The Contractor is responsible for installation and fine-tuning the position of the cameras. The Contractor must provide all materials necessary for a complete system including the controller interface. The Owner will configure the detection processors installed in the controller cabinet. The Contractor must notify the Engineer 10 Working Days before installing the cameras. The Contractor must test all video detection equipment before installation. The testing must include verifying that all components of the camera and lens are operational and that the video image processor unit can power up and receive a signal from the camera. After installation, the Contractor must perform the same verification in the field before scheduling configuration. The Owner is responsible for configuration of the detection zones. The Contractor and the Engineer must be present during the configuration of the detection zones. The Contractor must keep the video detection equipment fully operational until the end of the project. Within 10 Working Days of Substantial Completion, the Contractor must upgrade the video detection processor software and the PC based management software to the most current version.

8-31.3(5)D WIRELESS SENSOR DETECTION

Each Wireless Sensor Detection System must contain one or more Wireless Sensors buried in the roadway for vehicle detection, and 1 or 2 SPP radios per Job Site mounted along the roadway shoulder to receive and process information from the data collected by the sensors and Wireless Repeaters. These must also be mounted along the roadway shoulder for providing two-way relay between out-of-range wireless sensors.

An in-pavement Wireless Sensor must be provided for each Wireless Sensor location shown on the Drawings. The Wireless Sensor is designed for permanent deployment in all traffic conditions, including freeways, arterials and parking lots, for detecting the presence or absence of a vehicle at the Wireless Sensor.

Access Point Contact Closure Cards in conjunction with up to 2 digital radios (Serial Port Protocol – SPP) must be provided at each Wireless Sensor Detection System location for communicating to the wireless sensors in the roadway and other wireless repeaters on the roadside. The SPP are identified to be mounted on roadside poles in the Drawings. An SPP maintains two-way wireless data reception with the in-pavement sensors and/or with the repeaters in case of out-of-range sensors. It also communicates to the roadside traffic signal controller via the Contact Closure Card, and to/from the central network management centers. The Isolator is used between each SPP radio and APCC to extend the communication range between the devices and provides both electrical isolation and surge protection.

The Contractor must deliver all sensors, cards, access points and repeaters to the Traffic Signal Shop at 4200 Airport Way S for programming and configuration a minimum of 10 Working Days prior to installation.

Wireless Repeaters must be provided at the locations designated on the Drawings for two-way relay communications between out-of-range wireless sensors. At the identified locations in the design Drawings Wireless Repeaters will be pole mounted. The Wireless Repeater provides a two-way relay between the out-of-range sensors and the SPP radio.

Use the pole mounting brackets for mounting the SPP and repeaters. See Drawings for installation requirements.

Use the proper RJ45 connector crimping tool to attach connectors directly to the outdoor rated CAT5-E cable.

The Contractor must follow these steps to complete the installation of the Wireless Sensor Detection system:

1. Mark all sensor locations in the field before installation.
2. Coordinate with the Engineer for approval of all wireless sensors locations before installation. The Contractor must mark 5 intersections before requesting Engineer's approval. 2 Days notice is required before the requested field review date.
3. Install the wireless sensors per the manufacturer's installation recommendations.
4. Mount the SPP radio on the pole shown on the Drawings.
5. Coordinate with the Engineer to connect the SPP radio into the Isolator in the controller cabinet. The Contractor must have 5 locations ready for connection before contacting the Engineer and provide 2 Days notice before the requested day for final connection.
6. Turn on the SPP radio without any of the Repeaters installed and see if all Wireless Sensors are reliably communicating back to the SPP radio.
7. Install Repeaters at locations shown on the Drawings only for the Wireless Sensors that are not communicating with the SPP radio. All spare Repeaters must be delivered to the City.
8. SPP radios and repeaters must be mounted 25' above the roadway where possible unless otherwise indicated on the Drawings. The minimum height is 20 feet.

The Contractor must install each sensor according to the manufacturer's installation recommendations and as shown on the Drawings. After installation, the Contractor must ensure successful operation of the devices using the vendor supplied software utilities.

a. Identify and locate the Wireless Sensor on Job Site to ensure that the sensor is installed at the location as identified on the Drawings. The Engineer will approve the final sensor locations.
b. Record distances between each Wireless Sensor in a lane.
c. Use a 4-inch coring bit and drill rig to make a hole not more than 3 inches deep at the identified wireless sensor location. Dry coring is recommended with a vacuum to remove the dust.
d. Clean the surface of each hole with a brush. Make sure the surface is completely dry before applying the epoxy.
e. Use a fast drying epoxy as a sealant to backfill the hole for proper installation of the sensor inside the hole.
f. Apply the epoxy in each hole. Place the sensor in the hole on top of the epoxy, with the orientation indicator on the top of the sensor pointing in the direction of the traffic flow. Apply enough pressure to the sensor so that epoxy squeezes out around the edges of the sensor and that the sensor is flush with (or slightly below) the roadway surface. Make sure that the sensor installs level in the cored hole and is not tilted.

The SPP radios and repeaters must be pole or davit arm mounted using a clamp band at the designated location identified on the Drawings using the specified mounting brackets/kits.

The Contractor must provide a limited two-year warranty on the detection system transferred to the City of Seattle. During the warranty period, technical support must be available from the Supplier via telephone within 24 hours of the time a call is made by a user, and this support must be available from factory-authorized personnel or factory-authorized installers. During the warranty period, standard updates to the software must be available from the Supplier without charge. On-site

installation and/training support must be provided by a factory authorized representative before the Contractor begins any installation work. All documentation must be provided in the English language.

8-31.3(5)E DETECTOR LOOP LEAD-IN CABLE

The Contractor must sawcut pavement to a depth which provides a minimum 1-inch cover between the top of loop wire and pavement surface.

Lead in cable must be one continuous length from the splice at the handhole to the termination point in the controller cabinet.

The cable shield and drain wire must be grounded at the system ground only at the controller cabinet and must be continuous and insulated.

Each loop lead in wire must have a permanent cloth or plastic tag with the label number shown on the loop detector wiring chart specified on the Drawings. These tags must be placed at handhole splice and controller cabinet terminations.

8-31.3(6) OVERHEAD ILLUMINATED SIGN

Interior illuminated signs must be temporarily covered completely with a 6 mil minimum thickness opaque polyethylene sheeting until the sign is ready to be energized and the Engineer authorizes the Contractor to remove the sheeting.

The sign must be mounted as indicated on the Standard Plans unless indicated otherwise in Contract. The sign must be mountable and capable of being serviced with common tools. The clearance distance to the bottom of the sign at the lowest point on the span to the roadway must be a minimum of 16-1/2 feet and a maximum of 19 feet. On designated truck routes, this clearance must be a minimum 18 feet.

Signs must be plumb.

8-31.3(7) PREEMPTION DETECTORS AND CAMERAS

8-31.3(7)A EMERGENCY VEHICLE PREEMPTION DETECTORS

Opticom emergency vehicle preemption detectors must be installed per the manufacturer's instructions and other requirements of this Contract. No substitution will be allowed.

The detector cable must be brought back to the controller as shown on the wiring schedule on the Drawings. No splicing is allowed between the detector and the controller cabinet. When called for on the Drawings, the detector cable must be attached to a #9 galvanized iron wire messenger with vinyl electrical insulating tape, such as 3M Super 88 or approved equal, at 18-inch intervals. Any unused conductors must be tied together and grounded.

8-31.3(8) SIGNAL INTERCONNECT

8-31.3(8)A GENERAL

The Contractor must match the sag as closely as possible with wires already on poles to ensure minimal movement in windstorms and adjacent wire conflict.

All cable pulled through underground ducts must be lubricated with an approved cable pulling compound.

The Contractor must use a cable pulling grip to hold on to the jacketed messenger when pulling and tensioning. Pulling and tensioning must be done in such manner as to not damage the jacket. When separating the messenger from the jacketed conductor assembly for dead ending or splicing, the web must be split in the middle. Cable with damaged jackets will be rejected and promptly replaced by the Contractor at no expense to the Owner.

At corners and run ends, the messenger strand must be dead ended with either automatic strand vises or preformed guy grip dead end. When dead ending with strand vises, the Contractor must cut the strand and remove the jacket from the steel strand, exposing enough strand so that the ends of the strand coming through the chuck of both strand vises can be overlapped and bonded together to form a continuous ground. Use a one bolt guy clamp to bond the strand ends together.

Do not splice interconnect cable. The cable must be a continuous run between the terminal strip of one controller to the terminal strip of the next controller. The messenger wire must be removed from aerial figure 8 cable in pole risers and conduit.

The shield of all cables entering an aerial terminal compartment must terminate on a common terminal. The shield must be connected to the terminal strip of the controller at the start of a system and then connected only at alternate controls along the route of the system.

The installation of controllers and the connection to the energized interconnect cable must be done starting at the master control point and going to the end of the system. When controllers are to be connected into new or existing systems, take care not to disrupt the integrity of the entire system. A plan of order for converting from an old to a new system must be submitted for approval by the Engineer at least 10 Working Days in advance.

An extra 6 feet of interconnect cable must be coiled in the nearest handhole to the controller cabinet. After the cable has been pulled into the controller cabinet, the outside jacket must be stripped back 3 feet. All exposed wiring must have the gel removed from each wire individually. The Jacket end must be sealed to prevent the gel from leaking out of the cable. Sealing must be done by applying a small portion of duct seal, well pressed between the wires and jacket and then firmly taped with 4 to 6 wraps of vinyl electrical insulating tape, such as 3M Super 88 or approved equal, extending 2 inches from each side of the

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jacket end to hold the seal in place. After cleaning and sealing, the exposed length of wiring must be re-twisted as a pair with the original mate. Use an approved shield grounding connector to ground the shielding.

Interconnect cable in conduit must be installed as specified in Section 8-30.3(5).

8-31.3(9) SIGNAL WIRING

8-31.3(9)A CONDUCTOR INSTALLATION

The Contractor is responsible for making all circuits fully functional after pulling in new cables.

Cable and wire which is damaged in pulling must be promptly replaced with new cable at the sole expense of the Contractor.

When conductors and cables are being installed, use care to not exceed tension limitations recommended by the manufacturer. Conductors may be pulled directly by hand. However, if conductors are pulled by any mechanical means, use a dynamometer with drop needle hand on every mechanical pull.

On mechanical pulls, sufficient insulation must be stripped off the conductor to form a pulling eye and then firmly taped before pulling; or a cable grip must be used. When pulling eyes are used or when the conductor is formed into a loop, limit the pulling force applied directly to the conductor to 0.008 pound per circular Mil area of copper conductor, but must not exceed the recommended limits of the conductor's manufacturer. When a cable grip is applied over nonmetallic sheathed cables, limit the maximum pulling force to 1,000 pounds, provided this is not in excess of the force as calculated above.

To limit the side wall pressure at bends in duct and conduit runs, the pulling force in pounds must not exceed 100 times the radius of the bend in feet or the manufacturer's recommendation, whichever is less. Adequate lubrication of the proper type to reduce friction in conduit and duct pulls must be used. Lubricant must be of a non-hardening type approved by the Engineer.

In existing conduits where new cable will be installed which contain existing traffic and street light wiring as noted on the Drawings, the Contractor must protect existing wiring from damage due to pulling new cable. Use a cable pulling compound to minimize cable pulling tensions and adverse effects on existing insulation, jackets and shields.

Enough cable must be pulled into controller cabinets to allow approximately 4 feet of cable to be stripped and coiled around the bottom of the cabinet before connections are made. The Contractor must terminate all cables on the terminal strip in the controller cabinet.

Cable routings on span wire must be securely attached to the span wire by 4 to 6 wraps of vinyl electrical insulating tape, such as 3M Super 88 or approved equal, spaced no more than 18 inches apart. Drip loops must be left at the point of entrance to span mounted signal heads and steel pole conduit entrance fittings to allow moisture to drip from the cable rather than run down the cable into entrances. Where the drip loop from the pole outlet to the span wire exceeds 18 inches, the cable must be secured to the pole to give a neat appearance.

All electrical cable for traffic signal facilities passing through handholes, junction boxes, conduit bodies, and vaults must be properly identified.

Each cable must be identified with the appropriate colored tape within 6 inches of a splice. Cable in handholes, junction boxes and conduit bodies must be appropriately marked near the center of the enclosed section of cable. Cable passing through Seattle City Light handholes and vaults must be identified with a permanent waterproof marker secured to the cable. The cable marker must indicate SDOT SERVICE for traffic signal service cable, SL SERVICE for street lighting cable, or SDOT SIGNAL for all other traffic signal cable usage.

Work in vaults must be per the National Electric Safety Code and SCL Standards. Cable being installed in maintenance holes and vaults with existing power cable must be racked on the wall opposite the power cable. If cable must be racked on the same wall with power cable, it must be mounted above the power cable, maintaining a 6-inch minimum separation. Every effort must be made to minimize any negative impact of power cable noise and transients on the new communications cable, while adhering to all safety regulations. See Section 1-07.28 item 9 regarding notifications required for work in or near SCL Structures. In handholes, all cables and conductors must be orderly to provide easy recognition and quick access. Racking of cables may be required by the Engineer.

Care must be exercised in working near and within any SCL vaults. Voltages present are as high as 26,000 volts, and the vault wiring will not be de-energized while the Contractor is working. The Contractor must adhere to all SCL safety and Electrical Safety Observer standards while working in vaults or in the vicinity of the electrical distribution system. Also see Sections 1-05.2(2), 1-07.1(2), and 1-07.28 item 9.

8-31.3(9)B SPLICES

Signal cable must be spliced only in terminal cabinets, in pedestrian push button assemblies, or at the signal head. Aerial splices must be covered by reverse wrapping of the first layer with vinyl electrical insulating tape, such as 3M Super 88 or approved equal, then a built up rounded end of the tape, then a minimum of 2 layers forward with the tape.

At locations where existing signal cables are being used, the traffic signal cables must be spliced in new or existing terminal cabinets, and each individual conductor must be insulated and the entire splice must be waterproofed.

Each individual splice or termination of extra leads must be insulated, taped and made waterproof.

Do not splice loop wire except with the loop lead in wire within the handhole.

Do not splice service cable or master cable except as shown on the Drawings.

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8-31.3(9)C TERMINATIONS

Conductors must terminate on a terminal strip or push on connectors at the signal equipment which it is serving. Use only terminal strips with screw type pressure binding posts. Stranded conductors must use compression type pressure fittings at the terminal strip. Compression-type pressure fitting must be applied using an irreversible crimping tool. Single solid conductors must attach directly to the screw post; otherwise use compression type pressure fittings when more than 1 conductor is attached.

All electrical terminations must be tightened to their prescribed torque value.

All terminals must be marked with field wiring termination numbers printed on back or front-mounted marking strips.

8-31.3(9)D PEDESTRIAN PUSHBUTTON CABLE

Do not splice pedestrian pushbutton cable. The cable must be one continuous length from the pedestrian pushbutton to the termination point in the controller cabinet. The cable shield must be grounded to the system ground only at the controller end. The cable shield between cabinet and pedestrian pushbutton must be continuous throughout intermediate junction boxes, must completely cover the wires, and must be insulated to prevent grounding in any junction box or in any conduit.

8-31.3(9)E CAT5-E CABLE

The Contractor must use an outdoor, 600V rated jacketed CAT5-E cable. The Contractor must use the proper RJ45 connector crimping tool to attach connectors directly to the outdoor rated CAT5-E cable. Do not splice CAT5-E. Underground installation of CAT5-E cable must be accomplished without damaging the cable. Damaged cable must be replaced by the Contractor at no cost to the Owner. Follow manufacturer recommendations for cable installation. Use shield cable as specified in Division 9.

8-31.3(9)F ELECTRICAL SERVICE CONNECTIONS

The Contractor must furnish and install equipment and wiring for a single 2 phase 120/240 volt, 60 Hz AC electrical services. The electrical service cable must be installed as indicated on the Drawings.

A service cabinet must be provided and located as shown on the Drawings. Meter enclosures may be required as shown on the Drawings. Service cabinet must be wired per the Standard Plans. Service bond must occur in the service cabinet.

All final service connections of signal system to overhead secondaries or to secondaries in vaults or handholes will be made by Seattle City Light at the project's expense. The Contractor must arrange a schedule with the Engineer for service connections at the preconstruction conference.

8-31.3(9)G SERVICE CABINETS

Power sources shown on the Drawings are approximate only; exact location will be determined in the field.

8-31.3(10) GROUNDING AND BONDING

All grounding and bonding must comply with the National Electrical Code and Seattle Electrical Code.

All conductive appurtenances containing electrical or communication conductors including but not limited to cabinets, metallic conduit, metal poles, pedestals, and junction boxes, must be made mechanically and electrically secure to form a continuous system which must be effectively grounded. This continuous system must include any related traffic management system and must only have 1 service bond.

Where conduit (including steel conduit) systems are used, all metallic appurtenances must be electrically bonded by the equipment ground conductor. Conduit risers must be bonded to equipment grounding conductor not SCL distribution ground. The grounding electrode conductor must be fed through the riser and bonded at the top of the riser.

Only 1 grounding electrode conductor is required in any conduit, raceway, junction box, handhole, or pole.

All conduit runs with branch circuit conductors or feeder conductors must have the equipment grounding conductor installed in the conduit unless noted otherwise on the Drawings.

The equipment grounding conductor must interconnect all ground rods in each circuit. The grounding electrode conductor must be installed in one continuous length without a splice or joint. If necessary, splices or connections must be made by irreversible compression-type connectors listed as grounding and bonding equipment.

Equipment grounding conductors, grounding electrode conductors, and the service neutral must only be bonded and grounded at the service entrance point as required under the NEC and the City of Seattle Electrical Code.

Only 1 conductor must be installed under any ground clamp.

Ground rods must be installed in firm undisturbed earth. Minimum spacing between ground rods must be 8 feet.

Grounding performance must be based on both the NEC and NESC.

Keep the equipment grounding conductor and neutral isolated from the logic ground circuits in the controller cabinet.

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8-31.3(11) POLE LINE HARDWARE INSTALLATION

Span wire portions that are directly above KCM trolley wires must be insulated spanwire and covered with plastic cable guard. The cable guard must extend a minimum of 4 feet beyond each side of the trolley wire track. See Section 1-07.28 item 4 regarding notifications required for coordination of work with KCM trolley lines.

Span wire must be secured to steel strain poles by pole bands, and to timber poles by single strand guy eye bolts. Span wire sag must be 5 to 7 percent of the total span. Pole bands and eye bolts must be installed as detailed on the Standard Plans.

Span wire must be secured to eye bolts or strain clamps at poles by use of self-locking cable clamp type dead ending devices. Span wire must be secured to bull rings and anchors by the use of cable guy wrap and guy thimbles. Span wire must be secured to strain insulators by the use of cable guy wraps.

Strain insulators must only be installed when the traffic signal spans over KCM trolley, streetcar, or light rail overhead wires. Strain insulators must be installed on all spans and down guys at a distance of 9 feet from the face of wood poles, and 3 feet from the face of steel poles.

Tether wire must be mounted a minimum of 18 feet above the roadway.

On steel poles, do not use lag or through bolts.

8-31.3(12) RELOCATING EQUIPMENT

When existing equipment is to be relocated, the Contractor must furnish and install all necessary new Materials and equipment (including all hardware) required to install the salvaged equipment in the new installation. Any new hardware required to complete the installation must be of the same quality and type as hardware required in these Specifications for all other new Work.

All traffic signals, flashing beacons, and illuminated signs to be relocated must be cleaned and re-lamped.

8-31.3(13) REMOVAL AND SALVAGE OF EXISTING ELECTRICAL EQUIPMENT

Refer to Section 2-02.3(3)G and 2-02.3(7)C.

8-31.3(14) OWNER FURNISHED EQUIPMENT AND MATERIALS

The Contractor must pick up equipment and Material, as specified and at pickup locations specified in the Contract, and install such as indicated on the Drawings.

The Contractor must provide written notice to the SDOT Signal Operations Engineer at least 5 months in advance of the proposed pickup date for any traffic signal controller cabinets that are needed for permanent or temporary signal work. For installation of the traffic signal controller cabinet, the Contractor is required to have power service at the cabinet location and to be hooked up to keep the electronics warm and dry until energizing the traffic signal.

8-31.3(15) CHECK OUT PROCEDURE

The Contractor must arrange a schedule with the Engineer at least 2 Working Days in advance for a complete intersection check out after having completed the installation of the controller cabinet, all signal and illuminated sign equipment, pedestrian signal activators, vehicle detection, interconnect cable system and all associated wiring and connections as called for on the Drawings. The Contractor must be present and assist with the check out by energizing each field circuit and assisting as necessary to verify completeness of the installation except for the controller unit and auxiliary units of the controller assembly. If the intersection is found to be incomplete or inadequate, the Contractor will be notified of the deficiencies to be corrected.

8-31.3(16) TURN ON/CUT OVER PROCEDURE

See Section 8-31.3(1)A. Upon acceptable check out of an intersection, the Contractor, after conferring with the Engineer, must arrange a schedule for cut over from the old signals or a turn on of a new installation. A request for “turn on” of a new signalized intersection or “cut over” modifications to existing signalized intersection must be submitted in writing to the Engineer at least 15 Working Days before the proposed date of an existing signal cut over, and 15 Working Days before the proposed date of a new signal turn on. The Engineer will respond to the Contractor within 5 Working Days of receipt of request for cut over or turn over.

As-built drawings: The Contractor must submit “redline” as-built wiring diagram to the Engineer at checkout. Also see Sections 1-05.3(11), 8-31.3(5)B, 8-31.3(5)C, and 8-31.3(5)E. See Section 8-31.3(17) for final as-built Drawing requirements.

Turn ons or cut overs must be scheduled and completed between the hours of 9:00 a.m. and 2:30 p.m. Any alternative times must be submitted by the Contractor at least 15 Working Days before the proposed date and time of the signal turn on or cut over. Alternative times must be approved by the Engineer.

The Owner will deliver to the Project Site and plug into the controller cabinet, the controller unit and the auxiliary units. The signal timing for the controller unit will be done by the Owner. The Contractor must not energize the signals until the Engineer is on the Job Site and has authorized the Contractor to proceed. To maintain safe traffic conditions, existing signals must remain in operation until a simultaneous cut over to the signal can be accomplished, unless an alternate procedure is approved in writing by the Engineer. New signals must not obscure existing traffic controls.

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The Contractor must be present and must be prepared at such turn on time, with Materials and tools necessary to correct any malfunctions which may occur. Turn on must not take place if any subsequent work requires turning off the signal system.

Do not install signal heads at any intersection earlier than 10 Working Days before turn on or cut over. All new vehicular and pedestrian signals including backplate and illuminated signs must be temporarily covered completely with a 6 mil opaque polyethylene sheeting, or approved equal until the new signals are ready to be energized. A 1-inch diameter hole must be cut into the opaque plastic cover in front of each vehicular signal lens and a 1" x 3" slot in front of each pedestrian signal lens to allow for a visual check of indications during performance testing.

Immediately after turn on or cut over, all existing vehicular and pedestrian signals that have been deactivated must be covered or removed. The old signal heads must not obscure the new traffic controls at any time.

8-31.3(17) FINAL INSPECTION AND AS-BUILT DRAWINGS

See Section 1-05.11.

As soon as practicable after completion of all signal and related Work, the Contractor must submit to the Engineer for approval, as built wiring drawings indicating revised field wiring and revised controller assembly wiring. Final "redline" as-built wiring diagrams to be placed in controller cabinets must be in-place 1 Working Day after acceptance of Turn-on/Cut-over. See Sections 8-31.3(5)B, 8-31.3(5)C, 8-31.3(5)E, 8-31.3(16), and 1-05.3(4).

8-31.3(18) RESERVED

8-31.3(19) SIGNAL CAMERAS

8-31.3(19)A CCTV CAMERA

All CCTV cameras must be installed at the locations shown on the Drawings. All cameras must be securely mounted per manufacturer's specifications. The Contractor must submit Shop Drawings for all attachments to existing signal strain poles and utility poles. All mounting hardware must be adjustable. The Contractor must adjust the mounting hardware as necessary for each camera installation to ensure that the camera is mounted level. The Contractor must verify that the mounting plate supporting the camera equipment at each location is level before installing the camera equipment. Contractor must use a plumb-level placed across the mounting plate in two directions (90 degree offset) to ensure that the mounting plate is level.

For each camera location, the camera control cable must be installed per manufacturer specifications between the camera and the signal cabinet. The camera control cable must be coiled in the handhole adjacent to the controller cabinet. The Contractor must notify the Engineer 10 Working Days before final connection. Final termination will be conducted by the Owner.

All un-terminated/un-connected cables must have sufficient slack coiled in each signal cabinet or handhole to allow proper connections to all communications equipment within the camera or signal cabinet.

Cameras must be 4 feet clear of trolley lines.

At each signal controller cabinet, the Contractor must connect the video monitor to the coaxial video cable and connect the camera control device to the camera control cable. The Contractor must provide the camera controller interface to be placed in the signal controller cabinet. The Contractor must conduct Proof of Performance Testing and demonstrate to the Engineer the following features of the camera installation:

1. Display camera video on the Contractor-provided monitor.
2. Program the I.D. generator to display the location on line 1 and the cardinal direction the camera is pointing on line 2.
3. Pan and tilt the camera (For PTZ cameras).
4. Zoom and focus the camera in both fast and slow modes.
5. Turn the camera off and on.
6. Change the iris to auto and manual.

Each of these features must be demonstrated successfully for the camera installation to be accepted.

8-31.3(19)B FISH-EYE CAMERA

Contractor must submit for approval to the Engineer the manufacturer's recommended video camera cable. Contractor must furnish and install a continuous cable between the camera and the termination in the controller cabinet. Camera cable must be coiled in the handhole adjacent to the controller cabinet. The Contractor must notify the Engineer 10 Working Days before final pull into cabinet. Sufficient cable slack must be provided in the adjacent controller handhole to enable final connection to the camera processor.

Contractor must furnish all camera mounting bracket and hardware to mount the luminaire bracket arm, mast arm, or pole as specified on the Drawings. Mounting hardware must include a camera mount kit and a clamp kit.

All external screws, nuts and locking washers must be stainless steel or galvanized. Self-tapping screws must not be used. All parts must be made of corrosion resistant materials. All materials used in construction must be resistant to fungus growth and moisture deterioration. An inert dielectric material must separate dissimilar metals. The camera assemblies must be capable of accurate detection when mounted greater than 30 feet above the road surface. The camera assemblies must be capable of accurate detection when mounted up to 150 feet from the stop bar.

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Installation of the camera must require no aiming or focusing of the camera assembly. The minimum Video Imaging Vehicle Detection System (VIVDS) set-up, as needed for detector setup and viewing of vehicle detections, must consist of a field setup computer with application software and/or a video monitor with interface software built-in to the VIVDS processor unit. The field-setup computer must have an Ethernet port for connection to the Machine Vision Processor (MVP).

8-31.3(20) DYNAMIC MESSAGE SIGN (DMS)

The Contractor must furnish and install the DMS as shown on the Drawings. The Contractor must furnish and install the auxiliary equipment cabinet as shown on the Drawings, Standard Plans and as specified in Section 8-31.

The Contractor must install fully equipped DMS sign units and related cables as shown on the Drawings and as recommended by the manufacturer. The Contractor must furnish and install the sign controller in the auxiliary equipment cabinet and terminate the cables.

The Contractor must store the sign in a secured location before installation. This storage area may be an outdoor secure facility. Any material arriving in a cardboard box must be stored indoors. If the sign is stored for more than 3 days, it must be stored indoors or energized so that the environmental enclosure is operable.

The equipment covered by this specification must be tested by the Contractor, and witnessed by the Engineer.

Final system acceptance must be defined as when all work and Materials provided for in this item have been furnished and completely installed, and all parts of the Work have been approved and accepted by the Engineer and the Dynamic Message Sign (DMS) System has been operated continuously and successfully for 90 Calendar Days with no more than 5 Working Days downtime due to mechanical, electrical and/or other malfunctions.

8-31.3(21) RAPID FLASHING BEACON SYSTEM

The Contactor must furnish and install a fully equipped rapid flashing beacon system and all related mounts and cables as shown on the Drawings and as recommended by the manufacturer. The Contractor must furnish and install all hardware for the system including all mounts and wiring.

8-31.4 MEASUREMENT

Measurement for “Signal Wiring, (Location)” will be by lump sum for each intersection.

Measurement for “Detector Loop, (Size)” and for “Detector Loop, Encapsulated, (Size)” will be by each complete installation.

Measurement for “Boom Truck and Operator For Inspector” will be by the hour.

Measurement for “Emergency Vehicle Preemption Detector, Opticom (model number)” will be per each complete installation.

Measurement for “Fish-Eye Detection Camera” will be per each installed.

8-31.5 PAYMENT

1. “**Install Owner Furnished Traffic Signal Controller Cabinet**, **(Type)**”, per each

The Bid Item price for “Install Owner Furnished Traffic Signal Controller Cabinet, (Type)” must include all costs for the work required to install the Owner furnished cabinet complete on the foundation and to make all field terminal connections with the cabinet.

2. “**Signal Head**, **(Type) (Description)**”, per each

The Bid Item price for “Signal Head, (Type) (Description)” must include all costs for the work required to furnish and install the signal head complete, including all mounting hardware for the mounting specified, installation, alignment, testing; and when specified, bimodal fiber optic arrow lens, louvers, backplates, and programming as may be required.

3. “**Bicycle Pushbutton Assembly**”, per each

4. “**APS Pedestrian Pushbutton Assembly**”, per each

The Bid Item price for “Bicycle Pushbutton Assembly” and for “APS Pedestrian Pushbutton Assembly” must include all costs for the work required to furnish and install the pushbutton assembly complete, including the button and housing, hardware, controller interface, and signs.

5. “**Detector Loop**, **(Size)**”, per each

6. “**Detector Loop**, **Preformed, (Size)**”, per each

The Bid Item price for “Detector Loop, (Size)” and “Detector Loop, Preformed, (Size)” must include all costs for the work required to install the preformed loop cable and suspension system and conduit complete to the first handhole from the loop, including pavement fillers, splices, hardware, and restoration of pavement surface.

7. “**Video Detection Camera**”, per each

The Bid Item price for “Video Detection Camera” must include all costs for the work required to furnish and install a functional video detection camera including but not limited to, video camera, mounting bracket, lens, housing, cables, processing unit, surge suppresser/lighting protection, splices, taps, and hardware,.

8. “**Wireless Sensor**”, per each

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The Bid Item price for "Wireless Sensors" must include the cost of all work to furnish, install, and test each sensor, sensor unit including epoxy.

9. "**Wireless Sensor Access Point**", per each

The Bid Item price for "Wireless Sensor Access Point" must include the cost of all work to furnish and install the Wireless Sensor Access Point with pole mount bracket and for the configuration, contact closure cards, expansion cards, access box, hardware, splices, and taps and testing each Access Point

10. "**Wireless Sensor Repeater**", per each

"Wireless Sensor Repeater" must include the cost of all work to furnish and install the "Wireless Sensor Repeaters" with pole mount bracket, hardware, and for the testing of each device.

11. "**Sign, Illuminated, (Size)**" per each

The Bid Item price for "Sign, Illuminated (Size)" must include all costs for the work required to furnish and install the illuminated sign complete, including all mounting hardware, sign wiring and photoelectric cell.

12. "**Emergency Vehicle Preemption Detector**, **Opticom (model number)**" per each.

The Bid Item price for "Emergency Vehicle Preemption Detector" must include all costs for the work required to furnish and install the emergency vehicle preemption detector, including all mounting hardware for the mounting specified, cabling to the controller cabinet, installation, alignment, and testing

13. "**Signal Wiring (Location)**", per lump sum

The Bid Item price for "Signal Wiring (Location)" must include all costs for the work required to furnish and install complete signal wiring at the location including terminal cabinets, signal lead wiring, pushbutton wiring, sign (attached to signal) wiring, service wiring, and loop lead in cable.

14. "**Terminal Cabinet**", per each

The Bid Item price for "Terminal Cabinet" must include all costs for the work required to furnish and install the complete cabinet including mounting hardware, terminal strips, splices, taps, and sealing.

15. "**Span Wire**", per linear foot

16. "**Span Wire**, **Catenary**", per linear foot

The Bid Item price for "Span Wire" and for "Span Wire, Catenary", must include all costs for the work required to furnish and install the spanwire complete, including wire, clamps, insulators and all hardware.

17. "**Relocate (Item)**", per each

18. "**Relocate (Item)**", per linear foot

19. "**Relocate (Item)**", per lump sum

The Bid Item price for "Relocate (Item)" must include all costs for the work required to remove and reinstall the item complete, including hardware and rehabilitating signals and signs as required.

20. "**Boom Truck and Operator For Inspector**", per hour

The Bid Item price for "Boom Truck and Operator for Inspector" must include all costs for the work required to provide a boom truck and operator for the field inspector as requested by the Engineer.

21. "**CCTV Camera, (Type)**", per each

The Bid Item price for "CCTV Camera, (Type)" must include all costs for the work required to furnish and install cameras, including but not limited to, camera, cabling, mounting hardware, controller interface, testing, equipment, labor and any other accessories required to provide an operational system.

22. "**Dynamic Message Sign**", per each

The Bid Item price for "Dynamic Message Sign" must include all costs for the work required to furnish and install dynamic message signs, including but not limited to the sign, sign controller, cabling, sign mounting brackets and hardware, testing, equipment, wiring, and other accessories required to provide an operational system.

23. "**Auxiliary Cabinet**", per each

The Bid Item price for "Auxiliary Cabinet" must include all costs for the work required to furnish and install the cabinet complete on the foundation and to make all field terminal connections with the cabinet.

24. "**Service Cabinet (Type)**", per each

The Bid Item price for "Service Cabinet" must include all costs for the work required to furnish and install the cabinet, wiring, and breakers complete on the foundation and to make all field terminal connections with the cabinet.

25. "**Rapid Flashing Beacon System, Hardwired, (Location)**", per lump sum.

The Bid item price for "Rapid Flashing Beacon System, Hardwired, (Location)" must include all costs for the work required to furnish and install the rapid flashing beacon system complete, including the signs, light bars, pushbuttons, wireless communication equipment, flash controller, controller cabinet, universal switching power supply, all mounting hardware and fittings, and all associated wiring and testing. Work for pushbutton posts, foundations, handholes, service cabinets, poles, conduit, and trenching, will be paid under their respective bid items.

26. "**Rapid Flashing Beacon System, Solar-Powered, (Location)",** per lump sum.

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The Bid item price for “Rapid Flashing Beacon System, Solar-Powered, (Location)” must include all costs for the work required to furnish and install the rapid flashing beacon system complete, including the signs, light bars, solar panels, battery, pushbuttons, wireless communication equipment, flash controller, controller cabinet, universal switching power supply, all mounting hardware and fittings, and all associated wiring and testing. Work for pedestrian pushbutton posts, foundations, handholes, poles, conduit, and trenching, will be paid under their respective bid items.

27. **"Fish-Eye Detection Camera”**, per each.

The Bid item price for “Fish-Eye Detection Camera” must include all costs for the work required to furnish and install a fully functioning camera, including all wiring, testing, mounting hardware and other appurtenances.

28. **Other payment information**

Existing Materials required to be relocated and found to be unacceptable by the Engineer must be replaced by new Material and will be addressed as extra work per Section 1-04.3.

Payment for providing an off-duty Uniformed Peace Officer will be as specified in Section 1-10.5.

All final service connections of electrical signal systems to overhead secondaries or to secondary in vaults or handholes will be made by Seattle City Light at the project’s expense.

All costs for furnishing and installing hardware not specifically called out, but required to complete the Work and approved by the Engineer must be included in the Bid Item prices for the applicable Bid Items.

See Section 1-05.2(2) regarding payment for Electrical Safety Observer

SECTION 8-32 POLES, PEDESTALS, AND FOUNDATIONS

8-32.1 DESCRIPTION

8-32.1(1) GENERAL

This Work consists of furnishing and installing poles, bracket arms, pedestals, posts, mast arms, concrete foundations and back guy assemblies as shown on the Standard Plans and as specified in this Section. The Contractor must become thoroughly familiar with the electrical and civil environment within the Project Site and with the relevant Work.

8-32.1(2) APPLICABLE ELECTRICAL CODES

See Section 8-30.1(2).

8-32.1(3) POLE AND PEDESTAL SHOP DRAWINGS

The Contractor must submit Shop Drawings and catalog cuts as specified in Section 1-05.3 for the following:

1. Metal poles and appurtenances
2. Anchor bolt extenders
3. Mast Arms
4. Anchor bolts, nuts, washers
5. Bracket Arms
6. Pedestals
7. Pole foundation reinforcing steel

For Contractor-designed poles, the Contractor must submit design calculations for all pole components, including foundation anchor bolts. The calculations must be signed by a Professional Engineer licensed in the State of Washington.

All poles which deviate from the Drawings will be considered an alternate proposal and requires a submittal to the Engineer for review and approval at least 10 Working Days in advance of ordering the poles. The alternate pole must comply with Section 9-33 and the requirements specified in the Contract. The Contractor accepts all responsibility for any impact the Engineer's decision may have on the Contractor’s critical path schedule and accepts any necessary adjustment to the critical path schedule to meet Contract Time at no additional or separate cost to the Owner. This submittal must be as specified in Section 1-05.3.

8-32.1(4) ELECTRICAL AND ELECTRONIC WORDS AND PHRASES

See Section 1-01.3.

8-32.2 MATERIALS

Materials must comply with the requirements of the following Sections:

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Materials	Section
Concrete	Section 6-02
Non-Shrink Cement Sand Grout	Section 9-04.3(2)
Poles, Mast Arms, Pedestals, Foundations, and Back Guy Assemblies	Section 9-33

All welds on tubular steel must comply with ANSI/AWS D1.1 Section 10 Tubular Structures.

8-32.3 CONSTRUCTION REQUIREMENTS

8-32.3(1) POLES

8-32.3(1)A GENERAL

See Section 8-32.3(2)A for foundation concrete mix design requirements.

The Contractor must lay out pole locations and grades as indicated on the Drawings. Poles must be located to provide a minimum of 3 feet clearance measured from the face of the curb to the face of pole unless otherwise indicated on the Drawings or Standard Plans.

Poles must be handled during loading, unloading, and erecting in such a manner that they are not damaged.

Field repair of galvanized surfaces must be accomplished by coating with a heated zinc alloy solder to a minimum thickness of 3 mils per ASTM A 780.

The Contractor must repair or replace all rejected poles at no expense to the Owner. If the Contractor elects to repair the rejected pole, a repair plan must be submitted at least 5 Working Days in advance.

8-32.3(1)B METAL POLES AND PEDESTALS

Do not erect street light poles and pedestals before concrete foundations have cured for a minimum 7 Days or have attained a minimum 70 percent of specified strength.

Do not load strain and mast arm poles before concrete foundations have cured for a minimum of 14 days or have reached specified strength.

Do not load strain poles type V, X, and Z with KCM loading until the concrete has attained design strength or has been cured a minimum 28 Days.

The Contractor may request concrete test samples or provide an ASTM accredited testing Laboratory approved by the Engineer to sample and test the concrete.

Use leveling nuts on all metal poles. Place leveling nuts and washers on anchor bolts to allow between 2 and 4 inches of non-shrink grout under the base plate. Place poles on the bolts and the leveling nuts and washers. The leveling nuts and washers must then be adjusted to plumb the pole.

The pole must be raked before loading such that it is plumb after all loads have been applied. Plumb is defined as an imaginary vertical line from the center line of the pole top passes through the center line of the pole base at ground level. A tolerance of ± 0.17 inches per foot of pole height above the ground will be permitted with the exception that in no case must the pole lean toward the pavement. Nuts must be torqued to the manufacturer's recommendations.

After pole anchor bolts and rake have been inspected and approved by the Engineer with loads applied, tape must be placed around the periphery of the anchor bolts and leveling nuts, then non-shrink cement sand grout must be placed under the pole to completely fill the void under the base outside the anchor bolts by packing from the bolts and finishing towards the outside. The non-shrink grout must be sloped at approximately 60 degrees away from the base plate. There must be a 1/2-inch drain tube in the non-shrink grout on the lowest side of the base to provide drainage from within the pole or pedestal to the outside (see Standard Plans 524a, 524b, and 563a). Installation of pedestals must comply with the same requirements for installation of metal poles, except raking will not be required.

8-32.3(1)C WOOD POLES

Wood poles must be set at the depth specified in the following table:

Pole Setting Depth

Length of Pole, ft.	Minimum Set Depth, ft.	Minimum Set Depth in Rock, ft.
20	5.0	3.0
25	5.0	3.0
30	5.5	3.5
35	6.0	4.0
40	7.0	4.0

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After each wood pole is set in the ground to the specified depth as indicated on SCL Construction Standard 0100.07, the space around the pole must be backfilled with selected earth or sand, free of rocks and other deleterious material, placed in layers approximately 4 inches thick. Each layer must be moistened and thoroughly compacted.

When wood poles are used as strain poles, the poles must be raked to be plumb after loading as defined in Section 8-32.3(1)B.

8-32.3(2) FOUNDATIONS

8-32.3(2)A GENERAL

Concrete mix for foundations must comply with the following requirements:

Type Pole or Pedestal	Class Concrete
Strain and Mast Arm Poles	Class 4000P
Non Strain Metal Poles	Class 3000
Chief Seattle Light Pole	Class 3000
Metal Street Light Pole	Class 3000
Pedestal	Class 3000
Pedestrian Pushbutton	Class 3000

Foundations must constructed against undisturbed soil. Concrete must be placed against undisturbed earth within a dry hole. If a dry hole is not maintained, the Contractor must select a method of concrete placement that does not adversely impact the strength or durability of the concrete. In unstable ground, the Contractor must submit a proposed method to provide undisturbed concrete placement for approval by the Engineer. If an approved permanent formwork or casing is left in place, then backfill between form material and undisturbed earth must be controlled density fill. Each foundation must be poured in one continuous pouring operation. Where new excavations are near an existing foundation, the Contractor must provide temporary support for the existing Structure as appropriate. Where foundations are installed on slopes, foundation depth is measured using the shortest bearing surface.

Anchor bolts must be set securely in place and held in a vertical position with the specified bolt projection and at the specified bolt circle to match the exact hole pattern of the item to be installed. The tops of the bolts must all be at the same elevation. Use a steel template at the lower end, and a wood or steel template at the upper end of the anchor bolts, to maintain the correct bolt pattern and spacing until the concrete has set. Anchor bolts must not be altered in any way after fabrication. Bending of anchor bolts is cause for rejection and removal of the entire foundation. The bolt circle must be measured by the Engineer before pouring the concrete.

Before placing concrete, all projecting anchor bolts must be taped with a corrosion protection tape from a point 6 inches below the top of the foundation to the top of the bolt. Tape must be per SCL Material Standard 7366.55 and must remain permanently in place. Immediately after concrete is placed, the location of the anchor bolts must be checked with a template conforming to the bolt pattern of the bases of the poles. After the concrete is placed, anchor bolts and conduit must be cleaned and kept free of concrete splatter and mortar.

Concrete must be float finished, edged and brushed where necessary. Adjusting anchor bolts to make them fit the hole pattern in the base plate will not be allowed after concrete has begun to set.

8-32.3(2)B TRAFFIC SIGNAL CONTROLLER FOUNDATIONS

Anchors, cinch anchors, nut couplers, square washer and bolts must be installed per Standard Plans, or by an alternate method recommended by the manufacturer. Where the manufacturer recommends installation differing from the Standard Plans, the Contractor must submit the manufacturer's recommendations to the Engineer for approval at least 5 Working Days in advance of installation. The cinch anchors must be sized as recommended by the traffic signal controller manufacturer. A bead of waterproof sealant must be installed under the lip of the traffic signal controller cabinet before installing the cabinet to prevent moisture penetration.

Tops of the traffic signal controller foundations must be level, and must be 6 to 8 inches above adjacent finished grade.

A 3/4-inch PVC conduit drain must be installed in all concrete foundations for traffic signal controllers Type II and Type III cabinet foundations to provide drainage from within the cabinet to the outside finished grade.

All cabinet foundations installed in a landscape area must include the installation of a concrete sidewalk maintenance pad on the door-side of the foundation. The maintenance pad must be concrete sidewalk, level, and constructed to the dimensions shown on Standard Plan 500a, 501a, and 501b, as applicable for the foundation type. Where the cabinet door opens into an existing sidewalk, the sidewalk width can be included in the maintenance pad depth dimension. There must be no gaps between the edge of the maintenance pad and the edge of the foundation. Verify the size and location of the maintenance pad with the Engineer prior to placement.

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8-32.3(2)C POLE, PEDESTAL AND PEDESTRIAN PUSHBUTTON POST FOUNDATIONS

Anchor bolts must be supplied by the Contractor on foundation installations unless specified otherwise in the Contract.

Reinforcing steel must be kept 3 inches clear from surrounding earth within the concrete pole foundation, and must be set securely in place.

Where the foundation is in or adjacent to, a proposed sidewalk/paved area, the top of the foundation must be at or just below the bottom of the adjacent sidewalk or paving Material. The Contractor must first coat the foundation top with a bond breaker, and then place sidewalk or paving Material over the top of the foundation. Install premolded joint Material in the construction joint where new pavement or sidewalk is placed over and around the foundation.

Where the foundation is in an unpaved area, the top of the foundation must be 3 inches below the finished ground level. The foundation must be poured to specified depth and a 3-inch deep, square finished pad must be provided above the foundation.

Conduits must extend 1 inch above the pole base plate. Anchor bolts must be installed, or be cut off, with sufficient projection above the foundation to allow 3 threads above the upper nut. Where inadequate projection is provided, bolt extenders may, if approved by the Engineer, be used, or complete removal and replacement of the foundation will be required at no expense to the Owner.

8-32.3(2)D EXISTING POLE FOUNDATIONS

Where grade changes decrease the standard bolt projection, bolt couplers may be used as approved by the Engineer. Existing foundation concrete must be chipped to a depth approved by the Engineer. Existing bolts must not be damaged by concrete chipping. Bolts must be cut. Use heavy-duty couplers with straight, all thread bolts. Bolt length is determined according to the necessary bolt projection for the foundation type. Additional rebar may be required by the Engineer.

Where existing pole foundations require bolt pattern changes, epoxy anchors may be used as approved by the Engineer. The Contractor must mark new anchor locations for approval by the Engineer before drilling holes. Anchors must be injection epoxy type. Core drilling must occur only with the Engineer present. Holes must be drilled with ANSI B212.15 matched tolerance carbide tipped drill bits with drill in roto-hammer mode or with a matched tolerance diamond core drill bit of the diameter specified by the bolt manufacturer. Drilled hole specifications must match ICC ESR 1562 or ICC ESR-1967. Anchors must be tightened with a calibrated torque wrench. Use of an impact wrench is not permitted. Anchors must be all-thread. Holes must be completely cleaned with compressed air or blow out pump before epoxy is poured into the holes. The epoxy must be set and cured per manufacturer recommendations.

8-32.3(3) BACK GUY ASSEMBLIES

Back guy assemblies for wood poles must be constructed as shown on the Standard Plans.

All through bolts must be properly trimmed and treated.

8-32.3(4) RELOCATING EQUIPMENT

When equipment is to be relocated, the Contractor must furnish and install all necessary materials and equipment including all new hardware required to complete the new installation. Any new hardware required to complete the installation must be of the same quality and type as hardware required in the Specifications for other new Work.

8-32.3(5) BRACKET ARMS

Mounting point of the bracket arm on wood poles must be located as necessary to provide the required mounting height of the luminaire above the pavement. However, the Engineer may field determine the required mounting height to provide required wire clearances. The Engineer requires a minimum 1 Working Day advance notice.

Wood pole bracket arms must be attached by 1 through bolt and 2 lag bolts. Through bolts on wood poles must be cut off so no more than 4 threads nor less than 3 threads are left exposed beyond the captive nut. The exposed end must be treated with galvanizing repair paint approved by the Engineer. Do not use this through bolt to mount any other hardware.

8-32.3(6) CHIEF SEATTLE BASE AND COLLAR

Where shown on the Drawings, the Contractor must install decorative Chief Seattle base and collar at the foundations of poles.

Chief Seattle base and collar materials must be purchased from SCL. For information on Chief Seattle base and collar purchase costs, lead times, and delivery requests, contact a SCL Electrical Service representative at (206) 615-0600 for orders north of Denny Way, or (206) 386-4200 for orders South of Denny Way.

Contractor must coordinate with SCL Electrical Service representative at the preconstruction meeting or a minimum of 120 Working Days advance notice for Chief Seattle base and collar pick up schedule. The Contractor must pick up the Chief Seattle base and collar and deliver to Project Site for installation.

Install decorative Chief Seattle base and collars as specified in Seattle City Light Construction Standard 1716.38.

8-32.4 MEASUREMENT

Measurement for davit poles and the attached davit arm will be per each as a combined unit.

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Measurement for “Chief Seattle Base and Chief Seattle Collar, (Material), (Size)” will be per each base and collar as a combined unit.

Measurement for “Install (Item), Owner Furnished” will be per each.

8-32.5 PAYMENT

1. “**Pole**, **Steel Strain, (Type)**”, per each
2. “**Pole**, **Steel Mast Arm**”, per each

The Bid Item price for “Pole, Steel Strain, (Type)” and for “Pole, Steel Mast Arm” must include all costs for the work required to furnish and install the pole complete, including pole cap, handhole, handhole cover, nut covers, bracket arm flange and bolts, base plate, all necessary hardware, raking, plumbing, and grouting.

3. “**Pole Steel Strain Davit, (Type) w/(Length) Arm**”, per each

The Bid Item price for “Pole, Steel Strain Davit, (Type) with (Length) Arm” must include all costs for the work required to furnish and install the complete pole, pole cap, the extension arm, including handhole, handhole cover, nut covers, steel pole extension tenon, steel pole luminaire tenon, welding, base plate, all necessary hardware, raking, plumbing, and grouting.

4. “**Pole**, **Steel Lighting (Length)**”, per each
5. “**Pole**, **Aluminum Lighting (Length)**”, per each

The Bid Item price for “Pole, Steel Lighting (Length)” and for “Pole, Aluminum Lighting (Length)” must include all costs for the work required to furnish and install the pole complete, including handhole, handhole cover, and all necessary hardware, raking, plumbing, and grouting.

6. “**Pole**, **Wood, (Length), (Type), (Class)**”, per each

The Bid Item price for “Pole, Wood (Length), (Type), (Class)” must include all costs for the work required to furnish and install the wood pole complete, including excavation, backfill, and compaction.

7. “**Mast Arm (Length)**”, per each

The Bid Item price for “Mast Arm, (Length)” must include all costs for the work required to furnish and install the mast arm complete with all necessary hardware, fittings and end cap.

8. “**Pedestal**, **(Material), (Length)**”, per each

The Bid Item price for “Pedestal, (Material), (Length)” must include all costs for the work required to furnish and install the pedestal complete including pipe, cap, base, collar, and all hardware.

9. “**Pedestrian Pushbutton Post**”, per each

The Bid Item price for “Pedestrian Pushbutton Post” must include all costs for the work required to furnish and install the post complete including all drilling and tapping, plumbing, steel pipe, pipe cap “meter collar”, grout, pipe flange, and all required hardware.

10. “**Foundation**, **Traffic Signal Controller (Type)**”, per each
11. “**Foundation**, **(Use)**”, per each

The Bid Item prices for “Foundation, Traffic Signal Controller (Type)” and for “Foundation, (Use)” must include all costs for the work required to construct the foundation complete in place including, but not limited to, excavation, excavation support, and furnishing and placing backfill, forming, concrete, reinforcing steel, anchor bolts, ground rods and/or systems, washers, nuts, nut covers, grout, wire, conduit, ground rod, handhole and drainage hardware.

12. “**Back Guy Assembly**”, per each

The Bid Item price for “Back Guy Assembly” must include all costs for the work required to furnish and install the back guy assembly complete including installation of all guy cable, hardware, insulators, pipe, fittings, and anchor.

13. “**Relocate (Item)**”, per each

The Bid Item price for “Relocate (Item)” must include all costs for the work required to remove and reinstall the item complete including all new hardware and rehabilitation as required.

14. "**Remove (Item)**", per each

The Bid Item price for “Remove (Item)” must include all costs for the work required to remove and salvage as required.

15. "**Bracket Arm**, **(Length)**", per each

The Bid Item price for "Bracket Arm, (Length)" must include all costs for the work required to furnish and install the bracket arm complete including hardware.

16. “**Install (Item), Owner Furnished**”, per each

The Bid Item price for “Install (Item), Owner Furnished” must include all costs for the work required to install the Owner furnished item including transportation of the item from the supply yard to the Job Site.

17. **“Chief Seattle Base and Chief Seattle Collar, Aluminum, 10 inch”**, per each
18. **“Chief Seattle Base and Chief Seattle Collar, Aluminum, 12 inch”**, per each
19. **“Chief Seattle Base and Chief Seattle Collar, Bronze, 10 inch”**, per each

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20. **"Chief Seattle Base and Chief Seattle Collar, Bronze, 12 inch"**, per each

The Bid Item price for "Chief Seattle Base and Chief Seattle Collar, (Material), (Size)" must include all costs for the work required to purchase from SCL and install the Chief Seattle decorative base and collar complete including hardware, as specified in this Section.

21. **Other payment information**

When installation of a new pole, pedestal, or post disturbs existing surface improvement that remain, the cost of surface restoration must be included in the Bid Item price of the pole, pedestal, or post as appropriate, see Section 1-07.16.

The installation of the pole number plate furnished by Seattle City Light will be considered as incidental to the cost of installing the pole.

If the Contractor proposes an alternate pole which is approved by the Engineer, no change will be made to the Bid Item price for the pole specified in the Bid Item.

See Section 1-05.2(2) regarding payment for Electrical Safety Observer.

SECTION 8-33 ELECTRICAL CONDUIT AND TRENCHING

8-33.1 DESCRIPTION

8-33.1(1) GENERAL

This Work consists of trench excavation, furnishing and installing conduit, condulets, and handholes for electrical systems as specified in the Contract and shown on the Standard Plans, except illumination and electrical services. For illumination and electrical services, see Section 8-34.

The Contractor must become thoroughly familiar with the electrical environment within the Project Site and with the relevant Work.

In areas where deteriorated conduits are encountered during trenching, the Contractor must promptly notify the Engineer who will then determine if sleeving of conduits is required to keep backfill from entering the conduit. It is important to preserve conduits whenever economically practical for future use.

8-33.1(2) APPLICABLE ELECTRICAL CODES

See Section 8-30.1(2).

8-33.1(3) ELECTRICAL CONDUIT SHOP DRAWINGS

The Contractor must submit Shop Drawings and catalog cuts as specified in Section 1-05.3 for the following items:

Shop Drawing and Catalog Cuts Submittals	
Conduit and Fittings	Condulets Junction Box
Stand-off Brackets	Expansion Fittings
Weatherhead	Seals and Sealing Compounds
Galvanizing Repair Material	PVC Coatings to be field installed
Handholes and handhole lids	Flexible Conduit

8-33.1(4) ELECTRICAL AND ELECTRONIC WORDS AND PHRASES

See Section 1-01.3.

8-33.2 MATERIAL

Materials must comply with the requirements of the following Sections:

Materials	Section
Non-Shrink Cement Sand Grout	Section 9-04.3(2)
Paint	Section 9-08
Conduits and Handholes	Section 9-34

8-33.3 CONSTRUCTION REQUIREMENTS

8-33.3(1) TRENCHING

Excavation required for the installation of conduit, foundations, and other Materials must be performed in such a manner as to cause the least possible damage to the streets, sidewalks, and other improvements. Do not excavate trenches any wider

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than necessary for the proper installation of the electrical appliances and foundations. Place excavated soils where they least interfere with traffic and surface drainage.

Trenching, conduit and other in-common installation, backfilling, and either temporary surfacing or final surfacing as necessary, must be scheduled daily and for minimum disturbance to traffic.

The Contractor must take all necessary steps to keep excavated native Material deemed suitable by the Engineer from becoming unsuitable. The requirements of Section 2-04 must apply.

Depth to top of conduit, or depth of cover, must be as follows unless specified otherwise in the Contract:

Location of Conduit	Depth of Cover
Under Railroad (Refer to Railroad Company's requirements)	48 inches below bottom of railroad ties
Under Asphalt & Concrete Pavement, Any Roadway or Driveway	36 inches
All Other Locations (e.g. Planting strips, sidewalks)	18 inches

The bottom of the trench for all conduit must be free of abrupt change of grade or alignment, and be free of objects and materials that could cause damage to conduit, conduit coating, or excessive bending of the conduit. The first 6 inches of backfill must be free of rock, gravel, or other deleterious objects and materials 1 inch or larger. The Engineer must approve all conduit installations before backfilling the trench.

Trench backfill must be compacted to 95 percent as specified in Section 2-04. The first loose lift of backfill over the conduit must be 8 to 12 inches.

Excavations over 4 feet deep are subject to protective systems as specified in Section 2-07.3.

Where trenches have shared facilities with illumination or electrical services, the larger minimum depth of cover requirement applies. See Section 8-34.3(1) for cover requirements for illumination and electrical service conduit trenches.

8-33.3(2) CONDUIT INSTALLATION

8-33.3(2)A GENERAL

Conduit must be installed as shown on the Drawings. When installing conduit under existing pavement or sidewalks, removal must comply with Section 2-02. Surface restorations must comply with the applicable Sections of the Standard Plans and Standard Specifications. Conduit and fittings within drainage and sanitary Structures and Sewer pump station wet wells are considered to be in a Class I environment and all construction must be in compliance with Article 501 of NEC.

Conduit must be installed in the number, type, size and location shown on the Drawings.

As-built drawings: For conduit runs that deviate from the location shown on the Drawings or on Shop Drawings reviewed by the Engineer, and are to be buried in concrete Structures such as floor slabs, retaining walls, abutments, or bridge superstructures, the Contractor must submit an as built drawing showing the actual locations of all roughed in conduit to the Engineer at least 5 Working Days before pouring the concrete. The as built drawing must show the conduit run, conduit size, and conduit Material type in red and must be dimensioned to the nearest 1 inch.

Conduit cable runs must be parallel to building lines and grouped together where possible.

Conduit cable runs parallel to curbs must be placed adjacent to back of curb unless detailed otherwise on the Drawings.

Changes of conduit direction must be made with manufactured or fabricated elbows of radius not less than that noted in the NEC.

Conduit installed within the metering and disconnect enclosure must be rigid metal and may be without PVC coating.

The Contractor may use larger size conduit when approved by the Engineer. Where larger size conduit is used, it must be for the entire length of the run from outlet to outlet.

Conduit terminating in enclosures (such as but not limited to poles, cabinets and pedestals) must extend vertically above the foundation a minimum of 1 inch, unless indicated otherwise on the Drawings. Exceptions to the 1-inch minimum are indicated on Standard Plans 500a, 521, 524, and 550a. Reducing couplings are not permitted. Conduit must not change size between handholes, or condulet access point.

Conduit entering through the bottom of a handhole must be located near the end walls to leave the major portion of the box clear and terminate 3 inches above the bottom of the handhole. Conduit entering through the sides of the handhole must enter from the direction of the run, and terminate flush with the box wall.

All conduit must be thoroughly cleaned and an appropriately sized mandrel pulled through it before installing wires or pull cord. Mandreling must be done in the presence of the Engineer.

Existing conduit to be incorporated into a new traffic signal system must be cleaned with a mandrel and a cylindrical wire brush and blown out with compressed air and a pull cord installed extending at least 3 feet beyond the conduit at each end.

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Conduit repairs: When small portions of damaged conduit repairs are necessary, repairs are permitted by using PVC in its place. The PVC must be coupled to the local conduit by beveled edge couplings slipped into place and then sealed with PVC cement. On repairs to steel conduit using PVC, a bonding #6 AWG jumper must be installed connecting the metal sections together with bonding clamps approved by the Engineer.

Marker stakes or tacks must be set flush with the ground to locate the ends of stubbed out conduits which may be buried so that they may be located in the future. All stubbed out conduits must be capped.

Conduit entrances into metal junction boxes (Except NEMA 1) must be drilled and tapped a minimum of 3 full threads for the size conduit used. Bosses must be provided where the wall thickness is not sufficient for the minimum number of threads.

Entry to electrical vaults or other Structures must be made such that the physical integrity of the vault or Structure is not impaired. Any hole for entry to vaults or Structures must be core drilled of a diameter no greater than 1-1/2 times the diameter of the conduit entering the vault. See Section 1-05.2(2) for site safety and coordination with SCL's Electrical Safety Observer.

Annular spaces around conduit, equipment grounding conductor, ducts, at wall penetrations of vault or other structural walls must be filled with non-shrink cement sand grout see Section 9-04.3(2). Threaded inserts must be coated with an approved rust preventative compound which is soluble in petroleum solvent.

At locations designated by the Engineer, fittings must be installed to provide a conduit channel that permits freedom for installing the electrical control wires. When conduit fittings are indicated on the Drawings, or where their installation is required by the Engineer, the Contractor must also furnish all necessary covers and gaskets. Expansion/deflection fittings per Standard Plans must be installed at all Structure expansion joints.

Conduits must be attached to walls and other surfaces (except poles) using approved one hole malleable iron pipe clamps and clamp backs.

Rigid steel conduit may be jacked or bored when approved by the Engineer.

New conduit that does not have wire installed (vacant) must have a pull cord installed extending at least 3 feet beyond the conduit at each end and fastened down.

8-33.3(2)B RIGID STEEL CONDUIT AND PVC COATED RIGID STEEL CONDUIT

When rigid steel conduit is cut, the ends must be made square and true with conventional pipe cutting equipment. Conduit must be threaded with a standard conduit cutting die. Burrs and sharp corners at the end of each conduit must be removed with a tapered reamer. Threads must be cleaned of all metal, lubricants, red lead, and any other Material which prevents joining with threaded counterparts. Conduit threads must be coated with a conduit thread compound designed to ease assembly and disassembly, and to improve electrical conductivity. Conduit must be joined with rigid steel conduit couplings. Running threads are not permitted for coupling conduit. When a standard coupling cannot be used, use an approved threaded union coupling. Tighten conduit securely to prevent the entrance of moisture, concrete, or other foreign Material and to provide a good electrical connection throughout the entire length of the conduit run. The method of tightening must not damage the conduit or coupling. Where the galvanizing on the conduit or the coupling has been damaged, it must be thoroughly painted, per the manufacturer's recommendations, with galvanizing repair paint meeting Federal Spec. MIL P 21035. An Alternate repair method must consist of applying a heated zinc alloy solder coating to a minimum thickness of 2 mils per ASTM A 780.

Bushings must be of the insulated throat type. The entire conduit system must be properly bonded and grounded per N.E.C.

Installation of the PVC coated system must be made under the following:

1. Coupling and Joining: All conduit connections must be made mechanically tight with strap wrenches to assure rigidity and maximum electrical conductivity. Over tightening that results in gouging of the PVC coating will not be permitted. After each connection is completed, any gouges, cuts or abrasions must be repaired. Solvent weld the sleeves to the conduit at each connection by applying touch up compound to the PVC coating before screwing on the sleeve. Cutting off plastic sleeves will be cause for rejection of that length of conduit.
2. Cutting: The conduit must be tightened securely in a vise or chuck. The cut must be made with a roll cutter or hack saw. When using either a jaw vise or a chain vise, the use of vise adapters will be required. If vise adapters are unavailable, use a jaw vise and wrap the portion of the coated conduit to be gripped in the vise with emery cloth with the coarse side toward the conduit. The use of a chain vise without adapters is not permitted.
3. Threading: When using a hand threader, use a tool with an adjustable guide. If the threader does not have an adjustable guide, ream the stationary guide 0.10 inch to accommodate the plastic coating. Whittling of the PVC coating is not permitted. After threading, apply touch up compound to indentations made by the vise. Raw field cut threads must be protected by the methods set forth above. For machine threading, use a threader designed for coated conduit.
4. Bending: PVC coated conduit may be bent with conventional bending equipment; however, the internal walls of the shoes must be machined out approximately 0.050 inch. Bending must be accomplished by segmented bending rather than a one shot bend. For sharp bends, saddles, or offsets, a PVC coated hickey is required. Any cuts, gouges, or abrasions must be coated with touch up compound. Coating the exterior of the conduit with a slippery substance such as wire pulling compound is permitted before bending.

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5. Touch up: During the installation of the coated conduit, the Contractor must assure that no metal is left exposed or uncoated. Metal exposed as the result of field cuts must be coated with touch up compound. If an uncoated accessory must be used, it must also be coated.
6. One hole malleable iron pipe strap, pipe spacers (clamp backs), and mounting brackets must be PVC coated.

8-33.3(2)C PVC CONDUIT

PVC conduit must be assembled with solvent welded joints per the manufacturer's written instructions. Bends and fittings must be factory produced.

8-33.3(3) CONDUIT RISERS

Conduit less than 2 inches in diameter mounted on wood poles must be mounted by use of 2 hole malleable conduit clamps spaced per NEC/NESC. Use a minimum of 2 clamps per length of conduit.

Conduit sized 2 inches and larger, or more than 1 conduit installed on wood poles, must be installed using stand off type brackets. Stand off brackets must be installed per NEC/NESC. with a 10-foot maximum spacing. Attachment must be near the top of each 10-foot length of conduit.

The conduit must be wrapped with corrosion protection tape conforming to SCL Material Standard 7366.55, 8 inches above and below finished grade.

Conduit risers must be the size indicated on the Drawings. The conduit between the pole and handhole, the 90 degree bend, and conduit up the pole to 10 feet above the surface must be rigid steel. The riser above the 10 foot-level must be PVC, Schedule 80. The riser must be equipped with a PVC weatherhead and must be grounded as indicated on Standard Plans.

8-33.3(4) HANDHOLES

Handholes must be installed per Standard Plans 550a and 550b. Unless dimensioned, handholes are located schematically, and must always be located outside the pedestrian travel way. The Contractor must provide the Engineer a minimum 1 Working Day advance notice regarding the exact handhole location.

When required by the Contract or Engineer, handhole extensions must be provided by Contractor and installed.

Unused conduit openings in handholes must be capped to afford protection against debris from entering the conduits.

Cables and conductors must be racked. The Contractor must select a racking method to be approved by the Engineer.

See Section 8-31.3(1)B for Traffic Signal handhole access requirements.

See Section 9-34.6 for additional handhole Material requirements.

8-33.3(5) JACKING OR BORING OR TUNNELING, RIGID STEEL AND OTHER CONDUIT

Rigid steel conduit may be jacked or bored when approved by the Engineer. Rigid nonmetallic type conduit may be installed under existing pavement if a hole larger than the conduit is predrilled and the conduit installed by hand.

When tunneling under existing pavement or other surface improvement is required for conduit installation, the Contractor must submit the proposed tunneling process including the Materials and methods for filling any voids created by the tunneling process at least 10 Working Days in advance for the Engineer's approval. Directional drilling must be as specified in Section 2-16.

8-33.4 MEASUREMENT

Measurement for "Conduit, (Use), (Material), (Size)" will be by the linear foot measured on the ground along the conduit to the center line of pole, to the 90 degree bend of a conduit riser, to equipment, or to the inside face of a handhole or of a vault.

Measurement for "Conduit Riser, (Use), (Size)" will be by each from and including the weatherhead to and including the 90 degree rigid steel bend underground.

Measurement for "Relocate (Item)" will be per each.

No separate measurement will be made for jacked or augered conduit. No measurement will be made for removal or restoration of surface improvements where the conduit is jacked or augered, but such measurement will be made at jacking pits and access holes as specified in Section 2-02.4.

Measurement for pavement restoration will be as specified in Sections 5-04.4 and 5-05.4 as applicable.

8-33.5 PAYMENT

1. "**Conduit**, **(Use), (Material), (Size)**", per linear foot

The Bid Item price for "Conduit, (Use), (Material), (Size)" must include all costs for the work required to furnish and install the conduit complete including all bends, fittings, condulets and hardware.

2. "**Trenching, (Use), Conduit**", per linear foot

The Bid Item price for "Trenching, (Use), Conduit" must include all costs for the work required to excavate, backfill with suitable Material, and compact the trench section for both conduit and conduit riser trenching. Payment for imported Material when required by the Engineer instead of native backfill Material will be paid as "Mineral Aggregate, (Type)", or other imported

Material acceptable to the Engineer. Where Material specified by the Engineer is not in the Contract and no Bid Item for "Mineral Aggregate, (Type)" is included in the Bid Form, payment will be made as specified in Section 1-04.1(2). All costs for replacement of suitable native Material which becomes unsuitable due to Contractor operations will be at the Contractor's sole expense.

3. "**Conduit Riser, (Use), (Size)**", per each

The Bid Item price for "Conduit Riser, (Use), (Size)" must include all costs for the work required to furnish and install the complete riser, including all conduit, fittings, ground rod, round rod handhole, molding, clamps and hardware from and including the weatherhead to and including the 90 degree rigid steel bend underground.

4. "**Handhole, (Use), (Type)**", per each

The Bid Item price for "Handhole, (Use), (Type)" must include all costs for the work required to furnish and install the handhole complete including excavation, backfill and compaction, groundrod, and handhole extensions when required.

5. "**Handhole, (Use), (Type), Polymer**", per each

The Bid Item price for "Handhole, (Use), (Type), Polymer" must include all costs for the work required to furnish and install the handhole complete including excavation, backfill and compaction, groundrod, and handhole extensions when required.

6. "**Relocate (Item)**", per each

The Bid Item price for "Relocate (Item)" must include all costs for the work required to relocate the specified item.

7. "**Remove (Item)**", per each

The Bid Item price for "Remove (Item)" must include all costs for the work required to remove and salvage as required.

8. **Other payment information**

Payment for jacked or augered conduit will be made at the Bid Item price for "Trenching, Conduit".

All costs for ground rod wells must be included in the Bid Item prices of the applicable Bid Items.

The (Use) designation in the Bid Item name is optional and intended to clarify the asset owner or intended use. Modification of the Bid Item name to include or exclude the (Use) designation does not change the intent of the Specifications relating to these items.

Conduit, trenching, conduit risers, and handholes used in illumination or electrical service construction must be as specified in Section 8-34.

See Section 1-05.2(2) regarding payment for Electrical Safety Observer.

SECTION 8-34 ILLUMINATION AND ELECTRICAL SERVICE CONDUIT AND TRENCHING

8-34.1 DESCRIPTION

8-34.1(1) GENERAL

This Work must consist of trench excavation, furnishing and installing conduit, conduit, condulets, and handholes for electrical systems related to illumination and electrical service connections as specified in the Contract and shown on the Standard Plans.

The Contractor must become thoroughly familiar with the electrical environment within the Project Site and with the relevant Work.

In areas where deteriorated conduits are encountered during trenching, the Contractor must promptly notify the Engineer who will determine if sleeving of conduits is required to keep backfill from entering the conduit. It is important to preserve conduits whenever economically practical for future use.

8-34.1(2) APPLICABLE ELECTRICAL CODES

See Section 8-30.1(2).

8-34.1(3) ELECTRICAL CONDUIT SHOP DRAWINGS

The Contractor must submit Shop Drawings and catalog cuts as specified in Section 1-05.3 for the following items:

Shop Drawing and Catalog Cuts Submittals	
Conduit and Fittings	Condulets Junction Box
Stand-off Brackets	Expansion Fittings
Weatherhead	Seals and Sealing Compounds
Galvanizing Repair Material	PVC Coatings to be field installed
Handholes and handhole lids	Flexible Conduit

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8-34.1(4) ELECTRICAL AND ELECTRONIC WORDS AND PHRASES

See Section 1-01.3.

8-34.2 MATERIAL

Materials must comply with the requirements of the following Sections:

Materials	Section
Non-Shrink Cement Sand Grout	Section 9-04.3(2)
Paint	Section 9-08
Conduits and Handholes	Section 9-34

8-34.3 CONSTRUCTION REQUIREMENTS

8-34.3(1) ILLUMINATION AND ELECTRICAL SERVICE TRENCHING

Excavation required for the installation of conduit, foundations, and other Materials must be performed in such a manner as to cause the least possible damage to the streets, sidewalks, and other improvements. Trenches must not be excavated wider than necessary for the proper installation of the electrical appliances and foundations. Excavated soils must be placed with the least impact to traffic and surface drainage.

Trenching, conduit and other in-common installation, backfilling, and either temporary surfacing or final surfacing as necessary, must be scheduled daily and for minimum disturbance to traffic.

The Contractor must take all necessary steps to keep excavated native Material deemed suitable by the Engineer from becoming unsuitable. The requirements of Section 2-04 apply.

Depth to top of conduits, or depth of cover, for illumination conduits must be a minimum of 24 inches per SCL Construction Standard 1716.07.

Depth to top of conduits, or depth of cover, for electrical service conduits must be a minimum of 36 inches per SCL Construction Standard 0224.07.

8-34.3(2) ILLUMINATION AND ELECTRICAL SERVICE CONDUIT INSTALLATION

8-34.3(2)A GENERAL

See SCL Construction Standard 1716.07 for illumination handhole and conduit requirements, and SCL Construction Standard 0224.01 for underground secondary service requirements.

Conduit must be installed as indicated on the Drawings. When installing conduit under existing pavement or sidewalks, removal must meet the requirements of Section 2-02. Surface restorations must comply with the applicable sections of the Standard Plans and Standard Specifications.

Conduit must be installed in the number, type, size and location indicated on the Drawings.

Conduit cable runs must be parallel to building lines and grouped together where possible.

Conduit cable runs parallel to curbs must be placed adjacent to back of curb unless detailed otherwise on the Drawings.

Changes of conduit direction must be made with manufactured or fabricated elbows of radius not less than that noted in the NEC.

Conduit installed within the metering and disconnect enclosure must be rigid metal and may be without PVC coating.

It is the option of the Contractor to use larger size conduit when approved by the Engineer. Where larger size conduit is used, it must be for the entire length of the run from outlet to outlet.

Conduit terminating in enclosures, including poles, cabinets, and pedestals, must extend vertically above the foundation a minimum of 1 inch, unless indicated otherwise on the Drawings. Exceptions to the 1 inch minimum are indicated on Standard Plan 550a. Reducing couplings will not be permitted. Conduit must not change size between handholes, or condulet access point.

All conduit must be thoroughly cleaned and an appropriately sized mandrel pulled through it prior to installing wires or pull cord. Mandreling must be done in the presence of the Engineer.

Existing conduit to be incorporated into a new system must be cleaned with a mandrel and a cylindrical wire brush and blown out with compressed air and a pull cord installed extending at least 3 feet beyond the conduit at each end.

Marker stakes or tacks must be set flush with the ground to locate the ends of stubbed out conduits which may be buried so that they may be located in the future. All stubbed out conduits must be capped.

Conduit entrances into metal junction boxes, except NEMA 1, must be drilled and tapped a minimum of 3 full threads for the size conduit used. Bosses must be provided where the wall thickness is not sufficient for the minimum number of threads.

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Entry to electrical vaults or other Structures must be made such that the physical integrity of the vault or structure is not impaired. Any hole for entry to vaults or Structures must be core drilled of a diameter no greater than 1-1/2 times the diameter of the conduit entering the vault. See Section 1-05.2(2) for site safety coordination with SCL's Electrical Safety Observer.

Annular spaces around conduit, equipment grounding conductor, ducts, at wall penetrations of vault or other structural walls must be filled with non-shrink cement sand grout (see Section 9-04.3(2)). Threaded inserts must be coated with an approved rust preventative compound which is soluble in petroleum solvent.

At locations designated by the Engineer, fittings must be installed to provide a conduit channel that permits freedom for installing the electrical control wires. When conduit fittings are indicated on the Drawings, or where their installation is required by the Engineer, the Contractor must also furnish all necessary covers and gaskets. Expansion/deflection fittings per Standard Plans must be installed at all structure expansion joints.

Conduits must be attached to walls and other surfaces, except poles, using approved one hole malleable iron pipe clamps and clamp backs.

Rigid steel conduit may be jacked or bored when approved by the Engineer.

New conduit that does not have wire installed (vacant) must have a pull cord installed extending at least 3 feet beyond the conduit at each end and fastened down.

Conduit entrances into metal junction boxes must be drilled and tapped a minimum of 5 full threads for the size conduit used. Bosses must be provided where the wall thickness is not sufficient for the minimum number of threads.

8-34.3(2)A1 AS-BUILT DRAWINGS

For conduit runs that deviate from the location indicated on the Drawings or on Shop Drawings reviewed by the Engineer, and are to be buried in concrete Structures such as floor slabs, retaining walls, abutments, or bridge superstructures, the Contractor is required to submit an as-built Drawing showing the actual locations of all roughed-in conduit to the Engineer at least 5 Working Days prior to pouring the concrete. The as-built Drawing must show the conduit run, conduit size, and conduit Material type in red and must be dimensioned to the nearest 1 inch.

8-34.3(2)A2 CONDUIT REPAIRS

When small portions of damaged conduit repairs are necessary, repairs are permitted by using PVC in its place. The PVC must be coupled to the local conduit by means of beveled edge couplings slipped into place and then sealed with PVC cement. On repairs to steel conduit using PVC, a bonding #6 AWG jumper must be installed connecting the metal sections together with bonding clamps approved by the Engineer.

8-34.3(2)B ILLUMINATION AND ELECTRICAL SERVICE RIGID STEEL CONDUIT AND PVC-COATED RIGID STEEL CONDUIT

When rigid steel conduit is cut, the ends must be made square and true with conventional pipe cutting equipment.

Conduit must be threaded with a standard conduit cutting die. Burrs and sharp corners at the end of each conduit must be removed with a tapered reamer. Threads must be cleaned of all metal, lubricants, red lead, and any other Material which prevents joining with threaded counterparts. Conduit threads must be coated with a conduit thread compound designed to ease assembly and disassembly, and to improve electrical conductivity. Conduit must be joined with rigid steel conduit couplings. Running threads are not permitted for coupling conduit. When a standard coupling cannot be used, an approved threaded union coupling must be used. Conduit must be tightened securely to prevent the entrance of moisture, concrete or other foreign Material and to provide a good electrical connection throughout the entire length of the conduit run. The method of tightening must not damage the conduit or coupling. Where the galvanizing on the conduit or the coupling has been damaged, it must be thoroughly painted with galvanizing repair paint Federal Spec. MIL-P-21035 per the manufacturer's recommendations, or a heated zinc alloy solder coating must be applied to a minimum thickness of 2 mils in accordance with ASTM A 780.

Bushings must be of the insulated throat type. The entire conduit system must be properly bonded and grounded in accordance with NEC.

Installation of the PVC-coated system must be made in conformance with the following:

1. Coupling and Joining: All conduit connections must be made mechanically tight with strap wrenches to assure rigidity and maximum electrical conductivity. Over-tightening that results in gouging of the PVC coating will not be permitted. After each connection is completed, any gouges, cuts or abrasions must be repaired. Solvent weld the sleeves to the conduit at each connection by applying touch-up compound to the PVC coating before screwing on the sleeve. Cutting off plastic sleeves is cause for rejection of that length of conduit.
2. Cutting: The conduit must be tightened securely in a vise or chuck. The cut must be made with a roll cutter or hack saw. When using either a jaw vise or a chain vise, the use of vise adapters will be required. If vise adapters are unavailable, a jaw vise must be used and the portion of the coated conduit to be gripped in the vise must be wrapped with emery cloth with the coarse side toward the conduit. The use of a chain vise without adapters will not be permitted.
3. Threading: When using a hand threader, a tool with an adjustable guide must be used. If the threader to be used does not have an adjustable guide, ream the stationary guide 0.10 inch to accommodate the plastic coating. Whittling of the PVC coating will not be permitted. After threading, apply touch-up compound to indentations made by the vise.

Raw field cut threads must be protected by the methods set forth above. For machine threading, the use of a threader designed for coated conduit must be used.

4. Bending: PVC-coated conduit may be bent with conventional bending equipment; however, the internal walls of the shoes must be machined out approximately 0.050 inch. Bending must be accomplished by segmented bending rather than a one-shot bend. For sharp bends, saddles, or offsets, a PVC-coated hickey is required. Any cuts, gouges, or abrasions must be coated with touch-up compound.
5. Touch-up: During the installation of the coated conduit, the Contractor must not leave any metal exposed or uncoated. Metal exposed as the result of field cuts must be coated with touch-up compound. If an uncoated accessory must be used, it must also be coated.
6. One hole malleable iron pipe strap, pipe spacers (clamp backs), and mounting brackets must be PVC coated.

8-34.3(2)C ILLUMINATION AND ELECTRICAL SERVICE PVC CONDUIT

PVC conduit must be assembled with solvent welded joints in accordance with the manufacturer's written instructions. Bends and fittings must be factory-produced.

8-34.3(3) ILLUMINATION AND ELECTRICAL SERVICE CONDUIT RISERS

Illumination conduit risers must be installed per SCL Construction Standard 0224.34.

Conduit risers must be the size indicated on the Drawings. The 90 degree bend and conduit up the pole to 10 feet above the surface must be rigid steel. The riser above the 10-foot level must be PVC, Schedule 80. The riser must be equipped with a PVC weatherhead and must be grounded as indicated on Standard Plans.

8-34.3(4) ILLUMINATION AND ELECTRICAL SERVICE HANDHOLES

Illumination and electrical service handholes must be installed per SCL Construction Standards 1716.07 and 0224.01, respectively.

Unless dimensioned, handholes are located schematically, and must always be located outside the pedestrian travel way. The Contractor must provide the Engineer a minimum 1 Working Day advanced notice of the exact handhole location.

When required by the Contract or Engineer, the Contractor must provide and install handhole extensions.

Unused conduit openings in handholes must be capped to prevent debris from entering the conduits. Cables and conductors must be racked. The Contractor must select a racking method to be approved by the

Engineer.

See Section 8-30.3(3) for SCL handhole, maintenance hole, and vault access requirements.

See Section 9-34.6 for additional handhole Material requirements.

8-34.3(5) JACKING, BORING, OR TUNNELING, RIGID STEEL AND OTHER CONDUIT

Rigid steel conduit may be jacked or bored when approved by the Engineer. Rigid non-metallic type conduit may be installed under existing pavement if a hole larger than the conduit is predrilled and the conduit is installed by hand.

When tunneling under existing pavement or other surface improvement is required for conduit installation, the Contractor must submit the proposed tunneling process including the Materials and methods for filling any voids created by the tunneling process at least 10 Working Days in advance for the Engineer's approval. Directional drilling must be in accordance with Section 2-16.

8-34.4 MEASUREMENT

Measurement for the Work specified in this Section will be as specified in Section 8-33.4.

8-34.5 PAYMENT

Payment for the Work specified in this Section will be as specified in Section 8-33.5.

END OF DIVISION

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DIVISION 9 MATERIALS

SECTION 9-00 DEFINITIONS AND TESTS

9-00.1 FRACTURE

Fractured aggregate is defined as aggregate particles which have one or more fractured faces. A face will be counted as fractured whenever one half or more of the projected area of the particle is comprised of a fractured face when viewed normal to the fractured face.

9-00.2 WOOD WASTE

Wood waste is defined as all material which, after drying to constant weight, has a specific gravity of less than 1.0.

9-00.3 TEST FOR WEIGHT OF GALVANIZING

At the option of the Engineer, the weight of zinc in ounce per square foot required by the various galvanizing Specifications may be determined by an approved magnetic thickness gage calibrated within the last 6 months for accuracy and demonstrated to the approval of the Engineer, in lieu of the other methods specified.

9-00.4 SIEVE ANALYSIS OF AGGREGATES

Sieve analysis for acceptance of aggregate gradation will comply with procedures specified in Section 9-03.13.

9-00.5 DUST RATIO

The dust ratio is defined as the percent of material passing the U.S. No. 200 sieve divided by the percent of material passing the U.S. No. 40 sieve.

9-00.6 SAND/SILT RATIO

The sand/silt ratio is defined as the percent of material passing the U.S. No. 10 sieve divided by the percent of material passing the U.S. No. 200 sieve.

9-00.7 GALVANIZED HARDWARE, AASHTO M 232

An acceptable alternate to hot dip galvanizing per AASHTO M 232 is zinc coatings mechanically deposited per AASHTO M 298, providing the minimum thickness of zinc coating is not less than that specified in AASHTO M 232, and the process does not produce hydrogen embrittlement in the base metal. Sampling and testing will be made by the Engineer in accordance with commonly recognized national standards and methods used in the SPU Materials Laboratory.

SECTION 9-01 PORTLAND CEMENT AND BLENDED HYDRAULIC CEMENT

9-01.1 TYPES OF CEMENT

Cement must be classified as Portland cement or blended hydraulic cement.

9-01.2 SPECIFICATIONS

9-01.2(1) PORTLAND CEMENT

Portland cement must comply with AASHTO M 85 or ASTM C 150 Types I, II, or III Portland cement, except that the cement must not contain more than 0.75 percent alkalis by weight calculated as Na20 plus 0.658 K20 and the content of tricalcium aluminate (C3A) must not exceed 8 percent by weight calculated as 2.650A1203 minus 1.692Fe203. Processing additions must comply with ASTM C 465 and the total amount of processing additions used must not exceed 1 percent of the weight of Portland cement clinker. Cement kiln dust may be used as a process addition above 1 percent but not exceed 4 percent of the weight of Portland cement clinker. When process additions greater than 1 percent are used, the type and amount of processing additions used must be shown on mill test reports.

The time of setting must be determined by the Vicat Test method per AASHTO T 131 or ASTM C 191.

9-01.2(2) LOW ALKALI CEMENT

When the Engineer requires the use of low alkali cement, the percentage of alkalis in the cement must not exceed 0.60 percent by weight calculated as Na20 plus 0.658 K20. This limitation applies to all types of Portland cement.

9-01.2(3) BLENDED HYDRAULIC CEMENT

Blended hydraulic cement must be Type IP, Type IS, Type IL, or Type IT cement conforming to AASHTO M 240 or ASTM C-595, except that the blended hydraulic cement must not contain more than 0.75 percent alkalis by weight calculated as Na2O plus 0.658 K2O and the content of tricalcium aluminate (C3A) must not exceed 8 percent by weight calculated as 2.650Al2O3 minus 1.692Fe2O3 and comply with the following additional requirements:

1. Type IP(X), Portland Pozzolan Cement, where (X) dictates pozzolan percentage. Type IP(X), Portland Pozzolan Cement, must be Portland cement and pozzolan. Pozzolan must be limited to fly ash or microsilica fume. Fly ash is limited to a maximum of 25 percent by weight of the cementitious material in air entrained concrete and 35 percent in

non-air entrained concrete. Microsilica fume is limited to a maximum of 15 percent by weight of the cementitious material.

2. Type IS(X), Portland Blast Furnace Slag Cement, where (X) dictates slag percentage. Type IS(X), Portland Slag Cement, must be Portland cement and ground granulated blast furnace slag. The addition of ground granulated blast furnace slag must be limited to a maximum of 30-percent by weight of the cementitious material in air entrained concrete and 50-percent in non-air entrained concrete.
3. Type IL(X), Portland Limestone Cement, where (X) dictates limestone percentage. Type IL(X), Portland Limestone Cement, must be Portland cement and limestone where the percent of limestone in the blend must be greater than 5 percent, and no more than 15 percent, of the total weight of Portland cement and limestone.
4. Type IT(AX)(BY), Ternary Blended Cement, where A is either “S” for Slag cement, “P” for pozzolan, or “L” for limestone; whichever is present in larger quantity by weight. And where B is either “S” for Slag cement, “P” for pozzolan or “L” for limestone. “X” is the targeted percentage by weight of constituent A, and “Y” is the targeted percentage by weight of constituent B. Portland cement that may be replaced by weight in the blend is limited to the following maximums:

Portland Cement Replacement Maximums

	Air Entrained Concrete	Non-Air Entrained Concrete
Total Cement Replacement	35%	50%
Fly Ash	25%	35%
Microsilica Fume	10%	10%
GGBFS	30%	40%
Limestone	15%	15%

The source and weight of the pozzolan, ground granulated blast furnace slag, or limestone must be certified on the cement mill test certificate and must be reported as a percent by weight of the total cementitious material plus limestone, if present. The pozzolan, ground granulated blast furnace slag, or limestone constituent content in the finished cement must not vary more than ± 5 percent by weight of the finished cement from the certified value.

Fly ash must be as specified in Section 9-23.6.

Ground granulated blast furnace slag must be as specified in Section 9-23.7.

Limestone must comply with the specifications of Section 9-23.10.

Microsilica fume must comply with the specifications of Section 9-23.8.

SECTION 9-02 BITUMINOUS MATERIALS

9-02.1 ASPHALT MATERIAL

9-02.1(1) RESERVED

9-02.1(2) RESERVED

9-02.1(3) RESERVED

9-02.1(4) ASPHALT CEMENT

Performance Grade (PG) asphalt binder meeting the requirements of AASHTO M 332 Table 1 of the grades specified in the Contract must be used in the production of HMA.

In addition to AASHTO M 332 Table 1 specification requirements, PG asphalt binders must meet the following requirements:

Property	Test Method	Additional Requirements by Performance Grade (PG) Asphalt Binders			
RTFO Residue: Average Percent Recovery @ 3.2 kPa	AASHTO T 3501	**PG58S-22**	**PG58H-22**	**PG58V-22**	**PG58E-22**
		N/A	N/A	30% Min.	35% Min.
		PG64S-28	**PG64H-28**	**PG64V-28**	**PG64E-28**
		20% Min.	25% Min.	30% Min.	35% Min.

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NOTE:

1. Specimen conditioned in accordance with AASHTO T 240 – RTFO.

The RTFO Jnrdiff and the PAV direct tension specifications of AASHTO M 332 are not required.

9-02.1(5) RESERVED

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9-02.1(6) CATIONIC EMULSIFIED ASPHALTS

Cationic Emulsified Asphalt

Grade	Type	Rapid Setting				Medium Setting						Slow Setting				Special Tack	
	AASHTO Test Method	CRS-1		CRS-2		CMS-2S		CMS-2		CMS-2H		CSS-1		CSS-1H		STE-1	
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Test on Emulsions																	
Viscosity Saybolt Furol S @ 77 °F (25 °C)	T 59	--	--	--	--	--	--	--	--	--	--	20	100	20	100	--	30
Viscosity Saybolt Furol S @ 122 °F (50 °C)	T 59	20	100	150	400	50	450	50	450	50	450	--	--	--	--	--	--
Storage stability test 1 day %	T 59	--	1	--	1	--	1	--	1	--	1	--	1	--	1	--	1
Demulsibility 35 m.l. 0.8% sodium dioctyl sulfosuccinate, %[1]	T 59	40	--	40	--	--	--	--	--	--	--	--	--	--	--	25	--
Coating Ability & Water Resistance																	
Coating, dry aggregate	T 59	--	--	--	--	good	--	good	--	good	--	--	--	--	--	--	--
Coating, after spraying	T 59	--	--	--	--	fair	--	fair	--	fair	--	--	--	--	--	--	--
Coating, wet aggregate	T 59	--	--	--	--	fair	--	fair	--	fair	--	--	--	--	--	--	--
Coating, after spraying	T 59	--	--	--	--	fair	--	fair	--	fair	--	--	--	--	--	--	--
Particle charge test	T 59	positive		positive		positive		positive		positive		positive[2]		positive[2]		positive	
Sieve Test, %	T 59	--	0.10	--	0.10	--	0.10	--	0.10	--	0.10	--	0.10	--	0.10	--	0.10
Cement mixing test, %	T 59	--	--	--	--	--	--	--	--	--	--	--	2.0	--	2.0	--	--
Distillation																	
Oil distillate by vol. Of emulsions %	T 59	--	3	1.5	3	--	20	--	12	--	12	--	--	--	--	--	5
Residue, %	T 59	60	--	65	--	60	--	65	--	65	--	57	--	57	--	45	--
Tests on Residue from Distillation Test																	
Penetration, 77 °F (25 °C)	T 49	100	250	100	250	100	250	100	250	40	90	100	250	40	90	100	200
Ductility, 77 °F (25 °C) 5 cm/min, cm	T 51	40	--	40	--	40	--	40	--	40	--	40	--	40	--	40	--
Solubility in trichlorethylene, %	T 44	97.5	--	97.5	--	97.5	--	97.5	--	97.5	--	97.5	--	97.5	--	97.5	--

NOTES:

1. The demulsibility test must be made within 30 days from date of shipment.
2. If the particle charge test for CSS-1 and CSS-1h is inconclusive, material having a maximum pH value of 6.7 is acceptable.

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9-02.1(6)A POLYMERIZED CATIONIC EMULSIFIED ASPHALT – CRS-2P

The asphalt CRS-2P must be a polymerized cationic emulsified asphalt. The polymer must be milled into the asphalt or emulsion during the manufacturing of the emulsion. The asphalt CRS-2P must comply with the following Specifications:

	AASHTO Test Method	Specifications	
		Minimum	Maximum
Viscosity @122 ºF, SFS	T 59	200	400
Storage Stability 1 day %	T 59	--	Note 1
Demulsibility 35 ml. 0.8% Dioctyl Sodium Sulfosuccinate	T 59	40	--
Particle Charge	T 59	Positive	--
Sieve Test %	T 59	--	0.30
Distillation			
Oil distillate by vol. of emulsion %	T 59 (Note 1)	0	Note 3
Residue	T 59	65	--
Test on the Residue from Distillation			
Penetration @77 ºF	T 49	100	250
Torsional Recovery % Or Toughness/Tenacity in-lbs	Note 2 Note 3	18 50/25	-- --

NOTES:

1. Distillation modified to use 300 grams of emulsion heated to 350 ºF ± 9 Fº and maintained for 20 minutes.
2. The Torsional Recovery test must be conducted according to the California Department of Transportation Test Method No. 332.
3. Benson method of toughness and tenacity; Scott tester, inch-pounds at 77 ºF, 20 inches per minute pull. Tension head 7/8 inch diameter.

At the option of the Supplier, the Benson Toughness/Tenacity test can be used in lieu of Torsional Recovery based on type of modifier used. If the Benson Toughness/Tenacity method is used for acceptance, the Supplier must supply all test data verifying Specification conformance as part of the manufacturer's certificate of compliance.

9-02.1(7) ASPHALT FOR SUB SEALING

Asphalt for sub sealing must conform to the requirements of AASHTO M 238 except that the minimum softening point must be 170 °F.

9-02.1(8) HOT MELT TRAFFIC BUTTON ADHESIVE

The bitumen adhesive Material must conform to the following requirements:

Specification	ASTM Test Method	Requirement
Flash Point, COC °F	D 92	550 Min.
Softening Point, °F	D 36	200 Min.
Brookfield Viscosity, 400 °F	D 2196	7,500 cP, Max.
Penetration, 100g, 5 sec, 77 °F	D 5	10-20 dmm
Filler Content, % by weight (Insoluble in 1,1,1 trichloroethane)	D 2371	50-75

Filler material must be calcium carbonate and must conform to the following fineness:

Sieve Size	Percent Passing
No. 100	100
No. 200	95
No. 325	75

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Hot melt bitumen adhesive must develop bond pull off strength greater than 100 psi between 0 °F and 120 °F.

9-02.2 SAMPLING AND ACCEPTANCE

9-02.2(1) CERTIFICATION OF SHIPMENT

Bituminous Materials may be accepted by the Engineer based on the asphalt Supplier's manufacturer's certificate of compliance incorporated in their Bill of Lading. This certification must include a statement certifying Specification compliance for each delivery of product shipped. Failure to provide this certification with the shipment is cause for rejection of the Material. The following information is required on this Bill of Lading:

1. Date shipped.
2. Project name and PW#
3. Grade of Commodity and manufacturer's certificate of compliance.
4. Anti-stripping additive brand, grade, and percentage.
5. Mass (Net Tons).
6. Volume (Gross Gallons).
7. Temperature of Load (°F).
8. Bill of Lading Number.
9. Consignee and Delivery Point.
10. Signature of Supplier's Representative.
11. Supplier (Bill of Lading Generator Business Name).
12. Supplier's Address.

The Bill of Lading must be supplied at the time of shipment of each load delivered. In addition to the copies the Contractor requires, one copy of the Bill of Lading including the manufacturer's certificate of compliance must be sent with the shipment for the sole use of Engineer.

9-02.2(2) SAMPLES

When requested by the Engineer, the asphalt Supplier must submit, by prepaid express or US mail, samples of asphalt binder that represent current production to the SPU Materials Laboratory as specified in Section 1-05.3(1)C at no cost to the Owner. At the discretion of the Engineer, samples of asphalt binder may be obtained by the Engineer from the Contractor's storage tanks.

9-02.3 TEMPERATURE OF ASPHALT

The temperature of paving asphalts in storage tanks when loaded for transporting must not exceed the maximum temperature recommended by the asphalt binder manufacturer.

9-02.4 ANTI STRIPPING ADDITIVE

When the Engineer requires heat-stable anti-stripping additive be added to the asphalt mix, then at the option of the Contractor, the method of adding anti-stripping additive can either be by direct mixing with the liquid asphalt, or by spraying on the aggregate on the cold feed. Once the method and type of anti-stripping additive proposed by the Contractor have been approved by the Engineer, the method, brand, grade, and amount of anti-stripping additive must not be changed without approval of the Engineer.

The amount of liquid anti-stripping additive designated by the Engineer to be used must not exceed 1 percent by weight of the liquid asphalt.

When polymer additives are sprayed on the aggregate, the amount will be designated by the Engineer, but must not exceed 0.67 percent by weight of the aggregate.

The use of another process or procedure for adding anti-stripping additive to the asphalt mix will be considered based on a proposal from the Contractor.

9-02.5 TEMPORARY PAVEMENT PATCH MATERIAL

Four temporary pavement patch material products approved by the Engineer for use include:

1. Unique Paving Material (UPM): Alpine Products, Phone: (253) 351-9828, E-mail: Skip@alpinetrafficproducts.com, Web-site: http://www.upm.com
2. Quality Pavement Repair (QPR): Phone: 1-800-388-4338, Web-site: http://www.qprcoldpatch.com
3. E Z Street: Lakeside Industries, PO Box 7016 Issaquah, WA 98027, Phone: (425) 313-2681, E-Mail: rickr@lakesideind.com, Web-site: http://www.lakesideind.com
4. U.S. Cold Patch: Phone: (425) 244-5000, Fax: (425) 423-9120, Web-site: http://www.uscoldpatch.com/

Other temporary patching products may be submitted to the Engineer for approval.

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SECTION 9-03 AGGREGATES

9-03.0 GENERAL

Mineral Aggregates most commonly used have each been given a Type number to identify a unique Mineral Aggregate blend known as Mineral Aggregate Type (Number). See the definition of Mineral Aggregate in Section 1-01.3. Requirements for each Mineral Aggregate identified by a Type number are specified in Sections 9-03.1, and 9-03.7 through 9-03.14. Mineral aggregates must be composed of clean, and of uniform quality, particulate size groups, and free from wood waste and other deleterious materials. They must be obtained only from sources approved by the Engineer. Written requests for source approval must be submitted to the Engineer not less than 10 Working Days before the intended use of the Mineral Aggregate. If the proposed source is one that the Engineer has no history of material performance with, the Engineer reserves the right to take preliminary samples at the proposed source, and make preliminary tests, to first determine acceptability of the new source and then perform the applicable material approval testing. Continued approval of a source is contingent upon the Mineral Aggregates from that source continuing to comply with Contract Specifications.

Mineral aggregates must comply with the Specifications for grading and quality for use in the Work; however, allowable exceptions may be specified in Contract. The Engineer reserves the right to sample and test Mineral Aggregate at any time including at the source.

Recycled Materials to be used as aggregates must comply with the Specifications in Section 9-03.16(1).

All percentages are by weight unless otherwise specified.

9-03.1 AGGREGATES FOR PORTLAND CEMENT CONCRETE

9-03.1(1) GENERAL REQUIREMENTS

Portland cement concrete aggregates must be manufactured from ledge rock, talus, or sand and gravel as specified in Section 2-01. They must possess the characteristics of shape and size such that the concrete, resulting from a mixture of fine and coarse aggregates in the specified proportions, has workability acceptable to the Engineer. Regardless of compliance with these Specifications, if the concrete is not of a workable character, or does not exhibit a proper surface when finished, either the fine or the coarse aggregate or both, will be rejected, or must be changed as required by the Engineer.

Before approval of any Portland cement concrete mix design, results of tests performed per ASTM C 1293 at an age of 12 months for the proposed coarse and fine aggregates must be submitted to the Engineer for evaluation of the potential for alkali silica reaction (ASR). The test must be conducted by a laboratory accredited for the test and the test results must be no older than 24 months from the date of the submittal. If results of ASTM C 1293 testing are not available, the Engineer may accept results of ASTM C 295 for evaluation in the interim until results of ASTM C 1293 tests are available and submitted for evaluation. In no case must the interim between the submittal of ASTM C 295 results and the submittal of ASTM C 1293 results exceed 14 months. If the time period between ASTM C 295 evaluation submittal and ASTM C 1293 test results submittal exceeds 14 months, aggregate sources that have been approved for use in mix designs based on the results of ASTM C 295 evaluation will be rejected, and mix design approvals incorporating those aggregates from those sources will be rescinded.

It is the intent of this Specification that aggregate sources have current ASTM C 1293 test results on file and that those results must be updated every 24 months at a maximum. The interim ASTM C 295 testing is intended to provide a mechanism to evaluate new aggregate sources until ASTM C 1293 test results can be submitted and not as a means to gain final approval. The 14 month time period between the submittal of ASTM C 295 test results and ASTM C 1293 test results is not limited to a single contract and must begin upon the first submittal of ASTM C 295 test results regardless of project or contract.

Based on previous experience or on Laboratory tests, the Engineer may determine that concrete aggregates from a given source are detrimentally reactive with alkalies in Portland cement, in which case that source must not be used. Upon determination of detrimentally reactive aggregates, the Contractor may submit results of testing by ASTM 1567 for each proposed mix design incorporating ASR mitigation measures for evaluation by the Engineer. If the Engineer determines that the Contractor's ASR mitigation is effective for a mix design, the Engineer may approve the mix design for use. Determination of the effectiveness of the proposed mitigation measures for a mix design must lie with the Engineer.

9-03.1(2) FINE AGGREGATE FOR PORTLAND CEMENT CONCRETE

9-03.1(2)A GENERAL

Fine aggregate for Portland cement concrete must consist of sand or other inert Materials, or combinations thereof, approved by the Engineer, having hard, strong, durable particles free from adherent coating. Fine aggregate must be washed thoroughly to remove clay, loam, alkali, organic matter, or other deleterious matter.

9-03.1(2)B DELETERIOUS SUBSTANCES

The amount of deleterious substances in the washed aggregate must not exceed the following values:

1. Particles having a specific gravity less than 1.95 must not exceed 1.0 percent of total weight.
2. Organic matter, by calorimetric test, must not be darker than the reference standard color (organic plate No. 3) AASHTO T 21 unless other tests prove a darker color to be harmless.

9-03.1(2)C GRADING

Fine aggregate for Portland cement concrete must be graded to conform to the following requirements expressed as percentages by weight:

Sieve	Type 6 Class 1		Type 7 Class 2	
	Max.	Min.	Max.	Min.
3/8" square	--	100	--	100
% Passing U.S. No.4	100	95	100	95
% Passing U.S. No.8	86	68	--	--
% Passing U.S. No.16	65	47	80	45
% Passing U.S. No.30	42	27	--	--
% Passing U.S. No.50	20	9	30	10
% Passing U.S. No.100	7	0	10	2
% Passing U.S. No.200 (wet sieving)	2.5	0	2.5	0

For fine aggregate Class 1, individual test variations under the minimum or over the maximum will be permitted as follows, provided the average of 3 consecutive tests is within the Specification limits:

Sieve Number	Permissible Variation in Individual Tests
No. 30 and coarser	2.0%
No. 50 and finer	0.5%

Within the gradation limits for fine aggregate Class 2, uniformity of gradation must be limited to a range of ± 0.20 of the reference Fineness Modulus. The reference Fineness Modulus must be determined from a representative sample from the proposed source as submitted by the Contractor.

9-03.1(2)D USE OF SUBSTANDARD GRADINGS

Fine aggregate with more than the maximum percentage passing any sieve may be accepted provided the cement content of the finished concrete is increased, at the Contractor's cost, by 1/3 percent for each 1 percent the fine aggregate passing each sieve is in excess of the maximum.

Fine aggregate Class 1 must not be used if it has a grading finer than the following:

Sieve Size	Percent Passing
U.S. No. 8	95
U.S. No. 16	80
U.S. No. 30	60
U.S. No. 50	25
U.S. No. 200	2.5

9-03.1(2)E USE OF CRUSHED RECYCLED PORTLAND CEMENT CONCRETE

Recycled Portland cement concrete must not be used as fine aggregate for new Portland cement concrete.

9-03.1(3) COARSE AGGREGATE FOR PORTLAND CEMENT CONCRETE

9-03.1(3)A GENERAL

Coarse aggregate for Portland cement concrete must consist of gravel, crushed stone, or other inert Material or combinations thereof approved by the Engineer, having hard, strong, durable pieces free from adherent coatings. Coarse aggregate must be washed thoroughly to remove clay, silt, bark, sticks, alkali, organic matter, or other deleterious material.

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9-03.1(3)B DELETERIOUS SUBSTANCES

The amount of deleterious substances in the washed aggregate must not exceed the following values:

Deleterious Substance	Not to Exceed
Amount finer than U.S. No. 200	0.5%
Pieces with a specific gravity less than 1.95	2.0%
Clay lumps	0.5%
Shale	2.0%
Wood Waste	0.05%

9-03.1(3)C DURABILITY

Coarse aggregate must not have a percentage of wear in the Los Angeles machine in excess of 35 after 500 revolutions per ASTM C 131. Additionally, when tested per WSDOT Test Method T 113, coarse aggregate must not have a Degradation Factor less than 30.

9-03.1(3)D GRADING

Coarse aggregate for Portland cement concrete when separated by means of laboratory sieves must conform to one or more of the following gradings as called for elsewhere in the Specifications, Special Provisions or in the Drawings:

	Percent Passing											
	AASHTO Grading No. 467		AASHTO Grading No. 4		AASHTO Grading No. 57		AASHTO Grading No. 67		AASHTO Grading No. 7		AASHTO Grading No. 8	
Sieve Size	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**
2” square	100	--	100	--	--	--	--	--	--	--	--	--
1-1/2" square	95	100	90	100	100	--	--	--	--	--	--	--
1" square	--	--	20	55	95	100	100	--	--	--	--	--
3/4" square	35	70	0	15	--	--	90	100	100	--	--	--
1/2" square	--	--	--	--	25	60	--	--	90	100	100	--
3/8" square	10	30	0	5	--	--	20	55	40	70	85	100
U.S. No. 4	0	5	--	--	0	10	0	10	0	15	10	30
U.S. No. 8	--	--	--	--	0	5	0	5	0	5	0	10
U.S. No. 16	--	--	--	--	--	--	--	--	--	--	0	5

In individual tests, a variation of 4 percent under the minimum percentages or over the maximum percentages will be allowed. The average of 3 successive tests must be within the percentages stated above. Coarse aggregate must contain no pieces larger than two times the maximum sieve size for the specified grading measured along the line of greatest dimension.

Acceptance of grading and quality of the aggregate will be based on samples taken from stockpiles at the concrete plant. The exact point of acceptance will be determined in the field by the Engineer.

When the Engineer approves, the coarse aggregate may be blended from other sizes if:

1. The resulting aggregate complies with all requirements for specified grading;
2. Each size used makes up at least 5 percent of the blend;
3. The Contractor supplies the Engineer with gradings for the proposed sizes, along with their proper proportions. If the aggregate comes from commercial sources, the Contractor must supply this information and have it approved before proportioning and mixing the concrete.

9-03.1(3)E USE OF CRUSHED RECYCLED PORTLAND CEMENT CONCRETE

With the approval of the Engineer, crushed recycled Portland cement concrete may be used as coarse aggregate for classes of concrete specified below. Crushed recycled Portland cement concrete must comply with the Specifications for coarse aggregate contained in Section 9-03.1(3). Recycled concrete that exhibits effects of alkali silica reaction, carbonate silica reaction, sulfate reaction or any other deleterious condition, must not be used. The concrete producer must submit a certification that the crushed recycled concrete was produced from sound stock and is not affected by these or any other deleterious conditions.

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In addition to the Specifications in Section 9-03.1(3)B, crushed recycled Portland cement concrete must contain an aggregated weight of less than 1 percent of asphalt concrete, brick, porcelain or other deleterious substances not otherwise noted.

Crushed recycled Portland cement concrete aggregate must be in a saturated condition before mixing and the water-cement ratio of the final mix must be limited to 0.45 maximum. Should the hardened concrete exhibit excessive cracking, unacceptable compressive strength or other undesirable characteristics, use of the mix must be discontinued.

The amount of crushed recycled Portland cement concrete used, by weight, as course aggregate must not exceed the following values:

Application	Not to Exceed
Roadway Cement Concrete (All mixes)	30%
Non-Roadway Cement Concrete (High strength mixes)	30%
Non-Roadway Cement Concrete (Non-high strength mixes)	100%
Structural Concrete Class 3000 or Higher	0%

9-03.1(4) COMBINED AGGREGATE GRADATION FOR PORTLAND CEMENT CONCRETE

As an option to using Coarse and Fine graded aggregates for Portland cement concrete, aggregate gradation may consist of a combined gradation. Aggregates must consist of sand, gravel, crushed stone, or other inert Material or combinations thereof, having hard, strong durable particles free from adherent coatings. Aggregates must be washed to remove clay, loam, alkali, organic matter, silt, bark, sticks, or other deleterious matter.

9-03.1(4)A DELETERIOUS SUBSTANCES

The amount of deleterious substances in the washed aggregate must not exceed the following values:

Deleterious Substance	Not to Exceed
Particles of specific gravity less than 1.95	2.0%
Organic matter, by colorimetric test, must not be darker than the reference Standard color (organic plate No. 3) AASHTO T21 unless other tests prove a darker color to be harmless.	--
Percentage of wear in Los Angeles machine for aggregates retained on the No. 4 sieve after 500 revolutions.	35%
Clay Lumps	0.3%
Shale	1.00%
Wood Waste	0.03%
Amount finer than No. 200 Sieve	2.0%

9-03.1(4)B GRADING

If a nominal maximum aggregate size is not specified, the Contractor must determine the nominal maximum aggregate size, using ACI 211.1 as a guide. In no case will the maximum aggregate size exceed 1/5 of the narrowest dimension between sides of the forms, 1/3 the depth of slabs, nor 3/4 of the minimum clear spacing between individual reinforcing bars, bundles of bars, or pretensioning strands.

The combined aggregate must conform to the following requirements based upon the nominal maximum aggregate size.

Nominal Maximum Aggregate Size	3	2-1/2	2	1-1/2	1	3/4	1/2	3/8	No. 4
3-1/2”	100								
3”	93-100[1]	100							
2-1/2”		92-100[1]	100						
2”	76-90		90-100[1]	100					
1-1/2”	66-79	71-88		87-100[1]	100				
1”	54-66	58-73	64-83		82-100[1]	100			

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Nominal Maximum Aggregate Size	3	2-1/2	2	1-1/2	1	3/4	1/2	3/8	No. 4
3/4”	47-58	51-64	55-73	62-88		87-100[1]	100		
1/2”	38-48	41-54	45-61		57-83		81-100[1]	100	
3/8”	33-43	35-47	39-54	43-64		60-88		86-100[1]	100
No. 4	22-31	24-34	26-39	29-47	34-54	41-64	48-73		68-100[1]
No. 8	15-23	16-25	17-29	19-34	22-39	27-47	31-54	39-73	
No. 16	9-17	10-18	11-21	12-25	14-29	17-34	20-39	24-54	28-73
No. 30	5-12	6-14	6-15	7-18	8-21	9-25	11-29	13-39	16-54
No. 50	2-9	2-10	3-11	3-14	3-15	4-18	5-21	6-29	7-39
No. 100	0-7	0-7	0-8	0-10	0-11	0-14	0-15	0-21	0-29
No. 200	0-2.0	0-2.0	0-2.0	0-2.0	0-2.0	0-2.0	0-2.0	0-2.0	0-2.5

1. NOTE: Nominal Maximum Size

Nominal maximum size for concrete aggregate is defined as the smallest standard sieve opening through which the entire amount of the aggregate is permitted to pass. Standard sieve sizes must be those listed in ASTM C 33.

The Owner may sample each component aggregate before introduction to the weigh batcher or as otherwise determined by the Engineer. Each separate component will be sieve analyzed alone per AASHTO Test Method T-11/27. All material components will be mathematically re-combined by proportions (weighted average), supplied by the Contractor.

9-03.1(5) RESERVED

9-03.2 AGGREGATE FOR BIORETENTION SOIL

9-03.2(1) GENERAL

In general, soil aggregate must be free of wood, waste, coating, or any other deleterious material, and all aggregate passing the No. 200 sieve size must be non-plastic.

9-03.2(2) MINERAL AGGREGATE FOR BIORETENTION SOIL

Sieve Analysis. Mineral aggregate for bioretention soils must be analyzed by an accredited lab using the sieve sizes noted below, and must meet the following gradation:

Sieve Size	Percent Passing
3/8” square	100
U.S. No. 4	60-100
U.S. No.10	40-100
U.S. No. 40	15-50
U.S. No. 200	2-5

9-03.3 STREAMBED AGGREGATE

9-03.3(1) QUALITY

Aggregates for streambed construction must be washed, naturally-formed, round to subangular, hard, strong, sound, durable, fracture-free pieces of igneous and metamorphic rock. Aggregate must be free of soft, weathered materials and seams of soft rock, must not contain any wood and other waste, and must be free of any coating.

The Contractor must submit certified test reports indicating streambed aggregate complies with all requirements of this Section.

All sand size aggregate (passing a U.S. No. 4 sieve and retained on a US No. 200 sieve) must meet the following requirements:

Property	Standard	Requirement
Specific Gravity	AASHTO T 84	Minimum 2.65

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All gravel (passing a 3-inch sieve and retained on a U.S. No. 4 sieve) and cobble (passing a 12-inch sieve and retained on a 3-inch sieve) aggregate must meet the same requirements for sand size aggregate and the following additional requirements:

Property	Standard	Requirement
Soundness	ASTM C 88	Not greater than 5% loss
L.A. Abrasion	AASHTO T 96	Max 20% loss at 500 revolutions

All boulder size aggregate (retained on a 12-inch screen) must meet the same requirements for gravel and cobble and the following additional requirements:

Property	Standard	Requirement
Accelerated expansion	CRD-C-148	Not greater than 15% breakdown
Absorption	AASHTO T 85	Not greater than 2%

9-03.3(2) GRADATIONS

Aggregate gradations for streambed construction are on a weight basis and must be as follows:

Streambed Aggregate Type 1	
Sieve Size	**Percent Passing**
8”	95-100
3” square	45-60
1-1/2” square	30-40
3/4” square	10-20
U.S. No. 4	0-3

The portion passing the U.S. No. 4 sieve size must have a minimum sand equivalent of 60.

Streambed Aggregate Type 2	
Sieve Size	**Percent Passing**
16”	95-100
8”	55-75
3”	20-35
1-1/2”	0-15
3/4”	0-5

Streambed Aggregate Type 3	
Sieve Size	**Percent Passing**
32”	95-100
24”	60-75
16”	40-55
8”	10-20
3”	0-10
3/4”	0-2

Streambed Aggregate Type 4	
Sieve Size	**Percent Passing**
8”	90-100
6”	45-65

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Streambed Aggregate Type 4	
Sieve Size	**Percent Passing**
4”	15-30
3/4”	0-3

9-03.4 AGGREGATE FOR BITUMINOUS SURFACE TREATMENT

9-03.4(1) GENERAL REQUIREMENTS

Aggregate for bituminous surface treatment must be manufactured from ledge rock, talus, or gravel, as specified in Section 3-01, which meets the following test requirements:

Test	Requirements
Los Angeles Wear, 500 Rev.	35% max.
Degradation Factor	30 min.

9-03.4(2) GRADING AND QUALITY

Aggregate for bituminous surface treatment must conform to the requirements in the following table for grading and quality. The particular type or grading to be used must be as shown on the Drawings. All percentages are by weight.

The Material must comply with these grading and quality Specifications when placed in hauling vehicles for delivery to the roadway, or during manufacture and placement into a temporary stockpile. The Engineer determines the exact point of acceptance.

	Percent Passing					
Sieve Size	**Crushed Cover Stone**	**3/4"-1/2"**	**5/8" U.S. No. 4**	**1/2" U.S. No. 4**	**3/8" U.S. No. 10**	**U.S. No. 4-0”**
1" square	100	100	--	--	--	--
3/4" square	100	95-100	100	--	--	--
5/8" square	95 100	-	95-100	100	--	--
1/2" square	--	0-20	--	95-100	100	--
3/8" square	--	0-5	--	--	90-100	100
U.S. No. 4	20-45	--	0-10	0-15	30-56	76-100
U.S. No. 10	--	--	0-3	0-3	0-10	30-60
U.S. No. 200	0-7.5	0-1.0	0-1.0	0-1.0	0-1.0	0-10.0
% fracture, by weight, min.	90	90	90	90	90	90
Sand equivalent min.	40	--	--	--	--	--
Static Stripping Test	Pass	Pass	Pass	Pass	Pass	Pass

The fracture requirement must be at least one fractured face and applies to Material retained on each sieve size U.S. No. 4 and above if that sieve retains more than 5 percent of the total sample.

The finished product must be clean, uniform in quality, and free from wood, bark, roots, clay, any organic material, and other deleterious materials.

Crushed screenings must be substantially free from adherent coatings. The presence of a thin, firmly adhering film of weathered rock is not considered as coating unless it exists on more than 50 percent of the surface area of any size between successive laboratory sieves.

The portion of aggregate for bituminous surface treatment retained on the U.S. No. 4 sieve must not contain more than 0.1 percent deleterious materials by weight.

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9-03.5 AGGREGATES FOR ASPHALT TREATED BASE (ATB)

9-03.5(1) GENERAL REQUIREMENTS

Aggregates for asphalt treated base must be manufactured from ledge rock, talus, or gravel, as specified in Section 2-01 that meet the following test requirements:

Test	Requirements
Los Angeles Wear, 500 Rev.	30% max.
Degradation Factor, Wearing Course	15 min.

9-03.5(2) GRADING

Aggregates for asphalt treated base must meet the following requirements for grading:

Sieve Size	Percent Passing
2" square	100
1/2" square	56-100
U.S. No. 4	32-72
U.S. No. 10	22-57
U.S. No. 40	8-32
U.S. No. 200	2.0-9.0

9-03.5(3) TEST REQUIREMENTS

When the aggregates are combined within the limits specified in Section 9-03.5(2) and mixed with the designated grade of asphalt, the mixture must be capable of meeting the following test values:

Test	Requirements
% of Theoretical Maximum Specific Gravity (G_{MM}) (approximate)	93 @ 100 gyrations
Tensile Strength Ratio Test	50 min. / no visual damage

The sand equivalent value of the Mineral Aggregate for asphalt treated base must not be less than 35.

9-03.6 AGGREGATES FOR HOT MIX ASPHALT (HMA)

9-03.6(1) GENERAL REQUIREMENTS

Aggregates for HMA must be manufactured from ledge rock, talus, or gravel, as specified in Section 3-01, and must meet the following test requirements:

Test	Requirements
Los Angeles Wear, 500 Rev.	30% max.
Degradation Factor, Wearing Course	30 min.
Degradation Factor, Other Courses	20 min.

The aggregate must be uniform in quality, and must be free from wood, roots, bark, extraneous materials, and adherent coatings. The presence of a thin, firmly adhering film of weathered rock is not considered as coating unless it exists on more than 50 percent of the surface area of the aggregate retained on any size sieve.

Aggregate removed from deposits contaminated with various types of wood waste must be washed, processed, selected, or otherwise treated to remove sufficient wood waste so that the oven dried material retained on a U.S. No. 4 sieve does not contain more than 0.1 percent by weight of material with a specific gravity less than 1.0.

9-03.6(2) HMA TEST REQUIREMENTS

Aggregate for HMA must meet the following test requirements:

1. The aggregate must meet the flat and elongated shape requirements, measured as percent by weight of flat-elongated per ASTM D 4791. The percent must not exceed 10 percent and the ratio must be 5:1.

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2. The fracture requirements for the combined coarse aggregate in the table below must apply to the aggregate retained on each sieve U.S. No. 4 and larger when tested per AASHTO T 335:

"Design ESALs" (Millions)	No. Fractured Faces	% Fracture
<10	1	90
≥10	2	90

3. The uncompacted void content for the combined fine aggregate is tested per Test Method for AASHTO T 304, Method A. The minimum voids must be 45 percent.

4. The minimum sand equivalent must be 45.

During verification by the Laboratory, the mix design must produce HMA mixtures that when combined within the limits specified in Section 9-03.6(6). and mixed with the designated grade of asphalt binder, using the Superpave gyratory compactor per AASHTO T 312, and at the required gyrations for N design with the following properties:

	HMA Class							
	3/8 Inch		1/2 Inch		3/4 Inch		1 Inch	
HMA Mix Criteria	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**
Voids in Mineral Aggregate (VMA), %	15.0	--	14.0	--	13.0	--	12.0	--
ESALs (Millions)	**Voids Filled with Asphalt (VFA), %**							
< 0.3	70	80	70	80	70	80	67	80
0.3 to < 3	65	78	65	78	65	78	65	78
3 to < 10	73	76	65	75	65	75	65	75
10 to < 30	73	76	65	75	65	75	65	75
≥ 30	73	76	65	75	65	75	65	75
Dust / Asphalt Ratio	0.6	1.6	0.6	1.6	0.6	1.6	0.6	1.6
Tensile Strength Ratio	80 min. / no visible damage							
	ESALs (Millions)		**$N_{Initial}$**		**N_{Design}**		**$N_{Maximum}$**	
% G_{mm}	< 0.3		≤ 91.5		96.0		≤ 98.0	
	0.3 to < 3		≤ 90.5		96.0		≤ 98.0	
	≥ 3		≤ 89.0		96.0		≤ 98.0	
Gyratory Compaction (number of gyrations)	< 0.3		6		50		75	
	0.3 to < 3		7		75		115	
	3 to < 30		8		100		160	
	≥ 30		9		125		205	

During the production run of each approved JMF, the HMA will not be evaluated for VMA or VFA for quality assurance purposes. The fine aggregate angularity, flat and elongated particles, and fracture and sand equivalent requirements apply at the time of HMA production.

9-03.6(3) GRADING

9-03.6(3)A GRADATION

The Contractor may furnish aggregates for use on the same Contract from a single stockpile or from multiple stockpiles, as long as all aggregate is from the same source. The gradation of the aggregates, including any use of RAP, mineral filler, and blending sand, must be such that the completed mixture complies in all respects with Section 9-03.6(6).

Acceptance of the aggregate gradation will be based on samples taken from the final mix.

9-03.6(3)B RECYCLED ASPHALT PAVEMENT (RAP)

Asphalt concrete planings or old asphalt concrete utilized in the production of asphalt concrete must be sized before entering the mixer so that a uniform and thoroughly mixed asphalt concrete is produced in the mixer. If there is evidence of the old asphalt concrete not breaking down during the heating and mixing of the asphalt concrete, the Engineer may elect to change the maximum size entering the mixer. No contamination by deleterious materials will be allowed in the old asphalt concrete used.

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RAP may be added to the mix in the proportions specified in Section 5-04.2(1). The Contractor is responsible for gradation for the new aggregate used in the production of the asphalt concrete, and when combined with recycled material, the combined Material must comply with the gradation Specifications of Sections 9-03.6(6) and 9-03.6(7) for the specified class of HMA, unless the Contract specifies otherwise. The new aggregate must comply with the general Specifications in Section 9-03.6(1) and must comply with the appropriate fracture Specifications in Section 9-03.6(2) item 2 for coarse aggregate, and sand equivalent requirements specified in Sections 9-03.6(2) and 9-03.6(4) for blending sand.

9-03.6(3)C RECYCLED PORTLAND CEMENT CONCRETE RUBBLE AND STEEL FURNACE SLAG

Recycled Portland cement concrete rubble and/or steel furnace slag may be blended with virgin aggregates in the proportions specified in Section 9-03.16(1)E. The proportion of each of these Materials in the mix will be considered independently and not cumulatively. The final mix must comply with the Specifications in Section 9-03.6. Recycled Portland cement concrete rubble and steel furnace slag must be as specified in Sections 9-03.16(1)B and 9-03.16(1)D respectively.

The Contractor must indicate on the mix design submittal the percentage of each in the proposed mix design.

9-03.6(4) BLENDING SAND

Blending sand must be clean, hard, sound Material, either naturally occurring sand or crusher fines, and must be material which will readily accept an asphalt coating. The exact grading requirements for the blending sand must be such that, when it is mixed with an aggregate, the combined product must comply with Section 9-03.6(6) for the specified class of HMA. Blending sand must have a sand equivalent value of at least 30.

9-03.6(5) MINERAL FILLER

Mineral filler, when used in HMA, must conform to the requirements of AASHTO M 17.

9-03.6(6) HMA PROPORTIONS OF MATERIALS

The Materials of which HMA is composed must consist of such sizes, grading, and quantity that when proportioned and mixed together, produce a well graded mixture complying with the requirements that follow.

The Contractor's HMA mix design must be between the following control points:

HMA Aggregate Gradation Control Points				
	Percent Passing			
Sieve Size	HMA Class 3/8 Inch	HMA Class 1/2 Inch	HMA Class 3/4 Inch	HMA Class 1 Inch
1 1/2" square				100
1" square			100	90-100
3/4" square		100	90-100	90 maximum
1/2" square	100	90-100	90 maximum	
3/8" square	90-100	90 maximum		
U.S. No. 4	90 maximum			
U.S. No. 8	3-67	28-58	23-49	19-45
U.S. No. 200	2.0-7.0	2.0-7.0	2.0-7.0	1.0-7.0

The aggregate percentage refers to completed dry mix, and includes mineral filler when used.

9-03.6(7) HMA TOLERANCES AND ADJUSTMENTS

After the Job Mix Formula (JMF) is determined as specified in Section 5-04.3(6), the constituents of the mixture at the time of acceptance must conform to the following tolerances:

Aggregate, Percent Passing[1]	Tolerance
1", 3/4", 1/2" and 3/8" sieves	± 6% each sieve
U.S. No. 4 sieve	± 6%
U.S. No. 8 sieve	± 6%
U.S. No. 200 sieve	± 2.0%
Asphalt binder	± 0.5%
VMA[2]	1% below minimum value in Section 9-03.6(2)
VFA[2]	Min. and Max. as listed in Section 9-03.6(2)

Aggregate, Percent Passing[1]	Tolerance
V_a[3]	2.5% minimum and 5.5% maximum

NOTES:

1. The tolerance limit for aggregate must not exceed the limits of the control points specified in Section 9-03.6(6), except the tolerance limits for sieves designated as 100 percent passing must be 99 to 100. The tolerance limits on sieves must only apply to sieves with control points.
2. The tolerances for VMA and VFA are for mix verification only.
3. The tolerance for V_a is for mix verification and acceptance.

Adjustments beyond the limits below require approval by the Engineer and require the development of a new mix design.

a. Aggregates: The Engineer may approve the Contractor's written request to adjust the JMF. The maximum adjustment from the approved mix design must be 2 percent for the aggregate retained on the U.S. No. 8 sieve and above, 1 percent for aggregate passing the U.S. No. 8 sieve, and 0.5 percent for the aggregate passing the U.S. No. 200 sieve. These field adjustments to the JMF will only be considered if the changes produce Material of equal or better quality. The adjusted JMF and allowed tolerances must be within the range of the control points specified in Section 9-03.6(7). V_a of the adjusted JMF must remain within the limits shown above.

b. Asphalt Binder Content: The Engineer may order the Contractor, or may approve the Contractor's written request, to change the JMF asphalt binder content a maximum of 0.3 percent from the approved mix design.

9-03.7 AGGREGATES FOR BALLAST AND CRUSHED SURFACING

9-03.7(1) BALLAST

Roadway ballast must be manufactured from ledge rock or talus obtained from sources approved by the Engineer. Roadway ballast must be as specified in Section 9-03.14 for Mineral Aggregate Type 14.

That portion of roadway ballast retained on a 1/4 inch square sieve must not contain more than 0.2 percent wood waste.

The Material from which ballast is to be manufactured must have a Degradation Value not less than 15 when tested per WSDOT Test Method T 113.

Mineral aggregate type 1 or type 2 may be substituted for roadway ballast in lieu of Mineral Aggregate Type 14 when specified in the Contract.

Ballast must be a crushed Material with no naturally occurring surfaces. The term ballast must apply to Material retained on each sieve size U.S. No. 4 and above if that sieve retains more than 5 percent of the total sample.

9-03.7(2) SHOULDER BALLAST

Shoulder ballast must be as specified in Section 9-03.7(1) for ballast except the gradation must be as specified in Section 9-03.14 for Mineral Aggregate Type 13. The sand equivalent and dust ratio requirements do not apply; however, the L. A. Abrasion and Degradation Factor requirements do apply.

9-03.7(3) CRUSHED ROCK

Except as otherwise specified in the remainder of this Section, crushed rock must be manufactured from ledge rock or talus and must comply with the grading, sand equivalent, and L. A. Abrasion Specifications of Section 9-03.14 for Mineral Aggregate Type 1, Type 2, and Type 3.

Crushed rock must have a Degradation Value of not less than 25 when tested per WSDOT Test Method T 113.

Crushed rock must be a totally crushed Material with no naturally occurring faces and must apply to Material retained on each sieve size No. 10 and above if that sieve retains more than 5 percent of the total sample. Crushed rock material retained on a No. 4 sieve must contain no more than 0.15 percent by weight of wood waste.

See Section 4-04.2 for possible use of other Mineral Aggregates in lieu of Crushed Rock, Mineral Aggregates Type 1 and Type 2.

9-03.7(4) MAINTENANCE ROCK

Maintenance rock must be as specified in Section 9-03.7(3) for crushed surfacing top course except that it must comply with the grading Specifications for Mineral Aggregate Type 3 in Section 9-03.14.

9-03.7(5) SAND FILLER

Sand filler must be natural deposit angular grains, Mineral Aggregate Type 11 be as specified in Section 9-03.14.

9-03.8 AGGREGATE FOR GRAVEL BASE

Gravel base must be as specified in Section 9-03.10(2) for Mineral Aggregate Type 17.

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9-03.9 CRUSHED GRAVEL

Crushed gravel must be manufactured from mechanically crushed clean, washed gravel, and must comply with the grading, sand equivalent, and L. A. Abrasion Specifications of Section 9-03.14 for Mineral Aggregate Types 1G, 2G, and 21 through 24.

Mineral Aggregate Type	Number of Fractured Surfaces	Minimum Percent Required
1G	2 or more	90%
2G	2 or more	90%
21	1 or more	75%
22	2 or more	90%
23	1 or more	75%
24	2 or more	95%

These fracture requirements apply to aggregates retained on all sieves sized U.S. No. 4 and larger, retaining at least 5 percent of total Mineral Aggregate weight.

See Section 4-04.2 for possible use of other Mineral Aggregates in lieu of Crushed Gravel, Mineral Aggregates.

Crushed gravel and crushed rock must be substantially free from adherent coatings. The presence of a thin, firmly adhering film of weathered rock is not considered as coating unless it exists on more than 50 percent of the surface area of any size between successive laboratory sieves.

The combined portion of Mineral Aggregate retained on the U.S No. 4 sieve must not contain more than 0.1 percent wood waste by weight. The portion of Material passing a U.S. No. 10 sieve must not have wood waste that results in more than 250 parts per million of organic matter by calorimetric tests when tested. The color must be measured after the sample has been in the test solution for 1 hour.

Mineral Aggregate Types 1G or 2G must not be used as base course materials for asphalt concrete pavement.

9-03.10 PIT RUN SAND, WASHED SAND, AND GRAVEL BACKFILL

Gravel backfill must consist of crushed, partially crushed, or naturally occurring granular Material corresponding to the Type of Mineral Aggregate specified in the Contract.

9-03.10(1) GRAVEL BACKFILL FOR FOUNDATIONS

9-03.10(1)A CLASS A BACKFILL

Class A gravel backfill for foundations must be as specified in Sections 9-03.7 and 9-03.14 for Type 2 or Type 14 Mineral Aggregates. When not specified in the Contract, Class A gravel backfill must be Mineral Aggregate Type 2.

9-03.10(1)B CLASS B BACKFILL

Class B gravel backfill for foundations must be Mineral Aggregates Type 17 or Type 27 per Section 9-03.14.

9-03.10(2) GRAVEL BACKFILL FOR WALLS

Gravel backfill for walls must consist of free draining sand and gravel from naturally occurring or screened sources; have such characteristics of size and shape that it readily compacts; and be as specified in Section 9-03.14 for Mineral Aggregate Type 17.

The combined portion of Material retained on a U.S. No. 4 sieve must contain no more than 0.20 percent by weight of wood waste.

Gravel backfill for mechanically stabilized earth walls must be as specified in the Contract.

9-03.10(3) GRAVEL AND SAND BACKFILL FOR PIPE BEDDING

The Contract specified class of Sewer and Storm Drain pipe bedding must comply with both Standard Plan 285 and Section 7-17.3(1), and must be Mineral Aggregate Type 9 and Type 22 as specified in this Section and Section 9-03.14.

Water Main distribution pipe bedding Material must be as specified in Section 9-03.14 for Mineral Aggregates Type 6 or Type 7 and Section 9-03.1(2). Water Main transmission pipe bedding must be as specified in Section 9-03.14 for Mineral Aggregate Type 9 as shown on Standard Plan 350 and this Section. The bedding Class specified on the Drawings must be as shown on Standard Plan 350.

Pea gravel bedding, Mineral Aggregate Type 9, must consist of screened sand, gravel, or other inert Materials, or combinations thereof, from sources approved by the Engineer, and must have hard, strong, durable particles free from adherent coatings. The Material must be washed thoroughly to remove clay, loam, alkali, organic matter, or other deleterious substances. The amount of deleterious substances remaining in the washed pea gravel must not exceed values specified in Section 9-03.1(2)B.

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Crushed gravel bedding, Mineral Aggregate Type 22 must be manufactured from screened crushed gravel. The finished product must be clean, uniform in quality, and free from wood, bark, roots, and other deleterious materials. The crushed screenings must be substantially free from adherent coatings. The presence of a thin, firmly adhering film of weathered rock is not considered as coating unless it exists on more than 50 percent of the surface area of any size between successive laboratory sieves. The portion of Mineral Aggregate Type 22 retained on a U.S. No. 4 sieve must not contain more than 0.1 percent deleterious materials by weight.

9-03.10(4) GRAVEL BACKFILL FOR DRAINS

Gravel backfill for drains must comply with the requirements for Mineral Aggregate Type 26 in Section 9-03.10(6).

9-03.10(5) PIT RUN SAND AND GRAVEL

Pit run sand and gravel must consist of free draining granular materials obtained from naturally occurring deposits or manufactured from screened gravel.

Pit run sand must be as specified in Section 9-03.14 for Mineral Aggregate Type 10.

Pit run sandy gravel must be as specified in Section 9-03.14 for Mineral Aggregate Type 15.

9-03.10(6) WASHED SAND AND GRAVEL

Washed sand and gravel must be as specified in Section 9-03.14 for Mineral Aggregate Types 4, 5, 6, 7, 26, and 28, whichever is specified in the Contract.

Washed sand and gravel must consist of screened sand, gravel or other inert Materials, or combinations thereof, from sources approved by the Engineer, having hard, durable particles free from adherent coatings. The Materials must be washed thoroughly to remove clay, loam, alkali, organic matter, or other deleterious substances. The amount of deleterious substances in the washed sand or gravel must not exceed the values specified in Section 9-03.1(2)B for Mineral Aggregate Types 6, 7, 26, and 28 and Section 9-03.1(3)B for Mineral Aggregate Types 4 and 5.

9-03.10(7) QUARRY RUN CRUSHED ROCK

Quarry run crushed rock must:

1. Be Mineral Aggregate Type 27 complying with the gradation, sand equivalent, dust ratio, and L.A. abrasion Specifications of Section 9-03.14.
2. Be 100 percent crushed.
3. Have a plasticity index of 4 maximum.
4. Be free of wood and organic matter.

Mineral Aggregate Type 27 may be used as specified in the Contract as a select fill. Also see Section 9-03.10(1)B.

9-03.11 BACKFILL FOR SAND DRAIN

9-03.11(1) SAND DRAIN BACKFILL

Sand drain backfill must conform to the following gradation, which does not correspond to a Mineral Aggregate Type in Section 9-03.14:

Sieve Size	Percent Passing
1/2" square	90-100
U.S. No. 4	58-100
U.S. No. 10	40-100
U.S. No. 50	3-30
U.S. No. 100	0-4
U.S. No. 200	0-3.0

9-03.11(2) SAND DRAINAGE BLANKET

Aggregate for the sand drainage blanket must consist of granular material, free from wood and other extraneous material, and must comply with the following grading requirements, which does not correspond to a Mineral Aggregate Type in Section 9-03.14:

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Sieve Size	Percent Passing
2 1/2" square	90-100
U.S. No. 4	23-100

The portion passing the U.S. No. 4 sieve must comply with the following grading requirements:

Sieve Size	Percent Passing
U.S. No. 10	50-100
U.S. No. 50	0-30
U.S. No. 100	0-7.0
U.S. No. 200	0-3.0

That portion of backfill for sand drains and sand drainage blanket retained on the U.S. No. 4 sieve must contain no more than 0.05 percent by weight of wood waste.

9-03.12 GRAVEL BORROW

Unless otherwise specified in the Contract, gravel borrow must be as specified in Section 9-03.10(2) and the grading Specifications in Section 9-03.14 for Mineral Aggregate Type 17.

If requested by the Contractor, the screen size may be increased if it is determined by the Engineer that larger size aggregate will be acceptable for the specified backfilling or embankment construction.

9-03.13 TEST METHODS FOR AGGREGATES

Material properties in these Specifications must be determined using the following test methods:

Title	Test Method
Sampling of Aggregates	AASHTO T 2
Organic Impurities in Fine Aggregate for Concrete	AASHTO T 21
Clay Lumps and Friable Particles in Aggregates	AASHTO T 112
Resistance to Degradation of Small-Size Coarse Aggregates by Abrasion and Impact in the Los Angeles Machine	AASHTO T 96
Material Finer than U.S. No. 200 Sieve in Aggregates	AASHTO T 11
Percent Fracture in Coarse Aggregates	AASHTO T 335
Sieve Analysis of Fine and Coarse Aggregates	AASHTO T 27
Method of Test for Determination of Degradation Value	WSDOT T 113
Lightweight Pieces in Aggregates	AASHTO T 113
Flat and Elongated Particles in Coarse Aggregate	ASTM D 4791
Sand Equivalent	AASHTO T 176
Determination of Length Change of Concrete Due to Alkali-Silica Reaction	ASTM C 1293
Petrographic Examination of Aggregates for Concrete	ASTM C 295
Determining the Potential Alkali-Silica Reactivity of Combination of Cementitious Materials and Aggregate (Accelerated Mortar Bar Method)	ASTM C 1567
Specific Gravity and Absorption of Coarse Aggregate	AASHTO T 85
Specific Gravity and Absorption of Fine Aggregate	AASHTO T 84
Determining the Liquid Limit of Soils	AASHTO T 89
Determining the Plastic Limit and Plasticity Index of Soils	AASHTO T 90
Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate	AASHTO T 104
Method of Testing Stone for Expansive Breakdown on Soaking in Ethylene Glycol	CRD-C 148
Resistance of Compacted Hot Mix Asphalt (HMA) to Moisture Induced Damage	AASHTO T 283
Uncompacted Void Content of Fine Aggregate	AASHTO T 304
Preparing and Determining the Density of the Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor	AASHTO T 312

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Title	Test Method
Theoretical Maximum Specific Gravity and Density of Hot Mix Asphalt (HMA)	AASHTO T 209
Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method	AASHTO T 308
Standard Test Method for Potential Expansion of Aggregates from Hydration Reactions	ASTM D 4792

9-03.14 MINERAL AGGREGATE CHART

Commonly used Mineral Aggregates are found in the following Mineral Aggregate Chart. The "No." indicated at the top of column 1 is commonly referred to as Mineral Aggregate "Type" number.

Gradation requirements for Mineral Aggregates Type 6 and Type 7 indicated on the following Mineral Aggregate Chart require additional sieves. These Mineral Aggregate Types are noted with a "*" in the first column labeled "No.". See the specified "Standard Specification Section" for these noted additional required sieves.

Mineral Aggregates with recycled Material will be referred to or will be specified as Mineral Aggregates (type) R; that is the numerical type followed by the R. If a Mineral Aggregate is specified in the Contract as a type R, it must contain a minimum of 75 percent of the maximum allowable recycled Material as specified in Section 9-03.16 and will be considered a separate Bid Item per the Bid Form. Note that type 1R and type 2R must comply with the requirements of crushed gravel Mineral Aggregates Type 1G and Type 2G (Sections 9-03.9 and 9-03.16).

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Mineral Aggregate Chart

No.	Aggregate Type	Use	Standard Specification Section	Sieve Sizes Sieve Analysis-Percent Passing by Weight																Sand Equivalent (Min.)	Dust Ratio (Max.)	L.A. Abrasion (Max.) %
				200 (wet sieving)	50	40	10	8	6	4	3/8	1/2	5/8	3/4	1	1-1/4	1-1/2	2	2-1/2	3			
1.	3/4" Minus Crushed Rock	Top Course & Keystone	9-03.7(3)	0-10	--	8-24	--	--	--	46-66	--	--	--	100	--	--	--	--	--	--	40	--	35
1G.	3/4" Minus Crushed Gravel	Top Course & Keystone	9-03.9	0-10	--	8-24	--	--	--	46-66	--	--	--	100	--	--	--	--	--	--	40	--	35
2.	1-1/4" Minus Crushed Rock	Base Course	9-03.10(1)A	0-7.5	--	3-18	--	--	--	25-45	--	--	50-80	--	80-100	100	--	--	--	--	40	--	35
2G.	1-1/4" Minus Crushed Gravel	Base Course	9-03.9	0-7.5	--	3-18	--	--	--	25-45	--	--	50-80	--	80-100	100	--	--	--	--	40	--	35
3.	Maintenance Rock		9-03.7(3) 9-03.7(4)	0-7	--	10-25	--	--	--	45-66	--	90-100	100	--	--	--	--	--	--	--	40	--	35
4.	1-1/2" Washed Gravel	Drain Rock AASHTO #4	9-03.10(6)	0-0.5	--	--	--	--	--	--	0-5	--	--	0-15	20-55	--	90-100	100	--	--	--	--	35
5.	1" Washed Gravel	Drain Rock AASHTO #57	9-03.10(6)	0-0.5	0-1	--	--	0-5	--	0-10	--	25-60	--	--	95-100	--	100	--	--	--	--	--	35
6.	Washed Sand		9-03.10(6)	0-2.5	9-20	--	--	68-86	--	95-100	100	--	--	--	--	--	--	--	--	--	--	--	--
7.	Building Sand		9-03.10(6)	0-2.5	10-30	--	--	--	--	95-100	100	--	--	--	--	--	--	--	--	--	--	--	--
9.	3/8" Washed Gravel	Pipe Bedding AASHTO #8	9-03.10(3)	0-1	--	--	--	0-10	--	10-30	80-100	--	--	--	--	--	--	--	--	--	--	--	35
10.	Pit Run Sand	Backfill Embankment	9-03.10(5)	0-10	10-60	--	--	40-100	--	75-100	100	--	--	--	--	--	--	--	--	--	--	--	--
11.	Sand Filler		9-03.7(5)	0-15	--	15-40	40-75	--	--	80-100	100	--	--	--	--	--	--	--	--	--	--	--	--
13.	2-1/2" Crushed Rock	Shoulder Ballast	9-03.7(2)	0-1	--	--	--	--	--	0-5	--	--	--	40-80	--	--	--	65-100	100	--	--	--	40
14.	2-1/2" Minus Crushed Rock	Roadway Ballast	9-03.10(1)A	0-9	--	0-16	--	--	--	26-44	--	--	--	--	50-85	--	--	65-100	100	--	35	2/3	40
15.	Pit Run Sandy Gravel	Backfill Embankment	9-03.10(5)	0-10	--	--	--	--	--	19-38	--	--	--	100	--	--	--	--	--	--	--	--	30
17.	Bank Run Gravel	Selected Backfill	9-03.10	0-5	--	--	--	--	--	24-71	--	--	--	--	--	--	--	--	--	95-100	60	2/3	--
21.	1-1/2" Crushed Gravel		9-03.9	0-3	--	--	--	--	--	0-24	--	45-70	85-100	--	--	--	100	--	--	--	--	--	30
22.	3/4" Crushed Gravel	VCP, PVC & CMP Pipe Bedding	9-03.9 9-03.10(3)	0-3	--	--	--	--	--	0-24	--	45-100	--	100	--	--	--	--	--	--	--	--	--
23.	1/2" Minus Crushed Gravel	Cover Rock	9-03.9	2-12	--	--	40-75	--	--	63-100	--	100	--	--	--	--	--	--	--	--	--	--	30
24.	1/2" Minus Crushed Gravel	Chip Rock	9-03.9	0-3	--	0-5	0-10	--	0-20	25-85	90-100	100	--	--	--	--	--	--	--	--	--	--	30
26.	3/4" Washed Sandy Gravel	Filter Material	9-03.10(6)	0-1	3-12	--	--	20-50	--	28-56	--	--	--	100	--	--	--	--	--	--	--	--	35
27.	Quarry Run Crushed Rock	Select Fill	9-03.10(1)B	0-15	--	0-50	--	--	--	20-70	--	--	--	70-100	--	--	--	100	--	--	25	2/3	35
28.	3/4" Washed Gravel	Drain Rock AASHTO #67	9-03.10(6)	0-1	--	--	--	0-5	--	0-10	20-55	--	--	90-100	100	--	--	--	--	--	--	--	35

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9-03.15 ROCK FACING MATERIAL

Rock for constructing new rock facing must be large, broken pieces of igneous and metamorphic rock types. Each rock must be rectangular, intact, fracture free, of sound and durable material, resistant to weathering, and free of soft weathered material and seams of soft rock susceptible to deterioration.

The size categories for rock must be as follows:

Size	Approx. Weight	Min. Approx. Dimensions	Approx. Volume
One-man rock	200-400 lbs	12”	2 cf
Two-man rock	500-800 lbs	13”	4 cf
Three-man rock	900-1200 lbs	16”	6.6 cf
Four-man rock	1300-2000 lbs	18”	12.5 cf
Five-man rock	2000-4000 lbs	24”	18.5 cf
Six-man rock	4100-6000 lbs	30”	31 cf

Do not use rocks less than 1-1/2 cubic foot in volume.

The Contractor must provide the services of an ASTM or AASHTO accredited testing laboratory approved by the Engineer to sample the rock from the quarry source, ensuring that rock samples are representative of the rock anticipated for use on the project, and to perform the following laboratory tests:

Characteristic	Standard	Allowance
Specific Gravity	ASTM C 127	Minimum 2.65
Soundness	AASHTO T 104 (section 5.2.2)	Not greater than 5% loss (Na2SO4)
Absorption	ASTM C 127	Not greater than 2%
L. A. Abrasion	ASTM C 131	Maximum 20% loss @ 500 revolutions
Degradation	WSDOT T 113	Minimum 15

All rock to be delivered to and incorporated into the project where rock facing is over 6 feet high, must meet the minimum testing requirements noted above; the rock must be stockpiled in a separate pile at the quarry before delivery to the Project Site and must be protected from contamination with other, untested rock sources.

9-03.16 RECYCLED MATERIAL

9-03.16(1) GENERAL REQUIREMENTS

Recycled materials that are identified below may be used in lieu of, or blended uniformly with, naturally occurring materials for aggregates in the percentages shown in Section 9-03.16(1)E. The final blended product must comply with the requirements for the specified type of aggregate. In addition, each recycled material component included in a blended product, must comply with the specific requirements listed below. The Contractor must provide a certification that the recycled materials are in conformance with the Standard Specifications before delivery. The certification must include the percent by weight of each recycled material.

For recycled materials that are imported to the Job Site, the Contractor must certify that the recycled material is not a Washington State Dangerous Waste per the Dangerous Waste Regulations contained in WAC 173-303. Upon request of the Engineer, the Contractor must provide results of testing supporting the certification.

9-03.16(1)A RECYCLED HOT MIX ASPHALT

For aggregates incorporating recycled hot mix asphalt, the Contractor must verify the maximum bitumen content for the blended mix. The Contractor must use AASHTO T 308 (0.70 may be used as a calibration factor) and AASHTO T 329 or other tests approved by the Engineer to determine the total bitumen content.

9-03.16(1)B RECYCLED PORTLAND CEMENT CONCRETE RUBBLE

Portland cement concrete rubble to be recycled into construction aggregates must not have been painted or exposed to dangerous or hazardous substances. Steel reinforcing must be removed and the concrete rubble must be separated from other debris before processing.

Recycled Portland cement concrete rubble must not be used:

1. Where it will be exposed to the elements.
2. Where free drainage is required.

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3. As structural fill, including pavement base or subbase, where wet conditions exist or are anticipated to exist.
4. As a backfill or bedding material for cast iron, ductile iron, or steel Water Mains and their associated appurtenances.
5. As a backfill or bedding material for any other utility where it crosses within 3 feet, horizontally or vertically, of cast iron, ductile iron, or steel Water Mains and their associated appurtenances.

Recycled Portland cement concrete rubble used as base course, fill or bedding material may contain an aggregated maximum of 20 percent by weight of asphalt concrete, brick or porcelain rubble. If used as or included in coarse aggregate for Portland or hydraulic cement concrete, the recycled Portland cement concrete rubble must be free of asphalt concrete, brick or porcelain and must comply with the deleterious materials Specifications in Section 9-03.1(4)A. If used as an aggregate for hot mix asphalt, it must have no more than 5 percent by weight of asphalt concrete, brick or porcelain and must otherwise comply with the deleterious substances Specifications in Section 9-03.6(1).

9-03.16(1)C RECYCLED GLASS CULLET

Recycled glass cullet must be from stock composed primarily of glass food and beverage containers (soda-lime-silica) and must not contain medical, toxic, or hazardous materials. Unless otherwise stipulated in the Special Provisions, recycled glass cullet must not be placed in whole or in any blended product within 3 feet of any final graded surface.

The maximum debris level of the cullet must be 5 percent. Debris is defined as any deleterious material which impacts the performance of the engineered fill and includes all non-glass constituents of the glass feedstock. The percentage of debris in cullet must be quantified using the following visual method: Between 1 and 3 pounds of processed cullet must be placed in a flat pan or plate, 8 to 10 inches in diameter and 1 to 2 inches in depth. The percentage of debris must be estimated using American Geological Institute (AGI) Data Sheets 15.1 and 15.2, "Comparison Charts for Estimating Percentage Composition," 1982.

Total lead content testing must be performed quarterly by the product Supplier. Tests must include a minimum of 5 samples. Sample collection must be conducted according to ASTM D75. The mean of these tests must not exceed 80 ppm. Total lead content testing will be conducted according to EPA Method 3010/6010. All test results must be kept on file by the product Supplier.

9-03.16(1)D RECYCLED STEEL FURNACE SLAG

Recycled Steel Furnace Slag must consist of furnace or tap slag as a direct byproduct of a primary steel furnace and must not contain dust or sludge from electric arc emission controls systems. Ladle slag, raker slag, synthetic slag, pit slag, clean out slag, or any other slag not produced in a primary steel furnace, must not be used.

Recycled Steel Furnace Slag aggregate must have an expansion less than 0.50 percent at 7 days when tested per ASTM D 4792. If expansion test results exceed 0.50 percent at 7 days, the Contractor must wet condition the stockpile for a period of 6 months at a minimum moisture content of 6 percent.

Testing for expansion must be conducted on samples at the rate of one each per 5,000 tons of material produced or once for every 6 months of production, whichever is more numerous. Test data and wet conditioning documentation must be retained by the producer and relevant test data or documentation must be submitted to the Engineer for all Material proposed for incorporation into the project.

Recycled steel furnace slag must not be used:

1. Where it will be exposed to the elements.
2. Where free drainage is required.
3. As pavement base or subbase, where wet conditions exist or are anticipated to exist.
4. As structural fill.
5. As an aggregate for Portland cement concrete.

The Contractor must provide to the Engineer the steel furnace slag blends that will be used in the final product before use. No recycled steel furnace slag must be incorporated into the project without prior approval of the Engineer.

9-03.16(1)E ALLOWABLE RECYCLED MATERIAL CONTENT

The maximum percent by weight of recycled materials that may be used to replace naturally occurring aggregates is shown in the following table:

Type	Material	Specification	Maximum Allowable Percent of Recycled Material by Weight			
			Hot Mix Asphalt	Concrete Rubble	Recycled Glass Cullet	Steel Furnace Slag
	Fine Aggregate for Portland Cement Concrete	9-03.1(2)	0	0	0	0

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Type	Material	Specification	Maximum Allowable Percent of Recycled Material by Weight			
			Hot Mix Asphalt	Concrete Rubble	Recycled Glass Cullet	Steel Furnace Slag
	Coarse Aggregate for Portland Cement Concrete	9-03.1(3)	0	See 9-03.1(3)E	0	0
	Bituminous Surface Treatment Aggregate	9-03.4	0	0	0	0
	Aggregate for Asphalt Treated Base	9-03.5	See 5-04.2	50	0	0
	Aggregates for Hot Mix Asphalt	9-03.6	See 5-04.2	50	0	20
1.	3/4" Minus Crushed Rock	9-03.7(3)	0	0	15	20
1G.	3/4" Minus Crushed Gravel	9-03.9	20	100	15	20
2.	1-1/4" Minus Crushed Rock	9-03.10(1)A	0	0	15	20
2G.	1-1/4" Minus Crushed Gravel	9-03.9	20	100	15	20
3.	Maintenance Rock	9-03.7(3) 9-03.7(4)	20	100	15	20
4.	1-1/2" Washed Gravel	9-03.10(6)	0	0	0	0
5.	1" Washed Gravel	9-03.10(6)	0	0	0	0
6.	Washed Sand	9-03.10(6)	0	0	0	0
7.	Building Sand	9-03.10(6)	0	0	0	0
9.	3/8" Washed Gravel	9-03.10(3)	0	0	0	0
10.	Pit Run Sand	9-03.10(5)	0	0	0	0
11.	Sand Filler	9-03.7(5)	0	0	0	0
13.	2-1/2" Minus Crushed Rock	9-03.7(2)	20	100	15	20
14.	2-1/2" Crushed Rock	9-03.10(1)A	20	100	15	20
15.	Pit Run Sandy Gravel	9-03.10(5)	20	100	100	20
17.	Bank Run Gravel	9-03.12	20	100	100	20
21.	1-1/2" Crushed Gravel	9-03.9	0	0	15	0
22.	3/4" Crushed Gravel	9-03.9 9-03.10(3)	0	0	100	0
23.	1/2" Minus Crushed Gravel	9-03.9	20	100	15	20
24.	1/2" Minus Crushed Gravel	9-03.9	0	0	0	0
26.	3/4" Washed Sandy Gravel	9-03.10(4)	0	0	100	0
27.	Quarry Run Crushed Rock	9-03.10(7) 9-03.10(1)B	0	0	100	20
28.	3/4" Washed Gravel	9-03.10(6)	0	0	0	0

None of the values presented in this table override any provision restricting the use of recycled materials included elsewhere in these Specifications.

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SECTION 9-04 JOINT AND CRACK SEALING MATERIALS

9-04.1 PREMOLDED JOINT FILLERS

9-04.1(1) FILLER FOR CONTRACTION JOINTS IN CEMENT CONCRETE PAVEMENT

Premolded joint filler for use in cement concrete transverse and longitudinal contraction joints must consist of a suitable asphalt mastic encased in asphalt saturated paper or asphalt saturated felt. It must be sufficiently rigid for easy installation in summer months and not too brittle for handling in cool weather. It must meet the following test requirements:

When a strip 2 inches wide and 24 inches long is freely supported 2 inches from each end and maintained at a temperature of 70°F, it must support a weight of 100 grams placed at the center of the strip without deflecting downward from a horizontal position more than 2 inches within a period of 5 minutes.

The thickness and width of joint filler must be as shown in the Standard Plans unless the Contract specifies otherwise. Where no premolded joint filler thickness is indicated, the premolded filler thickness must be 3/8 inch.

9-04.1(2) FILLER FOR THROUGH (EXPANSION) JOINTS IN CEMENT CONCRETE PAVEMENT

Premolded joint filler for through (expansion) and isolation joint applications must conform to the Specifications for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction, AASHTO M 213, except the requirement for water absorption is not applicable, or ASTM D 7174 Specifications for Preformed Closed-Cell Polyolefin Expansion Joint Fillers for Concrete Paving and Structural Construction. The thickness and width of premolded joint filler for through (expansion) joints must be as indicated on the Standard Plans unless otherwise specified in the Contract. Where no premolded filler thickness is indicated, the thickness must be 3/4 inch.

9-04.1(3) ELASTOMERIC EXPANSION JOINT SEALS

Premolded elastomeric expansion joint seals must conform to AASHTO M 220 and must be formed by an extrusion process with uniform dimensions and smooth exterior surfaces. The cross-section of the seal must be shaped to allow adequate compressed width of the seal, as approved by the Engineer.

9-04.2 JOINT SEALANTS

9-04.2(1) HOT POURED JOINT SEALANTS

Hot poured joint sealants must comply with AASHTO M 324 Type IV, except that the Cone Penetration at 25 °C must be 130 max. Hot poured joint sealants must be sampled per ASTM D 5167 and tested per ASTM D 5329. The hot poured joint sealant must have a minimum Cleveland Open Cup Flash Point of 205 °C per AASHTO T 48.

9-04.2(2) POURED RUBBER JOINT SEALER

The physical properties of the joint sealer, when mixed per the manufacturer's recommendations, must be as follows:

	Physical Property	Physical Property When Mixed
1	Color	Gray or black
2	Viscosity[1]	Pourable and self-leveling at 50 °F
3	Application Life[1]	Not less than 3 hours at 72 °F and 50% relative humidity
4	Set to Touch	Not more than 24 hours at 72 °F and 50% relative humidity
5	Curing Time	Not more than 96 hours at 72 °F and 50% relative humidity
6	Non Volatile Content	Not less than 92%
7	Hardness Rating (Durometer: Shore A)	5-35
8	Resiliency	Not less than 80%
9	Bond test methods must be per WSDOT Test Method No. 412A	

NOTE:

1. Viscosity and application life may be waived providing the Material is mixed and placed by a pump and mixer approved by the Engineer, or if the Contract requires fast cure.

Suitable primer, if required by the manufacturer, must be furnished with each joint sealer. The primer must be suitable for brush or spray application at 50°F or higher and must cure sufficiently at 50°F to pour the joint within 24 hours. It must be considered as an integral part of the sealer system. Any failure of the sealer in the test described here, attributable to the primer, must be grounds for rejection of the sealer.

Acceptance of joint sealing compound for use on a project will be on the basis of Laboratory tests of samples representative of each batch of Material to be used on the job. A period of at least two weeks must be allowed for completion of these tests. Each container of the compound must be clearly identified as to manufacturer and batch number.

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9-04.2(3) POURED JOINT SEALER FOR WALKWAYS

Poured joint sealer used to seal sawed joints in sidewalks, stairs, plazas, and other walkways must be a polyurethane sealer conforming to Federal Specification TT S 00227E Type I (self-leveling) Class A or Type II (non-sag) Class A.

9-04.3 MORTAR AND NON SHRINK CEMENT SAND GROUT

9-04.3(1) JOINT MORTAR

Mortar for hand mortared joints must be as specified in Section 9-20.4(3) and consist of 1 part Portland cement, 3 parts fine sand, and sufficient water to allow proper workability.

Cement must conform to AASHTO M 85, Type I or Type II.

Sand must conform to AASHTO M 45.

Water must be as specified in Section 9-25.1.

The mortar mix must be approved by the Engineer before use.

9-04.3(2) NON SHRINK CEMENT SAND GROUT

9-04.3(2)A GENERAL

Before placing the grout, the contact surface must be thoroughly cleaned, roughened, and wetted with water. The grout must be covered with burlap sacks after the initial concrete set, promptly wetted, and maintained continuously moist until the required strength is obtained.

9-04.3(2)B GROUT FOR ANCHOR BOLTS, BRIDGE BEARINGS, AND DRAINAGE STRUCTURE

Non shrink cement sand grout used for grouting anchor bolts and bridge bearings, curb section to pavement anchors, and for use in drainage Structures except pipe connections, must be as specified in Section 9-20.3(2) grout type 2 for non-shrink applications.

9-04.3(2)C GROUT FOR PIPE CONNECTIONS

Grout for pipe connections to maintenance hole, catch basins, inlets, and similar utility appurtenances, and installing tees must comply with Section 9-20.4. Mix grout to a damp packing or ramming consistency.

9-04.3(2)D GROUT TYPE 1 FOR POST-TENSIONING APPLICATIONS

Grout type 1 for post-tensioning applications must be as specified in Section 9-20.3(1).

9-04.3(2)E GROUT FOR POLES AND PEDESTALS

Grout for grouting under poles and pedestals, and similar uses must comply with Section 9-20.3(2).

9-04.4 RUBBER GASKETS

9-04.4(1) RUBBER GASKETS FOR CONCRETE PIPES AND PRECAST MAINTENANCE HOLES

Rubber gaskets for use in joints of concrete Culvert or storm Sewer pipe and precast maintenance hole sections must conform to ASTM C 443.

9-04.4(2) SEALS FOR VITRIFIED CLAY PIPE (COMPRESSION)

Compression seals for vitrified clay pipe must conform to ASTM C 425. Each load of pipe delivered to the Job Site must be accompanied by a certificate of compliance stating that the compression seals conform to ASTM C 425 and showing test results of the lot from which the load of pipe was chosen.

Before shipment of pipe, the manufacturer must submit Shop Drawings illustrating the proposed joint sealing system and results of testing required by ASTM C 425. The Engineer may require that testing be performed in his presence before acceptance of any joint sealing system. Pipe must not be shipped without receiving the Engineer's approval of the jointing system.

9-04.4(3) SEALS FOR VITRIFIED CLAY PIPE (FLEXIBLE COUPLINGS)

Flexible couplings must comply with ASTM C 1173, Type B, including Figure 2 and Table 3. Before use, a catalogue cut and manufacturer's certification stating that the flexible coupling conform to this Specification must be submitted to the Engineer. This submittal must be made separately for every size and configuration of coupling to be used.

9-04.4(4) RUBBER GASKETS FOR ALUMINUM OR STEEL CULVERT OR STORM SEWER PIPE

Gaskets for use with metal Culvert or storm Sewer pipe must be continuous closed cell, synthetic expanded rubber gaskets per ASTM D 1056, Grade 2B3.

9-04.4(5) RUBBER GASKETS FOR ALUMINUM OR STEEL DRAIN PIPE

Gaskets for metal drain pipe must be self-adhering, butyl based scrim supported type. When specified, the gaskets must be as described in the Standard.

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9-04.4(6) PROTECTION AND STORAGE

Rubber gasket Material must be stored in a clean, cool place, protected from contaminants. They must be protected from direct sunlight at all times except during actual installation. Pipes with gaskets affixed must be installed in the line within 28 Days of date of delivery from the manufacturer. Rubber gaskets found on-site more than 28 Days after delivery from the manufacturer will be rejected. The Contractor must submit an invoice from the manufacturer stating date of delivery.

9-04.5 FLEXIBLE PLASTIC GASKETS

The gasket Material must be produced from blends of refined hydrocarbon resins and plasticizing materials reinforced with inert mineral filler and must contain no solvents. It must not depend on oxidizing, evaporating, or chemical action for adhesive or cohesive strength. It must be supplied in extruded rope form of such cross-section and size as to adequately fill spaces between the precast sections.

The gasket Material must be protected by a suitable removable two piece wrapper so designed as to permit removing one half, longitudinally, without disturbing the other. Its composition and properties must conform to those set forth as follows:

Property	Test Method	Minimum	Maximum
Bitumen (Petroleum plastic content)	ASTM D 4	50	70
Ash inert Mineral Matter	AASHTO T 11	30	50
Penetration	ASTM D 217	--	--
32 °F (300gm) 60 sec	--	75	--
77 °F (150gm) 5 sec	--	50	120
115 °F (150gm) 5 sec	--	--	150
Softening Point	ASTM D 36	320 °F	--
Specific Gravity at 77 °F	ASTM D 71	1.20	1.35
Weight per gallon, lb	--	10.0	11.3
Ductility at 77 °F (cm)	ASTM D 113	5.0	--
Flash Point COC, °F	ASTM D 93	600	--
Fire Point COC, °F	ASTM D 92	625	--
Volatile Matter	ASTM D 6	--	2.0

9-04.6 EXPANDED POLYSTYRENE

Expanded polystyrene must be of a cellular molded type with a density of 1.5 ± 0.25 pounds per cubic foot.

9-04.7 EXPANDED RUBBER

Closed cell expanded rubber joint filler must conform to ASTM D 1056, Grade No. 2B3.

9-04.8 SOLVENT CEMENTS

Solvent Cements for PVC underdrain pipe must conform to ASTM D 2564.

9-04.9 CRACK SEALING RUBBERIZED ASPHALT

Rubberized asphalt for crack sealing asphalt concrete pavement must conform to AASHTO M 173 (ASTM D 1190) and have a COC flash point (AASHTO T 48) of 400 ^{0}F minimum. AASHTO M 173 (ASTM D 1190) is modified to delete the Bond Test requirement. AASHTO T 48 is modified to require careful agitation of the rubberized asphalt sample during testing to prevent local overheating.

SECTION 9-05 STORM DRAIN AND SANITARY SEWER STRUCTURES, CULVERTS, AND CONDUITS

9-05.1 ACCEPTANCE BY MANUFACTURER'S CERTIFICATION

Certain drainage materials may be accepted by the Engineer based on a manufacturer's certificate of compliance as specified in Section 1-06.3. These materials are as follows:

1. Metal drain and underdrain pipe.
2. PVC drain pipe and underdrain pipe.
3. Polypropylene pipe.
4. Corrugated Polyethylene pipe.
5. Metal Culvert, Storm Drain pipe, and pipe arch less than 30 inches in diameter.
6. Metal Culvert end sections.

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7. Corrugated metal structural plate pipe, pipe arch, and under passes.
8. Ductile iron pipe, Vitrified clay pipe compression seals.
9. Vitrified clay pipe flexible couplings.

9-05.2 CONCRETE PIPE

9-05.2(1) GENERAL

Concrete pipe must be manufactured by plants certified by the National Precast Concrete Association (NPCA). Concrete pipe must comply with ASTM C 14 Class 3 for pipe less than 12 inches in diameter; ASTM C 76 Class IV for 12 and 15-inch diameter pipe; and ASTM C 76 Class III wall B for pipe 18 inches in diameter and larger. Exceptions may be specified in the Contract.

Pipe ends of reinforced concrete pipe must be bell and spigot, modified bell and spigot, or tongue and groove unless otherwise specified in the Contract.

The identification of the minor axis of elliptical reinforcement must be in accordance with Section 7-17.2(1).

9-05.2(2) BASIS FOR ACCEPTANCE OF CONCRETE PIPE

9-05.2(2)A GENERAL

The basis for acceptance of non-reinforced concrete pipe must be based on load bearing tests, material tests including absorption tests per ASTM C 497, inspection of the product at all stages of fabrication, and a manufacturer's certificate of compliance indicating acceptable results of 3 edge bearing tests performed at the Supplier within the 90 Day period immediately preceding shipment of the pipe to the Project Site. Acceptance of the concrete pipe based on criteria other than these Specifications must require a submittal to the Engineer for approval at least 10 Working Days in advance of delivery, specifying the "other criteria" in detail and how it is equivalent or better than the Specifications; a manufacturer's certificate of compliance stating the pipe must perform as specified in these Specifications; allow for the Engineer to visit the Supplier and observe the "other criteria," and must allow the Engineer to have a minimum 3 pipe samples provided to a location specified by the Engineer for the Engineer to conduct tests.

The basis for acceptance of reinforced concrete pipe 60 inches in diameter and smaller must be determined by the results of the 3 edge bearing test per ASTM C 76 for the load to produce a 0.01-inch crack. Testing to the ultimate load will ordinarily not be required, except as necessary to obtain samples for making the absorption test. In lieu of broken pieces of pipe obtained as before mentioned, 4-inch diameter cores from pipe sections selected by the Engineer, must be furnished to the Engineer for performing the absorption test. Sections of pipe which have been tested to the 0.01-inch crack limit will ordinarily not be further load tested; and such sections, if found without defect, meeting or exceeding the required Specifications will be accepted for use on the project.

Permeability test must be conducted as follows:

The pipe selected by the Engineer for testing must be placed plumb with either end down on a soft rubber impermeable pad and filled with water. The pipe must be kept full of water for a period of 20 minutes. At the end of 20 minutes, the outer surface of the pipe will be examined for leaks.

A leak is defined as a moist spot as determined by the Engineer.

The Engineer may test up to 2 percent of all sections in a size and class of pipe; however, no less than 5 pipe sections of any pipe size and class will be tested.

Concrete pipe larger than 27 inches and no larger than 60 inches in diameter will be inspected by the Engineer during its manufacture and if found acceptable, the Engineer will issue a certification of inspection. Pipe delivered for the Work must be delivered with this certificate of inspection. The Contractor must notify the Engineer a minimum 15 Working Days before delivery to arrange for this inspection by the Engineer.

Acceptance of reinforced concrete pipe larger than 60-inch diameter will be based on inspection of the size and placement of the reinforcing steel, the absorption test and, at the option of the Engineer, on compressive strength tests of 4-inch diameter cores cut from the pipe, or on compressive strength of representative test cylinders cast with and cured with the pipe.

The Contractor must provide a manufacturer's certificate of compliance stating that the gaskets for all concrete pipe comply with ASTM C 443, and that the pipe age at shipment is as specified in Section 9-05.2(3). The Contractor must also submit actual Shop Drawings detailing pipe reinforcement and joint design.

9-05.2(2)B PIPE ACCEPTANCE REPORT (PAR)

Concrete pipe with diameters of 27 inches and smaller must be accompanied with a Pipe Acceptance Report when delivered to the Project Site. A PAR can be prepared either by WSDOT or by the SPU Materials Laboratory for a specific size and class of concrete pipe. Pipe delivered for incorporation into the Work must comply with all Contract requirements. Approval of the pipe upon delivery by the SPU Materials Laboratory does not constitute acceptance of the pipe at any time.

9-05.2(3) AGE AT SHIPMENT

Concrete pipe may be shipped when it complies with all specified test requirements. Unless it is tested and accepted at an earlier age, it must not be considered acceptable and ready for delivery to the Work sooner than 28 Days after manufacture

when made with Type II Portland cement, nor sooner than 7 Days after manufacture when made with Type III Portland cement.

9-05.2(4) BEVELED CONCRETE END SECTIONS

Beveled concrete end sections must be plain concrete conforming to AASHTO M 86 or reinforced concrete conforming to the applicable sections of AASHTO M 170 with the design requirements as listed in Table 2, Wall B, Circular Reinforcement in circular pipe, and WSDOT Standard Plan B-70.20.

9-05.2(5) CONCRETE PIPE JOINTS AND TESTING

9-05.2(5)A GENERAL

All concrete pipe must be joined with rubber gaskets. The joints and gasket material must comply with the Specifications of ASTM C 443 and ASTM C 1619. Gasket Material must be protected as specified in Section 9-04.4(6).

Both bell and spigot must be reinforced in all pipe 30 inches or larger in diameter per Section 8.2 of ASTM C 76.

9-05.2(5)B TESTING CONCRETE PIPE JOINTS

When a particular type of pipe joint design, joint material, and/or joining method has not previously been tested and approved by the Engineer, the proposed joint design must be tested in the presence of the Engineer as described in Section 9 of ASTM C 443 to qualify the design, joint material, and/or joining method for acceptance. As determined by the Engineer, additional testing may be required if subsequent field testing of installed pipe indicates difficulty in verifying acceptable joined pipe performance. The tests made under this Specification must be conducted at the Supplier and the Contractor must make available space and facilities to accommodate the testing in an efficient and workmanlike manner.

9-05.2(6) PERFORATED CONCRETE SUBSURFACE DRAIN PIPE

Perforated concrete subsurface drain pipe must comply with the Specifications of AASHTO M 175, Type I, except that the perforations must be approximately 1/2 inch in diameter. Strength requirements must be as shown in Table I of AASHTO M 86.

9-05.3 DUCTILE IRON PIPE

Ductile iron pipe must conform to ANSI A21.51 or AWWA C151 and must be double cement mortar lined, push on joint or mechanical joint. The ductile iron pipe must be Class 50 unless indicated otherwise in the Contract.

Joints for ductile iron pipe must be rubber gasketed conforming to the Specifications of ANSI A21.11 or AWWA C111.

Cast iron fittings may be used with ductile iron pipe with Engineer's approval. The Contractor must submit the proposed fittings a minimum of 10 Working Days in advance, including a manufacturer's certificate of compliance stating the fitting meets or exceeds the performance of the material specified.

Saddles fastened to pipe with external bands are not acceptable on any new ductile iron pipe installation as specified in 7-17.3(2)C3 item 3. All fittings must be the same material as the pipe being connected.

9-05.4 POLYVINYL CHLORIDE (PVC) PIPE

PVC pipe must conform to the Specifications of ASTM D 3034 for diameter sizes 4-inch through 15-inch, and of ASTM F 679 for diameter sizes 18-inch through 48-inch. The minimum pipe stiffness must be 46 lb./in./in.

Joints for PVC pipe must conform to ASTM D 3212 using an elastomeric gasket conforming to ASTM F 477.

Fittings for PVC pipe must conform to ASTM D 3034, ASTM F 679, or ASTM F 1336. All fittings must be the same material as the pipe being connected except that fittings using other materials or constructed with more than one material may be used subject to the approval of the Engineer. The Contractor must submit the proposed alternate material at least 10 Working Days in advance, and must include a manufacturer's certificate of compliance stating the alternate material meets or exceeds the handling and load stress performance of that specified.

9-05.4(1) SLOTTED PVC SUBSURFACE DRAIN PIPE

Perforated polyvinyl chloride sub-surface drain (SSD) pipe and fittings must be either ASTM D2241 SDR 21 (Class 200) or ASTM D1785 Schedule 40. ASTM 2241 pipe must have rubber gasket joints, and ASTM D1785 pipe must have solvent welded joints. The slotted perforations must be 0.064" wide x 1.00" long and spaced 0.3 inch apart on center. The slotted perforations on the pipe must be oriented as specified in the Contract. Minimum pipe diameter is 6 inches and must not exceed 8 inches unless specified otherwise in the Contract.

9-05.4(2) C900 PVC PIPE

C900 PVC pipe must be manufactured from compounds conforming to cell classification 21454 as defined in AWWA C900-16. The integral bell joint system must meet the requirements of ASTM D-3139 and utilize an elastomeric seal meeting the specification defined in ASTM F-477. Unless noted otherwise, C900 pipe used for Sewer and drainage applications must be dimension ratio (DR) 18 and must be colored white.

C900 PVC pipe as specified in this Section may only be used for Sewer and drainage applications and is not allowed for use in Water Mains.

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9-05.5 VITRIFIED CLAY PIPE (VCP)

Vitrified clay pipe must conform to ASTM C 700, and all joints must be factory manufactured in conformance with Section 9-04.4(2). Vitrified clay pipe must be installed as specified in Section 7-17.

Vitrified clay pipe must be load tested per ASTM C301 for 3 edge bearing. Vitrified clay pipe must withstand the following minimum loads:

Minimum Test Loads

Extra Strength		High Strength	
Nominal Size (in)	**Load (lbs/ft)**	**Nominal Size (in)**	**Load (lbs/ft)**
4	2000	4	2200
6	2000	6	2200
8	2200	8	2400
10	2400	10	2600
12	2600	12	2900
15	3100	15	3400
18	3600	18	4000
21	4200	21	4600
24	4800	24	5300
27	5200	27	5700
30	5500	30	6100
33	5800	33	6400
36	6300	36	6900
39	6600	39	7300
42	7000	42	7700

9-05.5(1) PIPE ACCEPTANCE REPORT (PAR)

Vitrified clay pipe must be inspected by the SPU Materials Laboratory at the point of delivery. When delivered, vitrified clay pipe must be accompanied by all specified certifications and test results. Vitrified clay pipe that has not been inspected and approved by the SPU Materials Laboratory must not be incorporated into the Work. A pipe acceptance report will be completed by SPU Materials Laboratory personnel upon inspection of the pipe. Approval of pipe by the SPU Materials Laboratory upon delivery does not constitute acceptance of the pipe at any time.

9-05.6 POLYETHYLENE PIPE

9-05.6(1) CORRUGATED POLYETHYLENE DRAINAGE TUBING PIPE

9-05.6(1)A CORRUGATED POLYETHYLENE DRAINAGE TUBING DRAIN PIPE

Corrugated polyethylene drainage tubing drain pipe must comply with the Specifications of AASHTO M 252. The maximum size pipe allowed must not be larger than 10-inch diameter.

9-05.6(1)B PERFORATED CORRUGATED POLYETHYLENE DRAINAGE TUBING SUBSURFACE DRAIN PIPE

Perforated corrugated polyethylene drainage tubing subsurface drain pipe must comply with the Specifications of AASHTO M 252 Type 5. The maximum size pipe is 10 inches in diameter.

9-05.6(2) CORRUGATED POLYETHYLENE DRAIN PIPE

9-05.6(2)A GENERAL

Corrugated polyethylene drain pipe must be high density polyethylene (HDPE) complying with the Specifications of AASHTO M 294, Type S. The size of pipe allowed must range from a minimum 12-inch diameter through a maximum 48-inch diameter. All HDPE pipe delivered and used must be certified through the Plastic Pipe Institute (PPI) Third Party Certification program and must bear the Third Party Administered PPI seal.

9-05.6(2)B COUPLING BANDS

Joints for corrugated polyethylene drain pipe must be made with a bell/bell or bell and spigot coupling using elastomeric gaskets conforming to ASTM F 477. Joints for Storm Drain pipe must be made with a bell/bell or bell and spigot coupling and must conform to ASTM D 3212 using elastomeric gaskets conforming to ASTM F 477. All gaskets must be factory installed on the pipe per the Materialperson's recommendations.

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9-05.6(3) STEEL REINFORCED POLYETHYLENE PIPE FOR DETENTION

Steel Reinforced Polyethylene Pipe must comply with the specifications of ASTM F2562. Resins must comply with the specifications of ASTM D3350 and cell classification 345464C. Steel ribs must comply with the specifications of ASTM A 1008 or ASTM A 1011.

Joints must be as shown on the Drawings; either bell and spigot or welded couplers. Welded couplers must be installed by electrofusion welding or extrusion welding technology. The joints must be laboratory tested to 15 psi as specified in ASTM 3212.

9-05.6(4) PERFORATED CORRUGATED POLYETHYLENE SUBSURFACE DRAIN PIPE

9-05.6(4)A GENERAL

Perforated corrugated polyethylene subsurface drain pipe must be HDPE complying with the Specifications of AASHTO M 294, Type S. The size of pipe allowed must range from a minimum 12 inches in diameter through a maximum of 48-inch diameter. Perforations must be per AASHTO M 294. All HDPE pipe delivered and used must be certified through the Plastic Pipe Institute (PPI) Third Party Certification program and must bear the Third Party Administered PPI seal.

9-05.6(4)B COUPLING BANDS

Joints for perforated corrugated polyethylene subsurface drain pipe must be made with a bell/bell or bell and spigot coupling using elastomeric gaskets conforming to ASTM F 477. All gaskets must be factory installed on the coupling or on the pipe by the Materialperson.

9-05.6(5) POLYETHYLENE END SECTIONS

HDPE end sections must be manufactured out of polyethylene resin complying with ASTM D 3350.

9-05.7 ALUMINUM PIPE

9-05.7(1) GENERAL

See Section 7-16.2 for restrictions on the use of corrugated metal pipe.

Corrugated aluminum drain pipe, aluminum Culvert pipe, and aluminum pipe without perforations must conform to the applicable Specifications of AASHTO M 196.

The protective coating for aluminum pipe must be Treatment 5 as specified in Section 9-05.8(2)D, and the pipe must be constructed of helically corrugated lock seam aluminum pipe. An exception is allowed when gasketed helically corrugated lock seam aluminum pipe is specified in the Contract and Treatment 5 is not required.

Aluminum surfaces that are to be in contact with any Portland cement product (such as controlled density fill, concrete, grout, and mortar) must be protected by first cleaning the aluminum surface in contact with Portland cement product with solvent and then painting this surface with two coats of paint extending a minimum 2 feet beyond the area of contact with the Portland cement product. The paint must conform to Federal Specification TT P 645 (Primer, Paint, Zinc Chromate, Alkyd Vehicle).

9-05.7(1)A BASIS FOR ACCEPTANCE FOR ALUMINUM PIPE

The basis for acceptance of aluminum pipe will be the same as specified in Section 9-05.1, except when gasketed helically corrugated lock seam aluminum pipe is specified in the Contract. A qualification test, conducted by the Engineer, will be required of the Materialperson for gasketed helically corrugated lock seam aluminum pipe, as the Engineer is required to identify specific pipe sizes and gasket materials that perform acceptably and reliably with confidence in specific applications.

9-05.7(1)B COUPLING BANDS

9-05.7(1)B1 COUPLING BANDS FOR DRAIN PIPE

Coupling bands for corrugated aluminum alloy drain pipe must comply with the Specifications of AASHTO M 196 for coupling bands for Type I pipe, except that bands using projections (dimples) will not be allowed. The bands must be fabricated of the same material as the pipe.

Coupling bands for aluminum corrugated pipe must be 24 inch, two piece half circle corrugated pipe held together with angles and bolts. A neoprene gasket must be placed between the pipe and the bands. The bands must be made of the same material and have the same corrugation as the pipe, and must be as specified in Section 9-05.7(1)B2.

9-05.7(1)B2 COUPLING BANDS FOR CULVERT PIPE

Coupling for bands must comply with AASHTO M 196. Bands having projections in lieu of corrugations will not be allowed.

Steel bolts and nuts for coupling bands must comply with ASTM A 307 and must be galvanized per AASHTO M 232 or AASHTO B 633.

Aluminum angles must be of the same material as the coupling bands.

Rods, when required, must comply with ASTM B 221, Alloy 6061 T6.

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Asphalt coating must not be used on coupling bands.

Coupling bands and aluminum pipe must be the product of the same Materialperson.

9-05.7(1)B3 COUPLING BANDS FOR ALUMINUM PIPE

Section 9-05.7(4)B applies to aluminum pipes, except the band must have a range of thicknesses from not less than 0.60 inches to not larger than 0.105 inches.

Coupling bands and aluminum pipe must be the product of the same Materialperson.

9-05.7(1)C MITERED ENDS

The ends of aluminum pipe must not be beveled unless specified otherwise in the Contract. If beveled ends are specified, the ends of aluminum pipe over 30 inches in diameter must be mitered to conform to the slope of the embankment in which the pipe is to be placed whether the pipe is constructed normal to or at an angle with the centerline of the roadway.

9-05.7(1)D ALUMINUM END SECTIONS

Beveled aluminum pipe end sections 12 inches through 30 inches in diameter must be of the same Material and thickness and have the same protective coating as the pipe to which they are attached. Beveled pipe ends of these dimensions must be constructed in conformance with WSDOT Standard Plans.

Construction of end sections and toe plate extensions for aluminum pipes must comply with AASHTO M 196. In addition, they must be as specified in Section 9-05.7(2)G.

Do not use asphalt coating on aluminum end sections.

9-05.7(2) PERFORATED CORRUGATED ALUMINUM SUBSURFACE DRAIN PIPE

9-05.7(2)A GENERAL

Perforated corrugated aluminum subsurface drain pipe must comply with AASHTO M 196, except that the perforations may be located at any location on the tangent of the corrugations provided the other perforation spacing complies with the Specifications.

See Section 7-16.2 for restrictions on the use of corrugated metal pipe.

9-05.7(2)B COUPLING BANDS

Coupling bands for corrugated aluminum subsurface drain pipe must comply with AASHTO M 196 for coupling bands for Type III pipe. The bands must be fabricated of the same material as the pipe if metallic bands are used.

Acceptable coupling bands are two piece, helically corrugated with nonreformed ends and integrally formed flanges; universal bands (dimple bands); a smooth sleeve type coupler; and those bands specified in Section 9-05.7(1)B2. Smooth sleeve type couplers may be either plastic or aluminum, suitable for holding the pipe firmly in alignment without the use of sealing compound or gaskets.

9-05.7(3) ALUMINUM SPIRAL RIB PIPE

9-05.7(3)A GENERAL

See Section 7-16.2 for restrictions on the use of corrugated metal pipe.

Aluminum spiral rib pipe must comply with AASHTO M 196 and these Specifications. The size, alloy, and protective treatment must be as specified in the Contract.

The Materialperson of spiral rib pipe must submit to the Engineer a manufacturer’s certificate of compliance stating that the Material furnished complies in all respects with these Specifications. The Engineer may require additional information or tests to be performed by the Contractor, at no expense to the Owner.

Unless indicated otherwise in the Contract, spiral rib pipe must be furnished with pipe ends cut perpendicular to the longitudinal axis of the pipe. Pipe ends must be cut evenly. Spiral rib pipe must be fabricated by using a continuous helical lock seam with a seam gasket.

For spiral rib pipe, helical ribs must project outwardly from the smooth pipe wall and must be fabricated from a single uniform thickness material. The ribs must be 3/4” wide x 3/4” deep with a nominal spacing of 7-1/2 inches center to center. Pipe must be fabricated with ends that can be acceptably jointed with coupling bands.

For narrow pitch spiral rib pipe, helical ribs must project outwardly from the smooth pipe wall and must be fabricated from a single thickness of material. The ribs must be 3/8” x 1/8” wide (measured outside to outside) and a minimum of 0.4375 inches high (measured as the minimum vertical distance from the outside of pipe wall to top surface of the rib). The maximum spacing of ribs must be 4.80 inches center to center (measured normal to the direction of the ribs). The radius of bend of the metal at the corners of the ribs must be a minimum of 0.0625 inches with an allowable tolerance of ± 10 percent.

For wide pitch spiral rib pipe, helical ribs must project outwardly from the smooth pipe wall and must be fabricated from a single thickness of material. The ribs must be 3/4” x 1/8” wide (measured outside to outside) and a minimum of 0.95-inch high (measured as the minimum vertical distance from the outside of pipe wall to top surface of the rib). The maximum spacing of

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ribs must be 11-3/4 inches center to center (measured normal to the direction of the ribs). The radius of bend of the metal at the corners of the ribs must be 0.0625 inches with an allowable tolerance of ± 10 percent.

9-05.7(3)B CONTINUOUS LOCK SEAM PIPE

Pipes fabricated with continuous helical lock seam parallel to the rib may be used for full circle pipe. The lock seam must be formed in the flat between ribs and must conform to Section 13.2.1 through 13.2.5 of AASHTO M 196.

9-05.7(3)C BASIS FOR ACCEPTANCE FOR ALUMINUM SPIRAL RIB PIPE

The basis for acceptance will be a qualification test conducted by the Engineer for the Materialperson of helically corrugated spiral rib, narrow pitch spiral rib or wide pitch spiral rib lock seam pipe, as the Engineer is required to identify specific pipe sizes and gasket materials that perform acceptably and reliably with confidence in specific applications.

Continuous lock seam pipe must be sampled and tested per AASHTO T 249 and a manufacturer's certificate of compliance stating the results must be submitted to the Engineer.

9-05.7(3)D COUPLING BANDS

Coupling bands must be of the same material as the pipe. Coupling bands and gaskets must conform to Section 9-05.7(4)B.

9-05.7(4) ALUMINUM PIPE FOR DETENTION

See Section 7-16.2 for restrictions on the use of corrugated metal pipe.

Aluminum detention pipe must be helical or annular corrugated aluminum pipe, comply with the Specifications of AASHTO M 196, Type I with the gauge as indicated on the Drawings. The end plate and all end plate reinforcement must be aluminum alloy 6061 T6 structural plate with the thickness as indicated on the Drawings.

Coupling bands for corrugated aluminum detention pipes must be Type "D" per WSDOT Standard Plan B-60.40.

9-05.8 STEEL PIPE

9-05.8(1) GALVANIZED STEEL DRAIN PIPE

Galvanized steel pipe must be 4-inch inside diameter, Schedule 40 pipe complying with the Specifications of ASTM A 53.

9-05.8(2) STEEL CULVERT PIPE AND PIPE ARCH

9-05.8(2)A GENERAL

Steel Culvert pipe and pipe arch must comply with the Specifications of AASHTO M 36, Type I and Type II. Welded seam aluminum coated (aluminized) corrugated steel pipe and pipe arch with metallized coating applied inside and out following welding is acceptable.

See Section 7-16.2 for restrictions on the use of corrugated metal pipe.

9-05.8(2)B ELLIPTICAL FABRICATION

When elongated pipes are specified, circular pipes must be fabricated 5 percent out of round to form an elliptical section. The vertical or longer axis of the elliptical section must be clearly marked before shipping.

9-05.8(2)C COUPLING BANDS

Coupling bands must be flange bands or corrugated bands as shown on the Drawings, WSDOT Standard Plan B 60.40 Type D or as specified in the Contract, and must be fabricated of the same material as the pipe and with the same metallic protective treatment as the pipe. The corrugated bands must conform to the pipe and must comply with all applicable Specifications of AASHTO M 36 except that coupling bands for all sizes of steel pipe arch with 3" x 1" corrugations must be 24 inches wide. Bands having projections in lieu of corrugations will not be allowed.

Steel bolts and nuts for coupling bands must comply with ASTM A 307 and must be galvanized per ASTM A 153.

Steel angles, when required for coupling bands, must comply with AASHTO M 36.

Asphalt coating must not be used on coupling bands.

Coupling bands as specified in Section 9-05.7(4)B are also acceptable.

Coupling bands and pipe must be made by the same Materialperson.

9-05.8(2)D STEEL CULVERT PIPE ARCH

Steel pipe arch must be as specified for steel pipe and pipe arch except in the method of fabrication. Circular pipe must be fabricated in two semi circles, and the pipe arch must be fabricated in two separate sections, the upper portion or arch, and the bottom section including the connecting arcs.

Both longitudinal edges of the lower section of the pipe arch must be notched to provide interlocking seams which form the two segments into the full section when it is erected in the field. Hook and eye bolts, or other approved means, must be provided to hold the segments firmly together.

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Individual plates must be a minimum of 2 feet in length except for short or half sections required to complete the end section of the Culvert.

When protective treatment is specified on the Drawings, pipe arch must be coated with one of the following treatments:

Treatment Name	Description
Treatment 1	Coated uniformly inside and out with asphalt.
Treatment 2	Coated uniformly inside and out with asphalt and with an asphalt paved invert.
Treatment 3	Coated inside & out with fibers embedded in the spelter coating, then covered on both sides with asphalt.
Treatment 4	Coated as in Treatment 3 and with an asphalt paved invert.
Treatment 5	Coated inside and out with asphalt and a 100 percent periphery inside spun asphalt lining.
Treatment 6	Coated as in Treatment 3 and with a 100 percent periphery inside spun asphalt lining.

9-05.8(2)E STEEL END SECTIONS

9-05.8(2)E1 GENERAL

Construction of steel end sections must comply with the applicable provisions of AASHTO M 36, except that the end sections must be fabricated of the same material with the same metallic protective treatment as the pipe.

Do not use asphalt coating on steel end sections.

9-05.8(2)E2 FABRICATION

The shape, thickness, dimensions, and number of pieces must conform to WSDOT Standard Plan B-70.60 for the size and shape of pipe shown on the Drawings. They must be manufactured as integral units or formed so they can be readily assembled and erected in place. When bolts are used for assembly, they must be 3/8-inch diameter or larger and must be galvanized. No field welding or riveting is permitted.

9-05.8(2)E3 GALVANIZED HARDWARE

Bolts, nuts, and miscellaneous hardware must be galvanized per AASHTO M 232.

9-05.8(2)E4 TOE PLATE EXTENSIONS

Toe plate extensions must be furnished only when specified in the Contract. When required, the toe plate extensions must be punched with holes to match those in the lip of the skirt and fastened with 3/8-inch or larger galvanized nuts and bolts. Toe plate extensions must be the same material and thickness as the end section and must be fabricated of the same material with the same metallic protective treatment as the end section.

9-05.8(3) STEEL SPIRAL RIB DRAIN PIPE

9-05.8(3)A GENERAL

See Section 7-16.2 for restrictions on the use of corrugated metal pipe.

Steel spiral rib drain pipe must comply with AASHTO M 36 and these Specifications. The size, coating, metal and protective treatment must be as specified in the Contract.

The Materialperson of spiral rib drain pipe must furnish to the Engineer a manufacturer's certificate of compliance stating that the Material furnished complies in all respects with these Specifications. The Engineer may require additional information or tests to be performed by the Contractor, at no expense to the Owner.

Unless otherwise specified in the Contract, spiral rib drain pipe must be furnished with pipe ends cut perpendicular to the longitudinal axis of the pipe and must be cut evenly. Spiral rib pipe must be fabricated either by using a continuous helical lock seam with a seam gasket or a continuous helical welded seam paralleling the rib.

Spiral rib drain pipe must have helical ribs that project outwardly, must be formed from a single thickness of material, and must conform to one of the following configurations:

1. AASHTO M 36 Section 7.2.2.
2. 0.375 inch ± 1/8" wide x 0.4375" (minimum) deep at 4.80 inches center to center.
3. 3/4" wide x 5/8" deep at 12 inches center to center.

Pipe must be fabricated with ends that can be acceptably jointed with coupling bands.

When required, spiral rib pipe must be bituminous treated or paved. The bituminous treatment for spiral rib pipe must be as specified in Sections 9-05.8(2)C and 9-05.8(2)D.

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9-05.8(3)B CONTINUOUS LOCK SEAM PIPE

9-05.8(3)B1 GENERAL

See Section 7-16.2 for restrictions on the use of corrugated metal pipe.

Pipes fabricated with a continuous helical seam parallel to the rib may be used for full circle pipe. The lock seam must be formed in the flat between ribs and must conform to Sections 7.5.1 through 7.5.3 of AASHTO M 36.

For narrow pitch spiral rib pipe, the lap width specified in AASHTO M 36, Section 7.5.1 must be 1/4 inch.

For use in applications without bituminous treatment, the continuous lockseam requires acceptance by qualification testing conducted by the Engineer. The Contractor must provide the Engineer at least 3 Working Days advance notice to arrange for this testing.

9-05.8(3)B2 BASIS FOR ACCEPTANCE

The basis for acceptance will be a qualification test conducted by the Engineer for each Materialperson of helically corrugated, gasketed spiral rib, or narrow pitch spiral rib lock seam steel pipe as the Engineer is required to identify specific pipe sizes and gasket materials that perform acceptably and reliably with confidence in specific applications.

Continuous lock seam pipe must be sampled and tested per AASHTO T 249 and a manufacturer's certificate of compliance must be submitted to the Engineer indicating compliance of the pipe with these Specifications.

9-05.8(3)C CONTINUOUS WELDED SEAM PIPE

See Section 7-16.2 for restrictions on the use of corrugated metal pipe.

Pipes fabricated with a continuous helical welded seam parallel to the ribs may be used for full circle pipe. The welding process for galvanized steel pipe must be so controlled that the combined width of the weld and adjacent spelter coating burned by the welding does not exceed 3 times the thickness of the metal. If spelter is burned outside these limits, the weld and burned spelter must be acceptably repaired for damaged galvanizing. Testing for welded seam quality control must conform to AASHTO T 241. Welded pipe fabricated from aluminized steel pipe must have the coating of the welded area repaired by flame sprayed metallizing inside and out after welding.

Repair of Damaged Galvanizing: When the galvanized (zinc coated) surface has welding burn, all surfaces of the welded connections must be thoroughly cleaned by wire brushing and all traces of the welding flux and loose or cracked galvanizing removed, after which the areas must be repaired by flame spray metallizing both inside and out.

9-05.8(3)D COUPLING BANDS

Coupling bands must be of the same material as the pipe. Coupling bands and gaskets must conform to Section 9-05.8(4).

9-05.8(4) STEEL PIPE FOR DETENTION

See Section 7-16.2 for restrictions on the use of corrugated metal pipe.

Steel detention pipe must be aluminized helical or annular corrugated steel pipe, complying with the Specifications of AASHTO M 36, Type 2 with the gauge as specified in the Contract. The end plate and all end plate reinforcement must be structural steel plate of the type and thickness as designated in the Contract. Coupling bands for steel detention pipes must be Type "D" per WSDOT Standard Plan B 60.40 unless the Contract specifies otherwise.

9-05.9 PIPE COATINGS

9-05.9(1) ALUMINUM COATED CORRUGATED IRON OR STEEL DRAIN PIPE

9-05.9(1)A GENERAL

Aluminum coated (aluminized) corrugated iron or steel drain pipe must comply with the Specifications of AASHTO M 36. The aluminized sheet thickness must be 0.052 inch for 6-inch diameter drain pipe, and 0.064 inch for 8-inch and larger diameter drain pipe. Welded seam aluminum coated corrugated iron or steel drain pipe with metallized coating applied both inside and outside after welding is acceptable.

See Section 7-16.2 for restrictions on the use of corrugated metal pipe.

9-05.9(1)B COUPLING BANDS

Coupling bands for aluminum coated (aluminized) corrugated iron or steel drain pipe must comply with the Specifications of AASHTO M 36 for coupling bands for Type 2 pipe, except that bands using projections (dimples) are not permitted. The bands must be fabricated of the same material as the pipe, and with the same metallic protective treatment as the pipe.

Acceptable coupling bands for corrugated metal pipe must be made using a 2 piece, 24-inch wide corrugated coupling band, held together with angles and bolts. A neoprene gasket between the pipe and the band must be of the same material and corrugations as the pipe, and be as specified in Section 9-05.8(2)E.

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9-05.9(2) ALUMINUM COATED CORRUGATED IRON OR STEEL SUBSURFACE DRAIN PIPE

9-05.9(2)A GENERAL

Aluminum coated (aluminized) corrugated iron or steel subsurface drain pipe must comply with AASHTO M 36, except that perforations required in Class I, Class II, and Class III pipe may be located anywhere on the tangent of the corrugations, provided the other perforation spacing complies with Specifications. Welded seam aluminum coated corrugated iron or steel subsurface drain pipe with metallized coating applied both inside and outside after welding is acceptable.

The pipe may conform to any one of the Type III pipes specified in AASHTO M 36, and perforations in Class I, Class II, and Class III pipe may be drilled or punched. The aluminized sheet thickness must be 0.052 inch for 6-inch diameter subsurface drain pipe, and 0.064 inch for 8-inch and larger diameter subsurface drain pipe.

See Section 7-16.2 for restrictions on the use of corrugated metal pipe.

9-05.9(2)B COUPLING BANDS

Coupling bands for aluminum coated (aluminized) corrugated iron or steel subsurface drain pipe must comply with AASHTO M 36 for coupling bands for Type III pipe. The bands must be fabricated of the same material as the pipe and with the same metallic protective treatment as the pipe, if metallic bands are used.

Acceptable coupling bands are the two piece, helically corrugated band, with nonreformed ends and integrally formed flanges, universal bands (dimple bands), a smooth sleeve type coupler, and those bands meeting the Specifications of Section 9-05.8(2)E. Smooth sleeve type couplers may be either plastic or steel suitable for holding the pipe firmly in alignment without the use of sealing compound or gaskets.

9-05.10 PLASTIC FOAM

Polyethylene plastic foam (Ethafoam) used in underground utility separation must comply with the Federal Specification Cid A-A 59136 Type 1, Class 1, Grade A.

9-05.11 ABS COMPOSITE PIPE

ABS (acrylonitrile butadiene styrene) material must not be used unless specified in the Contract or permitted by the Engineer.

ABS composite pipe must comply with AASHTO M 264.

ABS composite pipe must be provided with Type OR flexible gasketed joints. Rubber gasketed joints must conform to ASTM C 443.

Fittings for ABS composite pipe must be specifically designed for connection to ABS composite pipe with solvent cement. All fittings must be the same material as the pipe being connected, except that fittings using other materials or constructed with more than one material may be used subject to the approval of the Engineer. Fittings must have sufficient strength to withstand handling and load stresses encountered.

9-05.12 SAFETY BARS FOR CULVERT PIPE

Steel pipe used as safety bars and steel pipe used as sockets must conform to ASTM A 53, Grade B. Steel tubing used as safety bars must conform to ASTM A 500, Grade B. Steel plate must conform to ASTM A 36.

9-05.13 FLOW CONTROL STRUCTURE

See Section 7-16.2 for restrictions on the use of corrugated metal pipe.

The flow control Structure must be made from a standard maintenance hole section as shown on Standard Plan 270 with diameter as indicated on the Drawings.

Where surface water is to enter directly through the cover of the flow control Structure, the frame and grate must be as shown on Standard Plan 264, and the precast slab must be as shown on Standard Plans 243a and 243b with opening details to fit the diameter of the chamber. In all other cases, standard ring and cover (see Standard Plan 230) must be used with a precast slab conforming to 200 Series Standard with a 24-inch round opening. Maintenance hole sections, castings, and slabs must be as specified in Section 7-05.

The flow control device and connection must consist of a PVC pipe cross with an orifice, a pipe connection, and shear gate with a galvanized steel chain. The diameters of the control device and connection must be the same as the diameter of the outlet pipe as specified in the Contract. The PVC pipe used for the cross and connection must comply with ASTM D 1785, Schedule 40. The PVC material used for the orifice plate and the shear gate must be plate material in compliance with ASTM D 1784, PVC Class 12454 B. The orifice plate material must be 1/4-inch thick and the shear gate material must be 1/2-inch thick. The shear gate pin must be of the same PVC material as the shear gate. The shear gate chain must be 1/8-inch diameter Type 304 stainless steel straight link chain permanently attached to the Structure.

9-05.14 GALVANIZED IRON PIPE

Galvanized iron pipe 4-inch diameter and smaller must be ASTM A 53 schedule 40 pipe.

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9-05.15 CEMENT SLURRY ABANDONING PIPE OR FILLING ANNULAR SPACE BETWEEN 2 PIPES

Materials must comply with the following standards:

Material	Standard
Portland Cement	Section 9-01
Fly Ash	Section 9-23.6
GGBFS	Section 9-23.7
Limestone	Section 9-23.10
Fine Aggregate	Section 9-03.1(2)
Chemical Admixtures	Section 9-23.4
Foaming Agent	ASTM C869
Water	Section 9-25.1

Material used to fill the annular space between an inner and outer pipe, or used to abandon pipe in place, must be a foamed cement slurry that is pumpable, flowable, and must completely fill the annular space between pipes or the interior space of the abandoned pipe without loss of volume. The foamed cement slurry must have the following properties:

Property	Requirement
Density – ASTM C138	65 pcf, min.
Slump – ASTM C143	8 inches, min.
Compressive Strength @ 24 hrs. – ASTM C4832	15 psi, min.
Compressive Strength @ 28 Days – ASTM C4832	150 psi, min.
Water-Cement Ratio	0.90 max.

In addition to the properties shown above, test cylinders made in accordance with ASTM C4832 from samples taken at the point of placement (after the pump, if used) must not show any loss of volume after the foamed cement slurry has achieved final set.

9-05.16 SIDE SEWER AND SERVICE DRAIN

Sanitary side Sewer and service drain side Sewer Material must be per the SMC Title 21 and other current Director's Rules, as applicable.

9-05.17 POLYPROPYLENE PIPE

Polypropylene Pipe, corrugated, single wall and double wall for diameter sizes 12-inch through 30-inch must conform to the Specifications of ASTM F2736. Third party certification that it complies with ASTM F2764 must accompany all delivered pipe.

Triple wall polypropylene pipe for diameter sizes 30-inch through 60-inch must conform to ASTM F2764. Third party certification that it complies with ASTM F2764 must accompany all delivered pipe.

9-05.18 COUPLINGS FOR PIPE JOINTING

All couplings must form a watertight joint when installed. Couplings used for jointing pipe must be per the requirements in the table below:

Application	Flexible Gasketed Coupling with Stainless Steel Shield	Heavy Duty Ductile Iron Body Gasketed Coupling	Stainless Steel Body Gasketed Coupling
Side Sewer Construction	X	X[1]	X[1]
Catch Basin Construction	X	X[1]	X[1]
Mainline Break-out and Reconnect, Mismatched Wall Thickness	X	--	--

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Application	Flexible Gasketed Coupling with Stainless Steel Shield	Heavy Duty Ductile Iron Body Gasketed Coupling	Stainless Steel Body Gasketed Coupling
Mainline Repair, Matching Wall Thickness (VCP, Concrete)	X	--	X
Mainline Repair, Matching Wall Thickness (DI, CI, PVC, HDPE)	X	X	X

NOTE: "X" denotes acceptable coupling type.

1. May not be used for the last connection between side sewer and mainline pipe.

Flexible gasketed couplings with stainless steel shielding must conform to the specifications of ASTM C 1173 for a Type B classification. Couplings must be sized to fit the specific pipe and material to which it is designed to join, such that the outer diameters of the pipes being coupled fall within the manufacturer's specified sizing range. The stainless steel shielding must perform as a shear ring for the coupling, and must be at least 0.012 inches thick. Shielding materials must be stainless steel. Interior shear rings are not acceptable for transitions from new to existing pipe.

Heavy duty ductile iron body gasketed couplings must be configured for the size and type of pipe to be jointed. Gaskets must be compounded for water and sewage service. Ductile iron bodies must be shop coated. Bolts must be corrosion resistant steel.

Stainless steel body gasketed couplings must be constructed of type 304 stainless steel. Bolts, nuts, and washers must be type 304 stainless steel. Gaskets must be compounded for water and sewage service.

SECTION 9-06 STRUCTURAL STEEL AND RELATED MATERIALS

9-06.1 STRUCTURAL CARBON STEEL

Structural carbon steel must conform to the Specifications of AASHTO M 270, Grade 36, Structural Steel For Bridges, unless the Contract specifies AASHTO M 183, Structural Steel.

9-06.2 STRUCTURAL LOW ALLOY STEEL

Structural low alloy steel must conform to the Specifications of AASHTO M 270, Grades 50 or 50W as specified in the Contract, unless the Contract specifies AASHTO M 223 or AASHTO M 222.

9-06.3 STRUCTURAL HIGH STRENGTH STEEL

Structural high strength steel must be high yield strength, quenched and tempered structural steel conforming to the Specifications of AASHTO M 270, Grades 70W, 100, or 100W as called out in the Contract, unless the Contract specifies AASHTO M 244.

9-06.4 BOLTS

9-06.4(1) UNFINISHED BOLTS

Unfinished bolts (ordinary machine bolts) must conform to the Specifications of ASTM A 307, Grade A or B. Nuts must comply with ASTM A 563, Grade A requirements. Washers, unless otherwise specified in the Contract, must comply with ASTM F 844 Specifications.

The Contractor must submit a manufacturer's certificate of compliance for the bolts, nuts, and washers before installing any of them.

9-06.4(2) HIGH STRENGTH BOLTS

High-strength bolts for structural steel joints must conform to either ASTM F 3125 Type 1 or 3 or ASTM A 490 Type 1 or 3, as specified on the Drawings or in the Project Manual. Tension control bolt assemblies, complying with all Specifications of ASTM F 1852 may be substituted where ASTM F 3125 high-strength bolts and associated hardware are specified.

When bolts are specified to be galvanized, tension control bolt assemblies must be galvanized after fabrication per ASTM B 695 Class 55 Type I.

Bolts conforming to ASTM A 490 must not be galvanized.

Bolts for unpainted and non-galvanized Structures must conform to ASTM F 3125 Type 3, ASTM A 490 Type 3, or ASTM F 1852 Type 3, as specified on the Drawings or in the Project Manual.

Nuts for high-strength bolts must comply with the following requirements:

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Bolt	Requirement
ASTM F 3125 Bolts	
Type 1 (black)	ASTM A 563 Grade C, C3, D, DH, and DH3 AASHTO M 292 Grade 2H
Type 3 (black weathering)	ASTM A 563 Grade C3 and DH3
Type 1 (hot-dip galvanized)	ASTM A 563 Grade DH AASHTO M 292 Grade 2H
ASTM A 490 Bolts	
Type 1 (black)	ASTM A 563 Grade DH and DH3 AASHTO M 292 Grade 2H
Type 3 (black weathering)	ASTM A 563 Grade DH3

Nuts that are to be galvanized must be tapped oversized the minimum required for proper assembly. The amount of overtap must be such that the nut will assemble freely on the bolt in the coated condition and must comply with the mechanical Specifications of ASTM A 563 and the rotational capacity test specified in ASTM F 3125.

Galvanized nuts must be lubricated per ASTM A 563 including supplementary requirement S2. Documentation must include the name, method of application, and dilution of the lubricant applied to the nuts.

Washers for ASTM F 3125 and ASTM A 490 bolts must comply with the Specifications of ASTM F 436 and may be circular, beveled, or extra thick, as required. The surface condition and weathering characteristics of the washers must be the same as for the bolts being specified.

Direct Tension Indicators must conform to the Specifications of ASTM F 959 and may be used with either ASTM F 3125 or M 253 bolts. Direct tension indicators must be galvanized by mechanical deposition per ASTM B 695 class 55. Hot-dip galvanizing will not be allowed.

All bolts, nuts, and direct tension indicators must be marked and identified as required in the pertinent Specifications.

Lock-pin and collar fasteners which comply with the materials, manufacturing, and chemical composition Specifications of ASTM F 3125 or ASTM A 490, and which comply with the mechanical property Specification in full size tests, and which have a body diameter and bearing areas under lock-pin head and collar not less than those provided by a bolt and nut of the same nominal size may be used. The Contractor must submit a detailed installation procedure to the Engineer for approval. Approval from the Engineer to use a lock-pin and collar fasteners must be received by the Contractor before use.

The Contractor must provide manufacturer's certificate of compliance for all bolts, nuts, washers, and load indicators. The manufacturer's certificate of compliance must include certified mill test reports and test reports performed on the finished bolt confirming that all of the materials provided comply with the Specifications of the applicable AASHTO or ASTM Specification. The documentation must also include the name and address of the test laboratory, the date of testing, the lot identification of the bolts and nuts, and coating thickness for galvanized bolts and nuts. Shipping containers (not lids) must be marked with the lot identification of the item contained therein.

Bolts must be sampled before incorporating into a Structure. For the purposes of selecting samples, a lot of bolts must be the quantity of bolts of the same nominal diameter and same nominal length in a consignment shipped to the Project Site. The minimum number of samples from each lot must be as follows:

Lot Size	Sample Size[1,2]
0-50	Note 3
51-150	4
151-1,200	6
1,201-10,000	10
10,001-35,000	16
35,001 and over	24

NOTES:

1. If bolts are galvanized, increase the sample size by 1.5 times the table value for the number of bolts being sampled.
2. Nuts, washers, and load indicator devices must be sampled at the same frequency as the bolts.
3. Manufacturer's certificate of compliance required — samples not required.

All testing of bolts, nuts, washers, and load indicating devices must be performed on specimens as they are to be installed.

All samples must include a manufacturer's certificate of compliance for each lot of bolts provided as defined in Section 1-06.3.

9-06.4(3) ANCHOR BOLTS

Anchor bolts must comply with the Specifications of ASTM F 1554 and, unless otherwise specified, must be Grade 105 and must conform to Supplemental Requirements S2, S3, and S4.

Nuts for ASTM F 1554 Grade 105 black anchor bolts must conform to ASTM A 563, Grade D or DH. Nuts for ASTM F 1554 Grade 105 galvanized bolts must conform to either ASTM A 563, Grade DH, or AASHTON M 292, Grade 2H, and must conform to the overtapping, lubrication, and rotational testing requirements in Section 9-06.4(2). Nuts for ASTM F 1554 Grade 36 or 55 black or galvanized anchor bolts must conform to ASTM A 563, Grade A. Washers must conform to ASTM F 436.

The bolts must be tested by the manufacturer in accordance with the pertinent Specifications. Anchor bolts, nuts, and washers must be inspected before shipping to the Project Site. The Contractor must submit to the Engineer for approval a manufacturer's certificate of compliance for the anchor bolts, nuts, and washers, as defined in Section 1-06.3. The Contractor must provide a sample of the anchor bolt, nut, and washer for testing upon request.

All bolts, nuts, and washers must be marked and identified as required in the Specifications.

9-06.5 STEEL CASTINGS

Steel castings must conform to the Specifications of AASHTO M 103, Mild to Medium Strength Carbon Steel Castings for General Application, grade 70-36, unless otherwise designated in the Contract.

9-06.6 GRAY IRON CASTINGS

Gray iron castings must conform to the Specifications of AASHTO M 105. The class of castings to be furnished must be as designated in the Contract.

9-06.7 MALLEABLE IRON CASTINGS

Malleable iron castings must conform to the Specifications of ASTM A 47.

9-06.8 STEEL FORGINGS AND STEEL SHAFTING

Steel forgings must conform to the Specifications of AASHTO M 102. The classes of forgings to be furnished must be those specified in the Contract.

Steel shafting must conform to the Specifications of AASHTO M 169, Grade Designation 1016 to 1030 inclusive, unless otherwise specified in the Contract.

9-06.9 BRONZE CASTINGS

Bronze castings must conform to the Specifications of AASHTO M 107, Bronze Castings for Bridges and Turntables.

9-06.10 COPPER SEALS

Copper sheets for seals must conform to the Specifications of AASHTO M 138. They must be UNS C12500, light cold rolled, and furnished in flat sheets each not less than 0.018 inches in thickness.

All splices or joints must be carefully brazed or soldered to produce a continuous water tight seal for the full length of each unit.

9-06.11 DUCTILE IRON CASTINGS

Ductile iron castings must conform to the Specifications of ASTM A 536, Grade 80 55 06, unless otherwise specified in the Contract.

9-06.12 WELDED SHEAR CONNECTORS

Welded shear studs must be made from cold drawn bar stock conforming to the Specifications of AASHTO M 169, Grades 1010 through 1020, inclusive, either semi killed or killed deoxidation.

The Material must conform to the following mechanical properties:

Property	Allowance
Tensile Strength	60,000 psi min.
Yield Strength	50,000 psi min.
Elongation	20% min.
Reduction of Area	50% min.

Mechanical properties must be determined per AASHTO Methods and Definitions T 244.

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At the manufacturer's option, mechanical properties of the studs must be determined by testing either the steel after cold finishing, or the full diameter finished studs.

9-06.13 ROADSIDE SIGN STRUCTURES

Materials in this Section apply to Division 6. See Section 9-28 for signing materials and fabrication.

All bolts must conform to AASHTO M 164. Washers for bolts must be per AASHTO M 293.

Posts for single post sign Structures must comply with ASTM A 500, Grade B or ASTM A 53, Grade B.

Posts for multiple post sign Structures must comply with AASHTO M 183. Posts complying with AASHTO M 222 or AASHTO M 223, Grade 50 may be used as an acceptable alternate to the AASHTO M 183 posts. All steel not otherwise specified must conform to AASHTO M 183.

Triangular base stiffeners for one directional multi post sign posts must comply with AASHTO M 222 or AASHTO M 223, Grade 50.

Base connectors for multiple directional steel breakaway posts must conform to the following:

Base Connectors	Standard
Bracket	Aluminum Alloy 6061 T-6
Bosses for Type 2B Brackets	ASTM A 582
Coupling Bolts	AASHTO M 164
Anchor Bolts	Type 304 stainless steel for threaded portion, AISI 1038 steel rod, and AISI 1008 coil for cage portion.

Anchor couplings for multiple directional steel breakaway posts must have a tensile breaking strength range as follows:

Anchor Couplings	Tensile Breaking Strength Range
Type 2A	17,000-21,000 lbs
Type 2B	47,000-57,000 lbs

For multi directional breakaway base connectors, shims must be fabricated from pregalvanized sheet steel. For one directional breakaway base connectors, single-post or multi-post, shims must be fabricated from brass conforming to ASTM B 36.

9-06.14 METAL BRIDGE RAILING

Metal bridge railing must conform to the type and material Specifications set forth in the Contract.

Section 8, part (b) of the Aluminum Association Standard Specifications for Aluminum Railing Posts Alloy A 344 T4 is hereby revised to provide that no x-ray inspection will be required after a foundry technique has been established for each mold which ensures production of castings that are free from harmful defects. Inspection for approval of castings will be made by the Engineer after the finished castings have been anodized as noted on the Drawings.

Welding of aluminum must be per Section 6.9 of the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, Fourth Edition-2001.

9-06.15 BOLTS, WASHERS, AND OTHER HARDWARE

Ordinary machine bolts and flat head bolts must be made from commercial bolt stock complying with ASTM A 307, and must be grade A. Drift bolts and dowels may be either wrought iron or medium steel. Washers may be cast iron or malleable iron or may be cut from medium steel or wrought iron plate.

All bolts and other hardware which are to be galvanized and which require bending or shaping must be hot forged to the required shape before galvanizing. Cold bending of such Material will not be permitted because of the tendency toward embrittlement during the galvanizing process. Galvanizing must be per AASHTO M 232.

Split rings for log cribbing of 4 inches inside diameter must be manufactured from hot rolled, low carbon steel conforming to ASTM A 711 AISI, Grade 1015. Each ring must form a true circle with the principle axis of the cross-section of the ring metal parallel to the geometric axis of the ring. The thickness of the metal section must be 0.195 inches ± 0.010 inches and the section must be beveled from the central portion toward the edges to a thickness of 0.145 inches ± 0.010 inches. It must be cut through in one place in its circumference to form a tongue and slot. Split ring connectors must be galvanized per AASHTO M 232.

Spike grid timber connectors must be manufactured according to ASTM A 47 for malleable iron castings. They must consist of 4 rows of opposing spikes forming a 4-1/8 inch square grid with 16 teeth which are held in place by fillets which are diamond shaped in cross-section.

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Nails must be round wire of standard form. Spikes must be wire spikes or boat spikes, as specified on the Drawings. Bolts, dowels, washers, and other hardware, including nails, must be black or galvanized as specified on the Drawings, but if not so specified must be galvanized when used in treated timber Structures.

SECTION 9-07 REINFORCING STEEL

9-07.1 GENERAL

Deformed steel bar must be free from loose mill scale, dirt, grease, or other defects affecting the strength of bond with concrete. Deformed steel bar coated with rust must be vigorously wire brushed clean. Size numbers must be taken to represent the diameter of the bar in 1/8-inch units, except where standard wire gauge sizes are specified in the Contract.

9-07.1(1) ACCEPTANCE BY MANUFACTURER'S CERTIFICATION

Reinforcing steel may be accepted by the Engineer based on the manufacturer's certificate of compliance.

9-07.1(1)A ACCEPTANCE OF MATERIALS

Steel reinforcing bar manufacturers use either English or a Metric size designation while stamping rebar. The actual size of the bar, whether stamped with an English or a Metric size designation is acceptable. The Drawings and the Standard Plans will continue to use an English size designation. The table below shows the comparable reinforcing steel bar size designations in the both units of measure:

English Designation	Bar Diameter	Metric Designation
#3	0.375 in	#10
#4	0.500 in	#13
#5	0.625 in	#16
#6	0.750 in	#19
#7	0.875 in	#22
#8	1.000 in	#25
#9	1.128 in	#29
#10	1.270 in	#32
#11	1.410 in	#36
#14	1.690 in	#43
#18	2.260 in	#57

9-07.1(2) BENDING

Steel reinforcing bars must be cut and bent by careful and competent workers. They must be bent cold to templates, which must not vary appreciably from the shape and dimension shown on the Drawings.

Hooks and bends of steel reinforcing bars must be bent to the following inside diameters unless shown otherwise on the Drawings:

Bar Size	Stirrups and Ties	All Other Bars
No. 3	1-1/2 "	6 bar diameters
No. 4	2"	6 bar diameters
No. 5	2-1/2 "	6 bar diameters
No. 6	4-1/2 "	6 bar diameters
No. 7	5-1/4"	6 bar diameters
No. 8	6"	6 bar diameters
No. 9 through No. 11	--	8 bar diameters
No. 14 through No. 18	--	10 bar diameters

The supplementary Specifications of AASHTO M 31 for bend tests must apply to size No. 14 and No. 18 steel reinforcing bars which have hooks or bends.

Hooked ends of steel reinforcing bars must be standard hooks unless shown otherwise in the Drawings. Standard hooks must consist of a 90, 135, or 180 degree bend as shown in the Drawings plus a minimum bar extension at the free end of the

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bar shown in the table below. Seismic hooks must consist of a 135 degree bend plus a minimum bar extension at the free end of the bar shown in the table below:

Minimum Bar Extensions for Standard and Seismic Hooks

	180º Hook	135º Hook		90º Hook	
Bar Size	**All Bars**	**Seismic Hook**	**All Other Bars**	**Stirrups and Ties**	**All Other Bars**
No. 3	2-1/2”	3”	2-1/4”	2-1/4”	4-1/2”
No. 4	2-1/2”	3”	3”	3”	6”
No. 5	2-1/2”	3-3/4”	3-3/4”	3-3/4”	7-1/2”
No. 6	3”	4-1/2”	4-1/2”	9”	9”
No. 7	3-1/2”	5-1/4”	5-1/4”	10-1/2”	10-1/2”
No. 8	4”	6”	6”	12”	12”
No. 9	4-3/4”	--	--	--	13-3/4”
No. 10	5-1/4”	--	--	--	15-1/4”
No. 11	5-3/4”	--	--	--	17”
No. 14	7”	--	--	--	20-1/2”
No. 18	9-1/4”	--	--	--	27-1/4”

9-07.1(3) LENGTHS

Net lengths of bent bars shown in the length column of the bar list on the Drawings are rounded to the nearest inch. Net length is the length of bar after all bend deductions are subtracted from the gross length.

9-07.2 DEFORMED STEEL BARS

Deformed steel bars for concrete reinforcement must conform to either AASHTO M 31 Grade 60, or ASTM A 706, except as otherwise noted. Steel reinforcing bar for the cast-in-place components of bridge Structures (excluding sidewalks and barriers but including shafts and concrete piles), and for precast substructure components of bridge Structures, must conform to ASTM A 706 only. However, in computing the ultimate unit tensile stress from test data, the area may be corrected for mass per linear foot of the bar within the weight tolerances listed. No such correction for mass is allowed for calculating the yield stress; the nominal area of the bar, as provided in Table 1 of AASHTO M 31 or ASTM A 706, must be used in this computation.

Deformed steel bars are referred to in the Drawings and Specifications by number: for example, No. 3, No. 4, No. 5,

9-07.3 EPOXY COATED STEEL REINFORCING BARS

Epoxy coated rebar must be coated per AASHTO M 284 with the additional following modifications:

1. The list of steel reinforcing bars acceptable for coating must include ASTM A 706.
2. The Contractor must furnish a written certification that properly identifies the material, the number of each batch of coating material used, quantity represented, date of manufacture, name and address of manufacturer, and a statement that the supplied coating material complies with the Specifications of AASHTO M 284.
3. Upon request, the Contractor must supply to the Engineer an 8 ounce representative sample of the coating material from each batch of coating material. The sample must be packaged in an airtight container and identified as epoxy coating material by batch number.
4. Before coating the bars, the Contractor must submit the coating material manufacturer’s recommendation on the proper use and application requirements of the coating material to the Engineer for review.
5. A manufacturer’s certificate of compliance stating that all bars have been coated per the coating material manufacturer’s recommendations and these Specifications must be furnished with each shipment. This certification must include for each bar size the preheat temperatures, cure times, thickness checks, holidays detected, and test results.
6. The Contractor must provide advance notice to the Engineer of the coating schedule at the coating facility so that Engineer inspection for approval may be provided.
7. The patching material, compatible with the coating material and inert in concrete, must be supplied with each shipment.
8. For projects where epoxy-coated steel reinforcing bars are used in the top mat of bridge decks only, the maximum amount of damage to the coating must not exceed 0.25 percent of the surface area of each bar.
9. The thickness of epoxy-coating must be 10 mils ± 2 mils.

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10. All samples must be submitted to the SPU Materials Laboratory as specified in 1-05.3(1)C.

9-07.4 PLAIN STEEL BARS

Where plain steel bars are specified, they must conform to the chemical and physical properties of AASHTO M 31, Grade 60, unless specifically noted otherwise. Plain steel bars are specified in the Contract by fractions of an inch of diameter; for example, 3/8-inch diameter, 1/2-inch diameter, or 5/8-inch diameter.

9-07.5 DOWEL BARS (FOR CEMENT CONCRETE PAVEMENT)

Corrosion resistant dowel bars must be the dimensions specified in Standard Plan 405c and meet the requirements of one of the following:

1. Stainless Steel Clad dowel bars must have a minimum 0.06 inches clad to a plain steel inner bar meeting the chemical and physical properties of AASHTO M31, Grade 60, or AASHTO M255, Grade 60. Stainless Steel Clad must meet the chemical properties of ASTM A249 or A269, Grade TP 316L.
2. Stainless Steel Tube dowel bars must have a minimum 0.06-inch-thick tube press fitted onto a plain steel inner bar meeting the chemical and physical properties of AASHTO M31, Grade 60, or AASHTO M255, Grade 60. A lubricant/adhesive must be used between the tube and the plain steel bar to fill any voids. Stainless Steel Tube material must meet the chemical properties of ASTM A249 or A269, Grade TP 316L.
3. Stainless Steel Solid dowel bars must be ASTM A276, Type 316L.
4. Corrosion-resistant, low-carbon, chromium plain steel bars for concrete reinforcement meeting all the requirements of ASTM A 1035 Alloy Type CS Grade 100 or Alloy Type CS Grade 120.
5. Zinc Clad dowel bars must be solid bars or tubular bars with the dimensions specified in Standard Plan 405c and meet the chemical and physical properties of AASHTO M 31, Grade 60 or AASHTO M 255, Grade 60. The bars must have a minimum 0.035 inches A710 Zinc alloy clad in addition to the to the plain steel solid bar or tube dimensions. A710 Zinc must be composed of: zinc: 99.5 percent, by weight, minimum; copper: 0.1 – 0.25 percent, by weight; and iron: 0.0020 percent, by weight, maximum. Each end of tubular bars must be plugged using a snug-fitting insert to prohibit any intrusion of concrete or other materials.
6. Multicoated fusion bonded epoxy bars must consist of an ASTM A615 bar with alternating layers of ASTM A934 coating and an abrasion resistant overcoat (ARO). The ASTM A934 coating must form the base and there must be two layers of each coating material. The minimum thickness of the combined layers of the ASTM A934 coating and ARO coating must be 20 mils. The ARO must meet the following requirements:

Test	Method	Specification
Gouge Resistance	NACE TM0215, 30 kg wt., LS-1 bit @ 25°C	< 0.22 mm
Gouge Resistance	NACE TM0215, 50 kg wt., LS-1 bit @ 25°C	< 0.44 mm

7. ASTM A513 steel tubes made from Grade 60 Carbon Steel Tube with the dimensions specified in Standard Plan 405c. Both the inside and outside of the tube must be zinc coated with G90 galvanizing in accordance with ASTM A653. The bars may be cut to length after being galvanized. Following zinc coating, the tubes must be coated with ASTM A1078 Type 2 epoxy coating. The thickness of the epoxy coating must be 10 mils plus or minus 2 mils. After all coatings have been applied, to prevent intrusion of concrete or other materials, the ends of the tube must be capped with a plug style insert cap with a diameter less than the outer dimension of the tube. The Contractor must furnish a written certification that properly identifies the coating materials, the number of each batch of coating material used, quantity represented, date of manufacture, name and address of manufacturer, and a statement that the supplied coating materials meet the requirements of ASTM A653 G90 and ASTM A1078 Type 2. An ASTM A1078 patching material, compatible with the coatings, inert in concrete, and recommended by the manufacturer must be supplied with each shipment for field repairs by the Contractor.

The surface of the finished cut-to-length corrosion-resistant, low-carbon, chromium plain steel bars for concrete reinforcement meeting all the requirements of ASTM A1035 dowels must be provided with a hot- rolled, as-rolled finish, including mill scale. The surface of all other finished cut-to-length dowels must be provided with a smooth “ground” or “cold drawn” finish.

Stainless Steel Clad and Stainless Steel Tube Dowel bar ends must be sealed with a patching material (primer and finish coat) used for patching epoxy-coated reinforcing steel as required in Section 9-07.3, item 7.

9-07.6 TIE BARS (FOR CEMENT CONCRETE PAVEMENT)

Tie bars must conform to the Standard Specifications for Deformed Billet Steel Bars for Concrete Reinforcement, AASHTO M 31, Grade 60 and must be coated per ASTM A 755. Deformed bar must be 5/8-inch diameter and 30 inches long.

The form of the deformed bar is subject to approval by the Engineer.

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Tie bars must be free from dirt, grease, or other defects affecting the strength or bond with the concrete. Tie bars must be epoxy encapsulated.

9-07.7 WIRE MESH

Welded wire for concrete reinforcement must meet the requirements of ASTM A1064, Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete. Welded wire reinforcement manufacturers must participate in the NTPEP Audit Program for Reinforcing Steel (rebar) Manufacturers and must be listed on the NTPEP audit program website displaying NTPEP compliance.

9-07.8 DEFORMED WIRE

Deformed wire must conform to the requirements of AASHTO M 336, Deformed Steel Wire for Concrete Reinforcement.

Deformed wire is noted in the Contract by the letter D, followed by a number indicating the cross-sectional area of the wire; for example, D2, D5, or D20.

9-07.9 COLD DRAWN WIRE

Cold drawn wire must conform to the requirements of AASHTO M336, Cold Drawn Steel Wire for Concrete Reinforcement.

Cold drawn wire is noted in the Contract by the letter W followed by a number indicating the cross-sectional area of the wire; for example, W2, W5, or W20.

9-07.10 PRESTRESSING REINFORCEMENT STRAND

Prestressing reinforcement must be 1/2-inch diameter for precast-prestressed concrete piles and 1/2-inch or 0.6-inch diameter for pretensioned concrete girders, post-tensioned segmental precast concrete girders, or cast-in-place prestressed concrete.

Prestressing reinforcement must be mill bright high tensile strength 7-wire low relaxation strand conforming to AASHTO M 203, Grade 270.

All prestressing reinforcement furnished for a given structural member must have a maximum elongation differential of 3 percent at stress of 0.8 of the ultimate strength of the prestressing steel. Each reel of prestressing reinforcement must be accompanied by a manufacturer's certificate of compliance, a mill certificate, and a test report. The mill certificate and test report must include the yield and ultimate strengths, elongation at rupture, modulus of elasticity, and the stress strain curve for the actual prestress reinforcing intended for use. All values certified must be based on test values and actual sectional areas of the Material being certified.

For every 5 reels furnished, one sample, not less than 5-1/2 feet long, must be sent to the SPU Materials Lab for testing as specified in Section 1-05.3. Samples of the furnished reels with manufacturer's certificate of compliance, a mill certificate, and test report may be shipped directly by the manufacturer to the Engineer. An independent inspector, approved by the Owner, must be present during sampling and must provide a written certification to the Engineer.

9-07.11 PRESTRESSING REINFORCEMENT BAR

High-strength steel bars must conform to AASHTO M 275, Type II.

Nuts must conform to either ASTM A 29 Grade C1045, or ASTM A 536 Grade 100-70-03, and must be capable of developing the larger of either 100 percent of the minimum ultimate tensile strength (MUTS), or 95 percent of the actual ultimate tensile strength (AUTS), of the bar. The anchor nuts must conform to the specified strength requirement while permitting a maximum 5 degree misalignment between the nut and the bearing plate. A minimum of 3 tests, each from a different heat, are required.

Couplers, if required, must be AASHTO M 169 Grade 1144, or equivalent steel, developing the larger of either 100 percent of the MUTS, or 95 percent of the AUTS, of the bar. The test must be performed with the coupler having a 1 inch unengaged segment between the two coupled bars. A minimum of 3 tests, each from a different heat, are required.

For unbonded bars under dynamic loading, the connections must withstand at least 500,000 cycles from 60 percent to 66 percent MUTS followed by at least 50 cycles between 40 percent MUTS and 80 percent MUTS. A minimum of 3 tests, each from a different heat, are required.

SECTION 9-08 PAINTS AND RELATED MATERIALS

9-08.1 PAINT

9-08.1(1) DESCRIPTION

Paints must be made from materials complying with the applicable Federal and State Paint Specifications, Department of Defense (DOD), American Society on Testing of Materials (ASTM), and Steel Structures Painting Council (SSPC) Specifications in effect at the time of manufacture. The colors, where designated, must conform to Section 9-08.1(8).

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9-08.1(2) PAINT TYPES

9-08.1(2)A VINYL PRETREATMENT

Vinyl pretreatment must be a two-component basic zinc chromate-vinyl butyral wash primer conforming to DOD-P-15328 (Formula 117 for Metals) and SSPC Paint 27. Zinc chromate must be the insoluble type. The paint must be supplied as two components that are mixed together just before use.

9-08.1(2)B GALVANIZING REPAIR PAINT, HIGH ZINC DUST CONTENT

Galvanizing repair paint must conform to Federal Specification MIL-P-21035B.

9-08.1(2)C INORGANIC ZINC-RICH PRIMER

Inorganic zinc-rich primer must be a two-component, self-curing, inorganic zinc-rich paint, conforming to either AASHTO M 300 or SSPC Paint 20 Type I.

9-08.1(2)D ORGANIC ZINC-RICH PRIMER

Organic zinc-rich primer must be a high-performance two-component epoxy conforming to SSPC Paint 20 Type II.

9-08.1(2)E EPOXY POLYAMIDE

Epoxy polyamide primer must be a two-component, VOC-compliant epoxy system, conforming to MIL-DTL-24441.

9-08.1(2)F PRIMER, ZINC-FILLED, SINGLE-COMPONENT, MOISTURE-CURED POLYURETHANE

Zinc-rich primer must comply with the following requirements:

Characteristic	Requirement
Vehicle Type	Moisture-cured polyurethane
Pigment Content	80% min. zinc by weight in dry film
Volume Solids	60% min.
Min. weight/gal	22.0 lbs

9-08.1(2)G INTERMEDIATE AND STRIPE COAT, SINGLE COMPONENT, MOISTURE-CURED POLYURETHANE

Characteristic	Requirement
Vehicle Type	Moisture-cured polyurethane
Pigment	A minimum of 3.0 lbs of micaceous iron oxide per gallon

Intermediate and any stripe coat must comply with the following requirements:

1. Minimum volume of solids is 50 percent.
2. A minimum of 3.0 lbs/gal of micaceous iron oxide.

The intermediate coating must be certified by the manufacturer to be able to be recoated by the top coat in a minimum of 4 days.

9-08.1(2)H TOP COAT, SINGLE-COMPONENT, MOISTURE-CURED POLYURETHANE

Characteristic	Requirement
Vehicle Type	Moisture-cured aliphatic polyurethane
Color	As specified in the Drawings or Special Provisions

The Top Coat must comply with the following requirements:

1. The resin must be an aliphatic urethane.
2. Minimum volume of solids is 50 percent.
3. The top coat must be a semi-gloss.

9-08.1(2)I RUST-PENETRATING SEALER

Rust-penetrating sealer must be a two-component, chemically-cured, 100 percent solids epoxy with maximum VOC 1.7 pounds/gallon.

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9-08.1(2)J BLACK ENAMEL

The enamel must conform to Federal Specification MIL PRF 24635E Type II Class II.

9-08.1(2)K ORANGE EQUIPMENT ENAMEL

The enamel must be an alkyd gloss enamel conforming to Federal Specification TT-E-489, except that the Sag Index must be 7 minimum. The color, when dry, must match that of Federal Standard 595, color number 12246.

For factory application to individual items of new equipment, samples and testing of the enamel are not required; however, the equipment manufacturer must match the color specified and must certify the quality of enamel used.

9-08.1(2)L EXTERIOR ACRYLIC LATEX PAINT-WHITE

This paint must conform to Federal Specification TT-P-96, Paint, Acrylic Emulsion, Exterior, except that the viscosity must be 75-85 K.U.

This paint may be used self-primed in multiple coats over salts-treated wood and on interior and exterior masonry surfaces.

9-08.1(3) WORKING PROPERTIES

The paint must contain no caked material that cannot be broken up readily by stirring. When applied to a clean vertical surface, the paint must dry without running, streaking, or sagging.

9-08.1(4) STORAGE PROPERTIES

Paints manufactured under these Specifications must show no skin over the surface after 48 hours in a filled container, when tested as outlined in Federal Test Method Standard No. 141D. A slight amount of skin or gel formation where the surface of the paint meets the side of the container may be disregarded. Variable percentages of anti-skinning agents are shown in those formulas set forth above that are susceptible to undesirable skin formation. The manufacturer will be allowed to vary the amount of anti-skinning agent given in the formulas provided the above results are accomplished and provided the paint does not dry to a nonuniform or nonelastic film.

9-08.1(5) FINENESS OF GRINDING

The paint must be ground so that all particles of pigment will be dispersed and be coated with vehicle, and the residue on a 325 sieve will not exceed 1 percent by weight of the pigment. Paint must be homogeneous, free of contaminant, and of a consistency suitable for use under intended application. Finished paint must be well ground, and the pigment must be properly dispersed in the vehicle, conforming to the requirements of the paint. Dispersion in the vehicle must be such that the pigment does not settle excessively, does not cake or thicken in the container, and does not become granular or curdled.

9-08.1(6) TEST METHODS

Except as otherwise specified, all paints must be sampled and tested in the ready-mixed form. The test methods must be as specified in Federal Test Method Standard No. 141D or as specified under AASHTO R 31, as applicable.

9-08.1(7) ACCEPTANCE

Except for batches of paint in total project quantities of 20 gallons or less that are accepted upon the manufacturer's certificate of compliance, the manufacturer must not ship any batch of paint until the paint has been tested and released by the SPU Materials Laboratory. This release will not constitute final acceptance of the paint. Final acceptance will be based on inspection or testing of Job Site samples as determined by the Engineer.

Project quantities of 20 gallons or less of the above paint types will be accepted without inspection upon the manufacturer's notarized certificate of compliance. This certificate must contain a statement by the manufacturer to the effect that the material complies with the paint type Specification, and it must include a list of materials and quantities used. One copy of the certificate must accompany the paint when shipped and one copy with a drawdown sample of the paint must be sent to the Laboratory. The paint may be used at once without further release from the Laboratory.

9-08.1(8) STANDARD COLORS

When paint is required to match a Federal Standard 595 color, the paint manufacturer or the Contractor may obtain a sample of the required color through the following internet link: http://www.colorserver.net. For the City of Seattle, the following colors are defined:

Color	Color Number
Black	27030
Seattle Safety Yellow	23594
Seattle Narrows Green	34227

Unless otherwise specified, all top or finish coats must be semigloss, with the paint falling within the range of 35 to 70 on the 60-degree gloss meter.

The Contractor must submit two minimum 4" x 6" paint chip samples to the Engineer at least 10 Working Days before the scheduled application as specified in Section 1-05.3. The color of the paint when dry must match the color of a Standard 595 color chip.

Commission Internationale de l'Eclairage (CIELAB) color system has determined standard values that are used worldwide to measure color. The values used by CIE are called L*, a* and b* and the color measurement method is called CIELAB.

The calculated Delta E must not exceed 1.0 deviation from the Commission Internationale de l'Eclairage color measurement analysis method for each color.

For the City of Seattle, the following colors are defined:

Color	Ill/OBS	L*	a*	b*
Washington Gray	D65/10-degrees	62.59	0.98	5.23
	A/10-degrees	63.06	1.80	5.70
	CWF/10-degrees	63.02	0.73	6.08
Cascade Green	D65/10-degrees	36.62	-6.53	-0.89
	A/10-degrees	35.82	-7.15	-2.53
	CWF/10-degrees	36.34	-5.09	-1.18
Mt. Baker Gray	D65/10-degrees	45.94	1.38	4.46
	A/10-degrees	46.40	1.70	5.05
	CWF/10-degrees	46.46	1.07	5.48
Mt. St. Helens Gray	D65/10-degrees	56.07	2.15	6.68
	A/10-degrees	56.76	3.08	7.52
	CWF/10-degrees	56.67	1.64	7.85
Seattle Railroad Green	D65/10-degrees	27.32	-0.97	0.01
	A/10-degrees	27.22	-1.14	-0.22
	CWF/10-degrees	27.35	-0.73	0.14

The Contractor must submit the specified and spectrophotometer or colorimeter readings taken per ASTM D 2244 to the Engineer at least 10 Working Days before the scheduled application as specified in Section 1-05.3. The Contractor must not begin applying until receiving the Engineer's written approval of the color samples.

When requested by the Engineer, the Contractor must submit a one-quart wet sample companion drawdown color sample for each batch of material.

The 1 quart wet sample must be submitted in the manufacturer's labeled container with product number, batch number, and size of batch. The companion drawdown color sample must be labeled with the product number, batch number, and size of batch. The Contractor must submit the specified samples to the Engineer at least 10 Working Days before the scheduled application or upon request by the Engineer in accordance with Section 1-05.3. The Contractor must not begin applying until receiving the Engineer's written approval of the samples.

9-08.2 POWDER COATING MATERIALS FOR COATING GALVANIZED SURFACES

The powder coating system must consist of two components: an epoxy primer coat and a polyester finish coat. The epoxy primer coat and the polyester finish coat materials must be from the same manufacturer.

The epoxy primer coat must be an epoxy powder primer conforming to the following requirements:

Property	Specification	Performance Requirement
Adhesion	ASTM D 3359 Method B	5B (no failure)
Flexibility	ASTM D 522 Method B	Pass 1/8″ mandrel bend
Pencil Hardness	ASTM D 3363	H Plus
Specific Gravity	ASTM D 792	1.25 minimum

The polyester finish coat must conform to American Architectural Manufacturers Association (AAMA) Specification 2604.

Degassing additives may be added as necessary to prevent pin holes in the finish coat. The degassing additives must be added per manufacturer's recommendations.

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The color of the powder coating system polyester finish coat must be as specified in the Drawings or Special Provisions.

9-08.3 PIGMENTED SEALER MATERIALS FOR COATING OF CONCRETE SURFACES

The pigmented sealer must be a semi-opaque, colored toner containing only methyl methacrylate-ethyl acrylate copolymer resins, toning pigments suspended in solution at all times by a chemical suspension agent, and solvent. Toning pigments must be laminar silicates, titanium dioxide, and inorganic oxides only. There must be no settling or color variation. Tinting must occur at the factory at the time of manufacture and placement in containers, before initial shipment. Use of vegetable or marine oils, paraffin materials, stearates, or organic pigments in any part of coating formulation is not permitted. The Contractor must submit a 1 quart wet sample, a drawdown color sample, and spectrophotometer or colorimeter readings taken per ASTM D 2244, for each batch. The calculated Delta E must not exceed 1.0 deviation from the Commission Internationale de l'Eclairage (CIELAB) color measurement analysis method for each pigmented sealer color.

The 1 quart wet sample must be submitted in the manufacturer's labeled container with product number, batch number, and size of batch. The companion drawdown color sample must be labeled with the product number, batch number, and size of batch. The Contractor must submit the specified samples and readings to the Engineer at least 14 Calendar Days prior to the scheduled application of the sealer. The Contractor must not begin applying pigmented sealer until receiving the Engineer's written approval of the pigmented sealer color samples

9-08.4 ABRASIVE BLAST MATERIALS

9-08.4(1) ABRASIVE BLAST MEDIA

Material used for field abrasive blasting must conform to Military Specification MIL A 22262B(SH) as listed on QPL-22262-28 as maintained by the Department of the Navy. The Contractor must provide the Engineer with certified test results from the abrasive blast media manufacturer showing that the abrasive blast material complies with the Military Specification. The Contractor must select the type and size of abrasive blast media to produce a roughened, sharp, angular surface profile conforming to the surface requirements specified by the manufacturer of the selected paint system.

9-08.4(2) LEAD ABATEMENT ADDITIVE

Lead abatement additive must be a granular chemical abrasive additive consisting of a complex calcium silicate designed to stabilize lead through multiple mechanisms, including, but not limited to, pH adjustment, chemical reactions, and encapsulation. The additive must be specifically designed and manufactured for lead paint abatement.

9-08.5 SURFACE CLEANING MATERIALS

9-08.5(1) BIRD GUANO TREATMENT

Bird guano treatment must consist of a 5.25 percent sodium hypochlorite solution.

9-08.5(2) FUNGICIDE TREATMENT

Fungicide treatment must consist of a 5.25 percent sodium hypochlorite solution.

9-08.5(3) WATER

Water used for water jetting steel surface cleaning operations must be clean, fresh water only, without any detergents, bleach, or any other cleaning agents or additives. Recycling of rinse water for water jetting operations is not allowed.

9-08.6 FILTER FABRIC

Filter fabric for water jetting operations must be a polypropylene, nonwoven, needle-punched geosynthetic, or equivalent material conforming to the following requirements:

Property	Specification	Performance Requirement
Grab Tensile Strength	ASTM D 4632	100 pounds minimum
Apparent Opening Size	ASTM D 4751	#70 sieve
Permittivity	ASTM D 4491	1.0 sec-1 or better

9-08.7 SINGLE-COMPONENT URETHANE SEALANT

Single-component urethane sealant must conform to ASTM C 920 Grade NS Class 25.

9-08.8 FOAM BACKER ROD

Foam backer rod must be closed-cell expanded polyethylene or polyurethane foam.

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SECTION 9-09 TIMBER AND LUMBER

9-09.1 GENERAL REQUIREMENTS

All timber and lumber for Structures must be Douglas Fir Larch, unless specified otherwise in the Contract. Timber and lumber for guardrail posts must be Douglas Fir Larch or Hem Fir. Timber and lumber for sign posts, mileposts, sawed fence posts, and mailbox posts, must be Western Red Cedar, Douglas Fir Larch, or Hem Fir.

9-09.2 GRADE REQUIREMENTS

Timber and lumber grades must be as determined by the current standards of the West Coast Lumber Inspection Bureau (WCLIB) or the Western Wood Products Association (WWPA).

Timber and lumber for Structures, unless specified otherwise in the Contract, must conform to these grades:

Material	Requirement
Materials 2” to 4” nominal thick, 5” nominal and wider (Structural Joists and Planks)	No. 1 and better, grade (Section 123 b of WCLIB) or (Section 62.11 of WWPA)
Materials 5” nominal and thicker (Beams and Stringers)	No. 1 and better, grade (Section 130 b of WCLIB) or (Section 70.11 of WWPA)

Timber lagging for soldier pile walls must be Douglas Fir Larch, grade No. 2 or better.

Timber and lumber for guardrail posts (classified as Posts and Timbers) must conform to these grades:

Material	Requirement
Douglas Fir	No. 1 and better, grade (Section 131 b WCLIB) or (Section 80.11 WWPA)
Hem Fir	Select Structural, grade (Section 131 a WCLIB) or (Section 80.10 WWPA)

Mileposts, sawed fence posts, and mailbox posts must conform to these grades:

Material	Requirement
4 x 4	Construction grade (Light Framing, Section 122 b WCLIB) or (Section 40.11 WWPA)
4 x 6	No. 1 and better, grade (Structural Joists and Planks, Section 123 b WCLIB) or (Section 62.11 WWPA)
6 x 6, 6 x 8, 8 x 10	No. 1 and better, grade (Posts and Timbers, Section 131 b WCLIB) or (Section 80.11 WWPA)
6 x 10, 6 x 12	No. 1 and better, grade (Beams and Stringers, Section 130b WCLIB) or (Section 70.11WWPA)

Sign posts must comply with Section 9-28.2.

9-09.2(1) SURFACING AND SEASONING

All timber and lumber must be sized as shown on the Drawings.

All timber and lumber to be painted must be surfaced on all sides. All timber and lumber to be painted must be thoroughly air or kiln dried to an equilibrium moisture content and must be stored in such a manner as to remain in a thoroughly dry condition until placed into the Work.

9-09.2(2) INSPECTION

Timber and lumber must be marked with a certified lumber grade stamp provided by one of the following agencies:

1. West Coast Lumber Inspection Bureau (WCLIB)
2. Western Wood Products Association (WWPA)
3. Pacific Lumber Inspection Bureau (PLIB)
4. Any lumber grading bureau certified by the American Lumber Standards Committee

A grading certificate must accompany each order of timber and lumber for use in Structures as specified in Section 9-09.2. The certificate must be issued by either the grading bureau whose stamp is shown on the material, or by the lumber mill which is under the supervision of one of the grading bureaus listed above. The grading certificate must include the following:

a. Name of the mill performing the grading.
b. The grading rules being used.
c. Name of the person doing the grading with current certification.
d. Signature of a responsible mill official.

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e. Date the lumber was graded at the mill.

f. Grade, dimensions, and quantity of the timber or lumber.

When the Material is delivered to the project, the Engineer will check the order for the appropriate grade stamp. The invoice and grading certificate accompanying the order must be accurate and complete with the information listed above. The grading certificate and grade markings will not constitute final acceptance of the Material. The Engineer may reject any or all of the timber or lumber that does not comply with the Specifications or has been damaged during shipping or upon delivery.

9-09.3 PRESERVATIVE TREATMENT

All timber and lumber requiring preservative treatment must be treated per AASHTO M 133. As specified by AASHTO M 133, the American Wood-Preservers' Association (AWPA) standards govern the Specifications for storing and curing the timber and lumber, the wood preservatives, the preservative treatment process, recording the results of the treatment, inspection, testing, and the identification of properly treated timber. Unless otherwise specified in the Contract, all timber and lumber must be treated per Sections U1 and T1 of the latest edition of the AWPA standards.

All cutting, boring, chamfering, routing, surfacing, and trimming must be done prior to treating. Any field drilling or cutoffs must be treated by two liberal applications of a compatible preservative. The applications must be per AWPA Standard M4-15 Standard for the Care of Preservative-Treated Wood Products.

All charges must consist of pieces of the same species that are similar in form, size, moisture content, and receptivity to treatment. The pieces in the charge must be separated to ensure contact of treating medium with all surfaces. The method of determining the retention of the preservatives must be by assay.

As specified in the Contract, all orders of treated timber and lumber will be accompanied by a Certificate of Treatment.

The Certificate of Treatment must include:

1. Name and location of the wood preserving company.
2. Customer identification.
3. Date of treatment and charge number.
4. Type of chemical used and amount of retention.
5. Treating process and identification of the Specification used.
6. Description of material that was treated.
7. Signature of a responsible facility official.

In addition to the Certificate of Treatment, all orders of treated timber or lumber must be accompanied by a Grading Certificate as specified in Section 9-09.2(2). Such certification or approved for shipment tag does not constitute final acceptance of the Material. The Engineer may reject any or all of the timber or lumber that does not comply with the Specifications or has been damaged during prolonged storage, shipping, or upon delivery.

All timber and lumber to be used in aquatic environments, unless specified otherwise in the Contract, must be chemically treated using BMPs. The producer of the chemically treated products must supply a written certification that the BMPs were utilized, including a description and appropriate documentation of the BMPs used. This information may be included on the Certificate of Treatment.

SECTION 9-10 PILES

9-10.1 TIMBER PILES

9-10.1(1) GENERAL

Timber piles must be untreated or treated with the preservatives specified on the Drawings and in Section 9-09.3.

Timber piles must have the following limiting diameters:

Length in Feet	Min. Butt Diameter 3 ft. Above Butt (inch)	Max. Butt Diameter 3 ft. Above Butt (inch)	Min. Tip Diameter (inch)
Under 40	12	20	7
40-54	12	20	7
55-74	13	20	7
Over 74	14	20	7

Timber piles must be strapped with at least 3 straps: one approximately 18 inches from the butt, one approximately 24 inches from the butt, and one approximately 12 inches from the tip. Additional straps must be provided at approximately 15-foot centers between the butt and tip. Strapping must encircle the pile once and be tensioned as tightly as possible. Straps must be 1-1/4 inches wide, 0.031 inch thick, cold rolled, fully heat treated, high tensile strapping, painted, and waxed, with an ultimate tensile strength of 5,100 pounds. The seal must be 2-1/4 inches long, 20 gage, crimped with a notch type sealer to furnish a joint yielding 80 percent of the strap tensile strength. Treated timber piles must be strapped after treatment.

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9-10.1(2) UNTREATED PILES

Except where specifically provided otherwise, untreated timber piles must be Douglas Fir, Western Red Cedar, or Larch. Piles for foundations must be Douglas Fir. Piles must be cut from sound, live trees and must contain no unsound knots. Sound knots will be permitted, provided the diameter of the knot does not exceed 4 inches, or 1/3 of the small diameter of the pile at the point where they occur, whichever is smaller. Any defect or combination of defects that impair the strength of the pile more than the maximum allowable knot will not be permitted.

Piles must be cut above the butt swell and must have a uniform taper from butt to tip. A line drawn from the center of the tip to the center of the butt must not fall outside the center of the pile at any point more than 1 percent of the length of the pile. A spiral grain or twist in excess of 1/4 turn in 10 feet of length will be cause for rejection.

Untreated timber trestle piles must have an average of at least 5 annual rings per inch measured radially over a distance of 3 inches at the butt, beginning at a point 3-1/2 inches from the heart. At least 9 inches of heartwood must show at the butt.

Ring count requirements for untreated timber foundation piles and detour trestle piles will be waived.

9-10.1(3) CREOSOTE TREATED PILES

For creosote treated piles, Douglas Fir timber must be used. All other requirements must be the same as for untreated piles except that the ring count requirement will be waived.

9-10.1(4) TIMBER COMPOSITE PILES

Timber composite piles must consist of a pile made up of two timber sections. The lower section must be untreated, and the upper section must be creosote treated.

The treated and untreated sections of timber composite pile must comply with the respective Specifications above for full length of treated and untreated timber piles.

9-10.1(5) PEELING

Untreated and creosote treated piles must be peeled by removing all of the rough bark and at least 80 percent of the inner bark. Any strip of inner bark remaining on the pile must not exceed 3/4 inch wide or 8 inches long, and there must be at least 1 inch of clean wood surface between any two such strips. At minimum, 80 percent of the surface on any circumference must be clean wood. All knots must be trimmed close to the body of the pile.

9-10.2 CONCRETE PILES

9-10.2(1) CONCRETE

Portland cement as specified in Section 9-01 must be used in all precast concrete piles.

The concrete for precast prestressed piles must be as specified in Section 9-19. The concrete for prestressed piles must have a minimum compressive strength of 6,000 psi at the age of 28 Days. The minimum compressive strength of concrete at the transfer of prestress must be 3,300 psi.

The concrete for all other precast piles must be Class 4000P. Mixing, transporting, and placing concrete must be as specified in Section 6-02.3.

The Contractor must mold and test a sufficient number of concrete test cylinders to determine the strength of the concrete as required by the Specifications. Under the surveillance of the Engineer, the test cylinders must be molded, cured, and tested per the procedures established by the Laboratory.

If a sufficient number of concrete test cylinders are not molded to satisfy all testing required on any one pile, cores measuring 4 inches in diameter by 5 inches in height must be taken and tested by the Contractor. If the strength of the core meets the required compressive strength of the concrete, the pile may be accepted. The coring and testing of the core must be done under the surveillance of the Engineer.

9-10.2(2) REINFORCEMENT

Reinforcement must be as specified in Section 9-07.

9-10.3 CAST IN PLACE CONCRETE PILES

9-10.3(1) REINFORCEMENT

Reinforcement for cast in place concrete piles must conform to AASHTO M 31, Grade 60.

9-10.4 STEEL PILE TIPS AND SHOES

Steel pile tips and shoes must be fabricated of cast steel conforming to ASTM A 148, Grade 90-60 [620-415] or ASTM A 27, Grade 65 35 [450-240] and be free from any obvious defects. Pile tips must be accompanied by a mill test report stating the chemical and physical properties (tensile and yield) of the steel.

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9-10.5 STEEL PILES

The Material for steel piles and pile splices must conform to ASTM A 36, except the Material for steel pipe piles and splices must conform to the Specifications of ASTM A 252, Grade 2. All steel piles may be accepted by the Engineer based on the manufacturer's certificate of compliance.

SECTION 9-11 WATERPROOFING

9-11.1 ASPHALT FOR WATERPROOFING

Asphalt for waterproofing must conform to the Specifications of ASTM D 312, Type 4.

The Material used as primer must conform to the Specifications of ASTM D 41, Primer for Use with Asphalt in Dampproofing and Waterproofing.

Acceptance must be as specified in Section 9-02.2(1).

9-11.2 WATERPROOFING FABRIC

Waterproofing fabric must be a saturated cotton fabric complying with the Specifications of ASTM D 173, Woven Cotton Fabrics Saturated with Bituminous Substances for Use in Waterproofing.

9-11.3 PORTLAND CEMENT MORTAR

Portland cement and fine sand for the mortar protection course must conform to the following Specifications:

Material	Section
Portland Cement	Section 9-01
Sand	Section 9-03.1(2)C
Mortar	Section 9-20.4

SECTION 9-12 MAINTENANCE HOLES, CATCH BASINS, AND INLETS

9-12.1 REINFORCED CONCRETE

9-12.1(1) GENERAL

Reinforced concrete must consist of Portland cement, fine and coarse aggregates and water, in which steel has been embedded in such manner that the steel and concrete act together.

All cast in place concrete must be Class 4000 as specified in 6-02.3(1) and 6-02.3(2). Strength determination must be per ASTM C 39. Precast components must conform to ASTM C 478 strength requirements.

The use of admixtures requires the approval of the Engineer. Concrete with air entraining admixture must comply with ASTM C 175.

9-12.1(2) CEMENT

Portland cement must be as specified in Section 9-01.

9-12.1(3) STEEL REINFORCEMENT

Reinforcement must consist of wire conforming to ASTM A 82 or ASTM A 496, or wire fabric conforming to ASTM A 185 or ASTM A 497, or Grade 60 steel bars conforming to ASTM A 615 or Grade 80 steel bars conforming to ASTM A 306.

9-12.1(4) AGGREGATES

Aggregates for cast in place concrete must conform to ASTM C 33.

9-12.2 STEPS, HANDHOLDS, AND LADDERS

9-12.2(1) GENERAL

The Material for maintenance hole steps, ladders, and handholds must be the same material in any individual drainage Structure. See Section 7-05.3(1)M for submittal requirement. Sizes of components, dimensions, and layout must conform to Standard Plan 232.

9-12.2(2) POLYPROPYLENE ENCAPSULATED REINFORCING STEEL

Polypropylene steel reinforced steps must be made of copolymer polypropylene plastic that encapsulates a 1/2-inch diameter grade 60 steel reinforcing steel. Steel reinforcing must conform to the Specifications of ASTM A 615, and copolymer polypropylene plastic must conform to Specifications of ASTM D 4101. Steps must have serrated tread, measure 13 inches center to center between legs of the step, and be designed to withstand pullout forces of 1500 pounds.

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The Contractor may, with the Engineer's approval, use plastic maintenance hole steps manufactured by Lane International Corporation, or steps manufactured by M.A. Industries, Inc.

9-12.3 MORTAR AND GROUT FOR SEWER AND DRAINAGE STRUCTURES

9-12.3(1) MORTAR FOR JOINTS

Mortar for jointing precast or masonry maintenance hole, catch basin, or inlet units must be one part Portland cement to not less than one part nor more than two parts sand meeting the requirements for Mineral Aggregate Type 7, mixed with the least amount of clean water necessary to provide a workable mortar. Joints between precast maintenance hole elements must also be rubber gasketed as noted in Section 7-05.3(1)I.

9-12.3(2) MORTAR FOR PLASTER COATING

Mortar for plaster coating or lining masonry unit maintenance holes must be proportioned according to either of the two alternates below:

Alternate	Parts by Volume Portland Cement	Parts by Volume Masonry Cement	Parts by Volume Hydrated Lime or Lime Putty	Plaster Sand Measured in Damp Loose Condition
1	1	1 (Type II)	0	Not less than 2-1/4 and not more than 3 times the sum of volumes of cement and lime
2	1	0	1/4	

9-12.3(3) GROUT

Grout for filling the void in Sewer and Drainage Structures where pipe connections are made must be non-shrink cement sand grout as specified in Section 9-04.3(2).

9-12.4 CONCRETE MASONRY UNITS

Concrete masonry unit (also called concrete masonry block) must conform to ASTM C 139, except that nominal horizontal thickness must be 6 inches measured radially, and blocks must have semicircular mortar grooves approximately 1-inch radius at the ends.

9-12.5 CONCRETE BRICK

Concrete brick must conform to ASTM C 55, Grade S.

9-12.6 CLAY BRICK

Clay brick must conform to ASTM C 32, Grade MM unless otherwise specified in the Contract.

9-12.7 METAL CASTINGS

9-12.7(1) MAINTENANCE HOLE RING AND COVER

Ring and cover casting dimensions must conform to the Standards. Rings must be manufactured from gray iron ASTM A 48, Class 30 or ductile iron ASTM A 536, Grade 80 55 06. Covers must be manufactured from ductile iron ASTM A 536, Grade 80 55 06. Rings and covers must be free of defects such as porosity, pittings, shrink cavities, cold shuts, cracks, and other surface defects which would impair serviceability. Repair of defects by welding or by the use of smooth on plasticized metals or similar material will not be accepted. Manufacturer must certify that the product conforms to these Specifications. As specified in Section 1-06.1, where source of material is different from manufacturer, the Contractor must also provide the name and location of the manufacturer

Castings must be bare metal. Artificially coated or painted castings will be cause for rejection.

Castings must be machine finished on the horizontal seating surface and the vertical facing surface common to the ring and cover to assure full bearing (nonrocking) for the entire width and circumference of the bearing surface and permit interchangeability with other castings of the same design, regardless of the source. The vertical face common to the ring and cover must be beveled as shown on the Standards. Upon request of the Engineer, the manufacturer must furnish at the foundry standard ring and covers for use by the Engineer in testing fit and seating.

All covers must be labeled with the following information:

1. Name or symbol of the manufacturer;
2. Owner's name (City of Seattle, min. 1/2-inch letters recessed flush with adjacent surface);
3. Material label "DUC" for Ductile Iron;
4. Identification of its use in 3-inch high lettering (such as Sewer or Drain); and

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5. Country of manufacture/origin.

Items 2. and 4. must be on the exposed face of the cover. Items 1., 3., and 5. may be located at the manufacturer's option. If located on the exposed face of the cover, item 1. and 3. must be adjacent to each other and must be set in at least 1/2-inch high recessed letters. Where lock type castings are called for, a locking device must permit the cover to be readily released from the ring. Movable parts must be made of non-corrosive metals and be designed to avoid possible binding. Upon request by the Engineer, the manufacturer must furnish testing apparatus at the foundry capable of applying uplift pressure on the lid of at least 20-foot head of water which the assembly needs to withstand without failure.

All maintenance hole rings must be labeled with the name or symbol of the manufacturer and the type of material.

9-12.7(2) METAL FRAME AND GRATE AND METAL COVER FOR CATCH BASINS OR INLETS

The frame may be made of gray iron, ASTM A 48, Class 30 minimum, or ductile iron, ASTM A 536, Grade 80 55 06, at the manufacturer's option. The grate and cover must be made of ductile iron only. Other applicable Specifications of Section 9-12.7(1) apply, except item (4) for identification marking.

Catch Basins, Type 242A and 242B and Inlets, Type 250A and 250B must be furnished with a vaned grate as shown on Standard Plan 265.

Where an ADA accessible casting is specified on the Drawings, the grate must not allow passage of a sphere larger than ½ inch in diameter and any elongated openings must be oriented perpendicular to the dominant direction of travel, as well as all other requirements in PROWAG R302.6.3.

9-12.7(3) CAST METAL INLETS

The castings for cast metal inlets must be cast steel or ductile iron as specified in Section 9-06.5 or Section 9-06.11. Substitutions may be accepted as specified in Section 1-06.1. Vaned grates must be embossed as shown on Standard Plan 264.

9-12.8 JUNCTION BOX

Junction box must comply with Standard Plan 277 and reinforcing must be per WSDOT Standard Plan for Type 1 catch basin.

9-12.9 SHOP FABRICATED CORRUGATED METAL MAINTENANCE HOLES

Where corrugated metal maintenance holes are specified, they must conform to the details as specified in the Contract. All pipe connections to the maintenance hole stubs must be made with a standard band type as shown on the Drawings.

See Section 7-16.2 for restrictions on the use of corrugated metal pipe.

9-12.10 MONOLITHIC CONCRETE MAINTENANCE HOLES

Monolithic concrete maintenance holes must conform to the Standard Plans.

9-12.11 OUTLET TRAPS

Catch Basin outlet traps must be constructed per Standard Plan 267.

9-12.12 GRATE INLETS AND DROP INLETS

Steel in grates, angles, and anchors for grate inlets and drop inlets must conform with AASHTO M 183, except structural tube must conform with ASTM A 500, Grade B. After fabrication, the steel must be hot dip galvanized with a minimum coating of 2 ounces of zinc per square foot per AASHTO M 111 or galvanized with a hot sprayed (plasma flame applied) 6 mm minimum thickness zinc coating.

Steel grating must be fabricated by weld connections. Bearing bars and cross bars must be resistance welded at the intersecting joints. Welds, welding procedures, and welding materials must conform to Standard Specifications for Welding issued by the American Welding Society.

Vaned grates must be embossed as shown on Standard Plan 264.

Substitution of grate designs will be permitted with the approval of the Engineer if:

1. The hydraulic capacity is not decreased.
2. The overall dimensions are the same allowing the grate to be interchangeable.
3. The strength is at least equal to the grate shown in the Standard.
4. A manufacturer's certificate of compliance is submitted indicating compliance with items 1, 2, and 3.

The Contractor has the option of furnishing either cast in place or precast inlets unless otherwise shown in the Contract. Alternate designs are acceptable provided they conform to fabricator's Shop Drawings approved by the Engineer for projects prior to Award.

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SECTION 9-13 RIPRAP, QUARRY SPALLS, AND SLOPE PROTECTION

9-13.1 GENERAL

The stone for riprap and quarry spalls must be hard, sound, and durable. It must be free from segregation, seams, cracks, and other defects tending to destroy its resistance to weather. Riprap and quarry spalls used for new rock facing or slope stabilization must comply with Specifications in Section 9-03.15.

9-13.2 LOOSE RIPRAP

Loose riprap must be free of rock fines, soil, or other extraneous material.

If the riprap contains insufficient 4-inch to 8-inch spalls, as defined in Section 9-13.6, the Contractor must furnish and place supplementary spall material from a source approved by the Engineer, at the Contractor's sole expense.

The grading of the riprap will be determined by the Engineer by visual inspection of the load before it is dumped into place, or, if so directed by the Engineer, by dumping individual loads on a flat surface and sorting and measuring the individual rocks contained in the load.

9-13.2(1) HEAVY LOOSE RIPRAP

Heavy loose riprap must comply with the following grading requirements:

	Minimum Size	Maximum Size
40-90%	1 ton (1/2 cy)	--
70-90%	300 lbs (2 cf)	--
10-30%	3"	50 lbs (spalls)

9-13.2(2) LIGHT LOOSE RIPRAP

Light loose riprap must comply with the following grading requirements:

	Size Range	Maximum Size
20-90%	300 lbs to 1 ton (2 cf to 1/2 cy)	--
15-80%	50 lbs to 1 ton (1/3 cf to 1/2 cy)	--
10-20%	3"	50 lbs (spalls)

9-13.3 HAND PLACED RIPRAP

Hand placed riprap must be as nearly rectangular as possible, 60 percent must have a volume of not less than 1 cubic foot. All stones used must be a minimum of 6 inches thick, and must extend through the wall.

9-13.4 SACK RIPRAP

Sack riprap must consist of concrete placed in sacks made of at least 10 ounce burlap and having a capacity of approximately 2.5 cubic feet. Each sack must be filled with approximately 1 cubic foot of concrete having a consistency in conformance with Section 6-02.3(4)C for non-vibrated concrete.

For sack riprap exposed to fresh water, the concrete must be unreinforced Class 3000; and for sack riprap exposed to salt water, the concrete must be Class 3000 as specified in Section 6-02.3.

The Portland cement and fine and coarse aggregates must conform to the requirements for Portland cement and fine and coarse aggregate of Section 9-01 and Section 9-03.1, respectively.

9-13.5 CONCRETE SLOPE PROTECTION

9-13.5(1) GENERAL

Concrete slope protection must consist of reinforced Portland cement concrete poured or pneumatically placed upon the slope with a rustication joint pattern or semi open concrete masonry units placed upon the slope closely adjoining each other.

9-13.5(2) SEMI OPEN CONCRETE MASONRY UNITS SLOPE PROTECTION

Precast cement concrete blocks must conform to the Specifications of ASTM C 90, Type II.

9-13.5(3) POURED PORTLAND CEMENT CONCRETE SLOPE PROTECTION

Cement concrete for concrete slope protection must be Class 3000 in conformance with Section 6-02.3.

Wire mesh reinforcement must conform to Section 9-07.7.

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9-13.5(4) PNEUMATICALLY PLACED PORTLAND CEMENT CONCRETE SLOPE PROTECTION

Cement must be Portland cement as specified in Section 9-01.

Aggregate must be fine aggregate as specified in Section 9-03.1. The moisture content of the fine aggregate at the time of use must be between 3 percent and 6 percent by weight.

Wire mesh reinforcement must be as specified in Section 9-07.7.

Water must be as specified in Section 9-25.1.

9-13.6 QUARRY SPALLS

Spalls must be hard, sound, and durable; and must be free from fracture, seams, cracks, and other discontinuities tending to adversely impact its resistance to weathering. Quarry spalls must meet the 5 test requirements specified in Section 9-03.15. Quarry spalls must comply with the following gradation requirements:

2-inch to 4-inch Quarry Spall

Sieve Size	Percent Passing
4”	100
2”	40 max.
1-1/4”	5 max.

4-inch to 8-inch Quarry Spall

Sieve Size	Percent Passing
8”	100
4”	40 max.
2”	5 max.

All percentages are by weight.

SECTION 9-14 EROSION AND LANDSCAPE MATERIALS

9-14.1 SOILS

The following soils and soil mixes are specified on Drawings or by the Engineer, according to project needs, and are all subject to the General Testing and Submittal Specifications of Section 9-14.1(A):

1. Topsoil Type A – Imported. A general purpose mix of sandy loam and compost as needed to comply with minimum organic matter content requirements. Similar to WSDOT’s Topsoil Type A Specification.
2. Reused Amended Site Soil. Soil from the Project Site that is either amended in place or moved/stockpiled during grading operations and then amended with compost as needed to comply with minimum organic matter content requirements.
3. Bioretention Soil. An imported mix made of Mineral Aggregate and compost specified to comply with the infiltration and filtration requirements of stormwater management Structures. Bioretention soil must be procured only from suppliers which have an active solid waste handling permit from the local jurisdictional Health Department as per WAC 173-350-220 or WAC 173-308.
4. Planting Soil. An imported soil mix for planting beds, planted medians, and planting strips.
5. General Turf Area Soil. An imported soil mix for passive-recreation turf areas.
6. High Performance Turf Mixes. An imported soil mix for intensive-use turf areas, including 3 different mixes of sand and compost to optimize drainage and fertility in different sites and uses.

9-14.1(1) GENERAL TESTING AND SUBMITTAL REQUIREMENTS

At least 10 Working Days prior to placement of any soils specified in Section 9-14, except for bioretention soils, the Contractor must submit to the Engineer the following as specified in Section 1-05.3. All test results must be from samples collected and tested less than 90 days prior to date of submittal.

1. Aggregate and Loam Analysis. Grain size analysis results of the Mineral Aggregate or sandy loam portion of each soil mix, performed by an accredited laboratory per ASTM C 136.
2. Compost Analysis. Quality analysis results for the compost portion of each soil mix performed per STA standards, as specified in Section 9-14.4(8).
3. Mix Analysis. Test results from an accredited soil laboratory, including the following content values:
   a. Total Nitrogen and Soluble Nitrogen (NO3 + NH3)

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b. Phosphorous
c. Potassium
d. pH
e. Organic Matter percent (Loss on Ignition method)
f. Conductivity
g. Calcium
h. Sulfur
i. Boron
j. Weed seed (for general turf area soil and high performance turf mixes)

4. Recommendations. Fertilizer and amendment recommendations for the specified plant type (turf, shrubs/groundcovers, or annuals: with special provisions for bioretention applications) and soil application depth; from the accredited laboratory, an accredited soil scientist or agronomist.
5. Mix Samples. Two 1-gallon samples of each soil mix or two 5-gallon samples for high performance turf mixes.
6. Manufacturer. The manufacturer's certificate of compliance as specified in Section 1-06.3 from the Supplier of the soil mix, and (if different) the Suppliers of the compost, including their name and address.
7. Laboratory Information. Include the following information about the testing laboratories:
   a. Name of laboratory including contact person,
   b. Address,
   c. Phone contact,
   d. Email address,
   e. Qualifications of laboratory and personnel including date of current certification by STA, ASTM, AASHTO, or approved equal.
8. Acceptance of Soils Prior to Placement. The Contractor must not place any soils or soil mixes specified in Section 9-14 until the Engineer has reviewed and confirmed the following:
   a. Soil mix delivery tickets. Delivery tickets must show that the full delivered amount of soil matches the product type, volume and Manufacturer named in the submittals.
   b. Visual inspection. Delivered product will be compared to the submitted sample, to verify that it matches the submitted sample.

The Engineer may inspect any loads of soil on delivery and stop placement if it is determined the delivered soil does not appear to match the submittals; and require sampling and testing of the delivered soil, before authorizing soil placement. The Contractor is responsible for all testing costs.

9-14.1(1)A BIORETENTION SOIL TESTING AND SUBMITTAL REQUIREMENTS

All test results must be from samples collected and tested less than 90 days prior to date of submittal. At least 10 Working Days prior to placement of bioretention soils, the Contractor must submit to the Engineer the following in accordance with Section 1-05.3:

1. Aggregate Analysis. Grain size analysis results of the Mineral Aggregate for bioretention soil (See Section 9-03.2(2)) performed by an independent laboratory in accordance with ASTM C 136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
2. Compost Analysis. Quality analysis results for the compost for bioretention soil performed in accordance with STA standards, as specified in Section 9-14.4(8).
3. Mix Analysis
   a. Organic Matter Content using Loss-On-Ignition Method, per ASTM D2974 or TMECC 05.07A. The percent organics in the mixed sample must be between 4 percent and 8 percent.
   b. Grain Size Analysis of the oven residue from Loss-On Ignition test to determine fraction passing #200 screen per ASTM C117, and the fraction passing #4, #10, #40, #100, and #200 screens per ASTM C136.

      The gradation analysis of the oven residue must confirm to the following requirements:

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Sieve Size	Percent Passing
3/8” Square	100
No. 4	57 – 100
No.10	37 – 100
No. 40	12 – 53
No. 200	2 - 8

Individual test variations under the minimum or over the maximum will be permitted, provided the average of 3 consecutive tests is within the limits specified.

4. Mix Samples. Two 5- gallon samples of the bioretention soil mix, along with the following information:
   a. The manufacturer’s certificates of compliance per Section 1-06.3 from the Supplier of the bioretention soil mix, and if different, the Suppliers of the mineral aggregate and compost components, including their names and addresses.
   b. A description of the equipment and methods to mix the mineral aggregate and compost to produce bioretention soil.
   c. Information about the testing laboratory, including the name of the laboratory and contact person, address, phone number, e-mail address, and qualifications of laboratory and personnel including date of current certification by STA, ASTM, AASHTO, or approved equal.

9-14.1(1)B HIGH PERFORMANCE BIORETENTION SOIL MEDIA (HPBSM) TESTING AND SUBMITTAL REQ

All test results must be within 45 days of blending and be taken from the same stockpile, batch, or source as will be used in the blending.

At least 10 Working Days prior to the blending of the HPBSM the Contractor must submit to the Engineer the following:

1. Component Sourcing and Testing
   a. Coconut Coir Fiber
      1) Source certificate or manufacturer cut sheet showing the source for and description of the material.
      2) Synthetic Precipitation Leaching Protocol (SPLP) performed by an independent Washington State Department of Ecology certified laboratory.
      3) Electrical conductivity (TMECC Method 04.10-A) performed by an independent certified laboratory.
      4) Material density in lbs/CF or lbs/CY.
   b. Filter Sand
      1) Source certificate or manufacturer cut sheet showing the source for and description of the material.
      2) Synthetic Precipitation Leaching Protocol (SPLP) performed by an independent Washington State Department of Ecology certified laboratory.
      3) Grain size analysis and coefficient of uniformity results performed by an independent certified laboratory in accordance with Section 9-03.13 for at least the sieves specified in Section 9-03.1(2)C for Mineral Aggregate, Type 6.
      4) Material density in lbs/CF or lbs/CY.
      5) The grain size analysis testing must be performed on the filter sand at least once for every 100 CY of HPBSM produced.
   c. Biochar
      1) Source certificate or manufacturer cut sheet showing the source for and description of the material including feedstocks.
      2) Synthetic Precipitation Leaching Protocol (SPLP) performed by an independent Washington State Department of Ecology certified laboratory.
      3) Proximate analysis results performed by an independent certified laboratory in accordance with ASTM D1762, Standard Test Method for Chemical Analysis of Wood Charcoal for the criteria shown.
      4) Presence of the metals listed per EPA method 6020.
      5) Grain size analysis results performed by an independent certified laboratory in accordance with ASTM D422, Standard Test Method for Particle-Size Analysis of Soils for at least the sieves shown in the material descriptions in Section 9-14.1(8).
      6) Material density in lbs/CF or lbs/CY.
      7) All biochar testing must be performed at least once for every 100 CY of HPBSM produced.
2. Laboratory Information. Include the following information for the laboratories used for the material testing:

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a. Name of Lab
b. Address
c. Phone number
d. Contact person with email
e. Date of current certification by STA, ASTM, AASHTO, or the Department of Ecology.

9-14.1(1)C HPBSM AND BIORETENTION POLISHING LAYER MEDIA BLENDING REQUIREMENTS

The Contractor must submit a "HPBSM and Bioretention Polishing Layer Media Blending, Delivery, and Protection Plan" in accordance with Section 1-05.3. The submittal must be approved by the Engineer prior to any blending of the HPBSM, or bioretention polishing layer media. The submittal must include the completed "HPBSM Blending, Delivery, and Protection Plan Form", as shown here: https://www.seattle.gov/utilities/your-services/sewer-and-drainage/for-our-waters/green-stormwater-infrastructure.

The HPBSM and bioretention polishing layer media blending Vendor/Contractor must have at least 3-years of soil blending experience. The blending must occur within 50 miles of Seattle, WA.

The Contractor must notify the Engineer at least 72 hours prior to blending of the date, time and location where the blending is to occur so the Engineer may attend and observe the blending.

The blending must occur on an impervious (asphalt or concrete) surface pad that has been thoroughly washed clean (e.g., pressure washed) prior to blending or in purpose-built soil blending equipment that has been washed. The blending pad must be large enough to be able to turn and mix the media without introducing contamination. The blending pad must be free of standing water before blending and must be protected from stormwater run-on from off the pad.

The HPBSM and bioretention polishing layer media must be mechanically blended to produce a homogeneous mix. The measurement of the components to be blended must be by weight on scale equipment capable of measuring within 1 pound or in full vessels of a known volume. Estimating the volumes of materials of partially full buckets or vessels must not be used. Prior to blending, the coconut coir fiber must be loose and hydrated such that its density is 4-5 pounds per cubic foot.

The materials must be blended until they are in a homogenous mixed state and then protected from contamination or saturation during storage, delivery, stockpiling, and placement.

The HPBSM and bioretention polishing layer media must be delivered to the Project Site in "super sack" bulk bags and must not be transported loose in a truck.

Suppliers who have demonstrated they can meet the qualifications in the past are provided at: https://www.seattle.gov/utilities/your-services/sewer-and-drainage/for-our-waters/green-stormwater-infrastructure.

9-14.1(1)D BIORETENTION POLISHING LAYER MEDIA TESTING AND SUBMITTAL REQUIREMENTS

At least 10 Working Days prior to the blending of the bioretention polishing layer media, the Contractor must submit to the Engineer the following. This information is required even if using the pre-approved Material. The dates of the tests must be within 45 days of blending and be taken from the same stockpile, batch, or source as will be used in the blending. All testing must be by a certified laboratory.

1. Component Sourcing and Testing
   a. Filter Sand
      1) Source certificate or manufacturer cut sheet showing the source for and description of the material.
      2) Synthetic Precipitation Leaching Protocol (SPLP) performed by an independent Washington State Department of Ecology certified laboratory.
      3) Grain size analysis results performed by an independent certified laboratory in accordance with Section 9-03.13 for at least the sieves specified in Section 9-03.1(2)C for Mineral Aggregate, Type 6.
      4) Material density in lbs/CF or lbs/CY.
      5) The grain size analysis must be performed on the filter sand at least once for every 50 CY of bioretention polishing layer media produced.
   b. Activated Alumina
      1) Synthetic Precipitation Leaching Protocol (SPLP) performed by an independent Washington State Department of Ecology certified laboratory.
      2) Producer cut sheet showing the source for and description of the material including Alumina (Al2O3) content, bulk density, surface area and gradation for at least the sieves shown in the material description above.
      3) Material density in lbs/CF or lbs/CY. Material densities provided by the manufacturer are acceptable for the activated alumina.
   c. Iron Aggregate
      1) Producer cut sheet showing the source for and description of the material including Iron content, and gradation for at least the sieves shown in the material description above.

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2) Synthetic Precipitation Leaching Protocol (SPLP) performed by an independent Washington State Department of Ecology certified laboratory.
3) Grain size analysis results performed by an independent certified laboratory in accordance with ASTM D422, Standard Test Method for Particle-Size Analysis of Soils for at least the sieves shown in the material descriptions in Section 9-14.1(8).
4) Material density in lbs/CF or lbs/CY.

2. Laboratory Information. Include the following information for the laboratories used for the material testing:
   a. Name of Lab
   b. Address
   c. Phone number
   d. Contact person with email
   e. Date of current certification by STA, ASTM, AASHTO, or the Department of Ecology.

9-14.1(2) TOPSOIL TYPE A - IMPORTED

Topsoil Type A must consist of an imported sandy loam as defined by the United States Department of Agriculture Classification System, and documented by a particle size analysis performed by an accredited laboratory.

Topsoil Type-A must have an organic matter content of at least 5 percent by dry weight where turf will be installed, and at least 10 percent by dry weight for all other landscape areas. Organic matter must be determined by Loss-on-Ignition test (ASTM D2974, or TMECC 05.07A). If additional organic content is needed to comply with these Specifications, soil must be amended with compost as specified in Section 9-14.4(8). Compost amendment requirements may be added at default rates of 22 percent by volume for turf or 38 percent for planting beds (1-3/4-inch amendment tilled to 8-inch depth for turf, 3-inch amendment tilled to 8-inch depth for beds); or calculated based on tests of the soil and compost, using the Soil Amendment Rate Calculator at http://your.kingcounty.gov/solidwaste/compost-calculator.htm or similar calculator available at http://www.soilsforsalmon.org/excel/Compost_Calculator.xls.

In addition to meeting the particle size requirements of USDA sandy loam, Topsoil Type-A must meet the following sieve Specifications:

Sieve Size	Percent Passing
1”	100
1/2”	>90
No.10	>70

Topsoil Type-A must be free from: materials toxic to plant growth; visible seeds, rhizomes, or roots; and any King County-listed noxious weeds or invasive root-propagating plants including horsetail, ivy, clematis, and knotweed. Soil found to contain these prohibited viable plant materials must be removed and replaced at the Contractor’s expense.

Testing and submittals must comply with Section 9-14.1.

9-14.1(3) REUSED AMENDED SITE SOIL

Reused amended site soil must be native topsoil taken from within the Project Site, either from areas where construction excavation is to be performed; from borrow, pit, or quarry sites strippings; or other designated sources. The general limits of the material to be utilized for topsoil will be specified in the Contract. The Engineer will make the final determination of the areas where the most suitable material exists within these general limits, and depth of excavation. The Contractor must reserve this material for the specified use.

In the production of reused amended site soil, all vegetative matter must become a part of the topsoil, except large brush and trees over 4 feet in height. Prior to removal, the Contractor must mow or otherwise reduce the height of the native vegetation to 1 foot or shorter. Plants on the King County Noxious Weed Lists or invasive root-propagating plants including horsetail, ivy, clematis, and knotweed must not be incorporated in the topsoil, and must be removed and disposed.

The final reused amended site soil must have a minimum organic matter content by dry weight of 5 percent for areas where turf will be installed, and 10 percent for all other landscape areas. Organic matter must be determined by Loss-on-Ignition test (ASTM D2974, or TMECC 05.07A). Native site topsoil must be amended with compost as described in Section 9-14.4(8), if more organic content is needed to comply with these Specifications. Compost amendment may be added at default rates of 22 percent by volume for turf or 38 percent for planting beds (1-3/4-inch amendment tilled to 8-inch depth for turf, 3-inch amendment tilled to 8-inch depth for beds); or calculated based on tests of the soil and compost, using the Soil Amendment Rate Calculator at http://your.kingcounty.gov/solidwaste/compost-calculator.htm or similar calculator available at http://www.soilsforsalmon.org/excel/Compost_Calculator.xls.

Designated material must be placed at locations approved by the Engineer that do not interfere with the construction of the Project. The Contractor must take all precautions to avoid disturbing the existing ground beyond the Project Site or other areas designated by the Engineer.

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Testing and submittals must be as specified in Section 9-14.1

9-14.1(4) BIORETENTION SOIL

Procure bioretention soil only from suppliers which have an active solid waste handling permit from the local jurisdictional Health Department as per WAC 173-350-220 or WAC 173-308.

Bioretention soil must be a well-blended mixture of Mineral Aggregate and compost measured on a volume basis. Fertilizer must not be added to bioretention soil. Bioretention soil for the types shown below must consist of fine compost as specified in Section 9-14.4(8) and Mineral Aggregate as specified in Section 9-03.2(2) in the ratios shown in the table below. The mixture must be well blended to produce a homogeneous mix and have the organic matter contents shown in the table below determined using the loss on ignition method.

Material	Mineral Aggregate	Fine Compost	Organic Matter
Bioretention Soil, Type 7030	68% - 72%	28% - 32%	3% - 7%

The HPBSM must be a blend of the following components in the following ratios.

Component	Ratio (by volume)
Filter Sand	70% (+/- 3%)
Coconut Coir Fiber	20% (+/- 2%)
Biochar	10% (+/- 1%)

Blending must not commence until the Engineer accepts the complete list of submittals in 9-14.1(1)B. The Engineer will issue written acceptance or rejection within 10 Business Days of receiving the complete list of required submittals.

9-14.1(4)A COCONUT COIR FIBER

The Coconut Coir Fiber must be double rinsed and buffered coco coir meeting the following requirements for quality:

Test / Method[1]	Criterion	Requirement
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and EPA Method 353.2	NO3+NO2	0.15 mg/L (Max.)
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and NEMI Method SM 4500-P E-99	Ortho-phosphorus	0.80 mg/L (Max.)
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and EPA Method 200.8 UCT-KED	Copper	10 µg/L (Max.)
Test Methods for the Examination of Compost and Composting (TMECC) Method 04.10-A	Electrical Conductivity	1.0 mmhos/cm (Max.)

NOTE:

1. The Synthetic Precipitation Leaching Protocol testing referenced above must be modified to use deionized water as the extraction fluid in lieu of the diluted acid described in EPA Method 1312. The lab must conduct one extraction per media sample and never conduct serial extractions on the same sample.

Suppliers who have demonstrated they meet the qualifications for this component in the past are provided at: https://www.seattle.gov/utilities/your-services/sewer-and-drainage/for-our-waters/green-stormwater-infrastructure.

9-14.1(4)B FILTER SAND

The filter sand must be fine aggregate for Portland cement concrete, Type 6 (Class 1) as per Sections 9-03.1(2)A, 9-03.1(2)B, and 9-03.1(2)C.

The filter sand must also meet the following requirements for quality:

Test / Method[1]	Criterion	Requirement
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and EPA Method 200.8 UCT-KED	Copper	10 µg/L (Max.)
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and EPA Method 353.2	NO3+NO2	0.15 mg/L (Max.)

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Test / Method[1]	Criterion	Requirement
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and NEMI Method SM 4500-P E-99	Orthophosphorus	0.15 mg/L (Max.)

NOTE:

1. The Synthetic Precipitation Leaching Protocol testing referenced above must be modified to use deionized water as the extraction fluid in lieu of the diluted acid described in EPA Method 1312. The lab must conduct one extraction per media sample and never conduct serial extractions on the same sample.

9-14.1(4)C BIOCHAR

The biochar must consist of screened and processed organic and inorganic residue remaining after the thermal processing of biomass in an oxygen-controlled environment.

The biomass feed-stocks must be limited to clean cellulosic material from:

a. Woody by-products of Pacific Northwest forestry operations (including cut residues left after a timber harvest, cut trees that are not marketable as lumber);

b. Chipped trees and brush from biomass reduction operations (i.e. commercial tree trimming); and

c. Agricultural residues such as nut shells, straw, orchard pruning, seeds, hulls, and pits.

The biomass feedstocks must not include any post-consumer or post-industrial sourced woody biomass (i.e. construction or demolition waste, wood contaminated with paints or sealers, metal, plastic, or other deleterious materials).

The biochar must be sourced from a producer with at least 3-years of experience producing biochar for soil amendments and/or water filtration and meet the following requirements for quality and grading:

Test / Method[1]	Criterion	Requirement
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and EPA Method 353.2	NO_3+NO_2	0.20 mg/L (Max.)
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and NEMI Method SM 4500-P E-99	Ortho-phosphorus	0.80 mg/L (Max.)
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and EPA Method 200.8 UCT-KED	Copper	10 µg/L (Max.)
Total C and H analysis by dry combustion-elemental analyzer (EPA Method 440.0). Inorganic C analysis by determination of CO2-C content with 1N HCl, as outlined in ASTM D4373 Standard Test Method for Rapid Determination of Carbonate Content of Soils. Organic C calculated as Total C – Inorganic C	Organic Carbon (C_{org})	60% (Min.)
	H: C_{org}	0.7 (Max.)
Proximate Analysis (ASTM D1762)	Volatile matter	20% (Max.)
	Ash	10% (Max.)
Metals (EPA Method 6020)	Arsenic	20 ppm (Max.)
	Cadmium	10 ppm (Max.)
	Lead	150 ppm (Max.)
	Mercury	8 ppm (Max.)
	Molybdenum	9 ppm (Max.)
	Nickel	210 ppm (Max.)
	Selenium	18 ppm (Max.)
	Zinc	1400 ppm (Max.)
Gradation (ASTM D422)	# 6	100% Passing
	# 100	100% Passing

NOTE:

1. The Synthetic Precipitation Leaching Protocol testing referenced above must be modified to use deionized water as the extraction fluid in lieu of the diluted acid described in EPA Method 1312. The lab must conduct one extraction per media sample and never conduct serial extractions on the same sample.

Suppliers who have demonstrated they meet the qualifications for this component in the past are provided at: https://www.seattle.gov/utilities/your-services/sewer-and-drainage/for-our-waters/green-stormwater-infrastructure.

9-14.1(5) PLANTING SOIL

Planting soil must consist of a mix of 2 to 3 parts Sandy loam soil and 1 part compost by volume. The resulting mix must contain approximately 8 to 15 percent organic matter by weight, tested by the loss on ignition method.

Sandy loam must be imported and must be as defined by the United States Department of Agriculture Classification System, and documented by a particle size analysis performed by an accredited laboratory. The sandy loam fraction of mix must be screened through a 1/2-inch mesh, to remove all rocks, plant parts, and other debris.

Compost used must be as specified in Section 9-14.4(8).

Sandy loam must be free from materials toxic to plant growth; visible seeds, rhizomes, or roots; and any King County-listed noxious weeds or invasive root-propagating plants including horsetail, ivy, clematis, and knotweed.

Testing and submittals must be as specified in Section 9-14.1.

9-14.1(6) GENERAL TURF AREA SOIL

General turf area soil is for general use and passive recreation lawn areas, where year-round maintenance and positive drainage are important. For sports fields or high-traffic lawn areas such as Seattle Center, the Contractor must use high performance turf mix, as specified in Section 9-14.1(7).

General turf area soil must consist of 2 parts sand complying with the particle distribution table in this Section, and 1 part compost by volume. The resulting mix must contain approximately 4 to 6 percent organic matter by weight, tested by the loss on ignitions method.

Sand used must meet the following particle distribution.

Screen Size	Percent Retained
3/8 inch	0
#4	<3%
#6	<5%
#10	<20%
#18	<20%
#20	25-50%
#30	
#35	
#40	>20%
#60	
#100	<10%
#200	<5%
#270	<5%
2um	<5%
<2um	<3%

Compost used must be as specified in Section 9-14.4(8) and be certified in compliance with the US Composting Council STA program.

Testing and submittals must be as specified Section 9-14.1

General turf area soil must not contain any viable seeds or roots capable of sprouting any State-listed noxious weed or invasive root-propagating plants including horsetail, ivy, clematis, and knotweed. Soil found to contain these prohibited viable plant materials must be removed and replaced at the Contractor's expense.

9-14.1(7) HIGH PERFORMANCE TURF SOIL

High performance turf soil is for athletic fields or high traffic lawn areas such as those used for events, with sub-surface drainage and in-ground irrigation.

High performance turf soil must consist of 80-95 percent quartz based sands, uniformly blended with 5-20 percent compost by volume. The ratio of sand to organic amendment will be determined by the Engineer, depending on the intended turf use:

1. High Performance - Standard Mix: 90 percent sand plus 10 percent compost
2. High Performance - Fertility Mix: 80 percent sand plus 20 percent compost
3. High Performance - Drainage Mix: 95 percent sand plus 5 percent compost

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Sand must be free of weed seeds and propagules, and must meet the following particle size distribution with a Coefficient of Uniformity between 2.5 and 4.5:

Size Fraction	Particle Size Range	Screen	Incremental % Retained	
Gravel	3/8”	3/8”	0%	
Gravel	>4.75 mm	#4	<3%	<30% combined
Gravel	3.44.75 mm	#6	<5 %	
Fine gravel	2.0-3.4 mm	#10	<20 %	
Very coarse sand	1.0-2.0 mm	#18	<20 %	
Coarse sand	0.5-1.0 mm	#35	25-50 %	>60% of sand
Medium sand	0.25-0.5 mm	#60	>20 %	
Fine sand	0.15-0.25 mm	#100	<10 %	<15% combined
Very fine sand	0.05-0.15 mm	#270	<5 %	
Silt	0.002-0.05 mm	By Hydrometer	<5 %	
Clay	<0.002 mm		<3 %	

Compost must be free of weed seeds and propagules, and be as specified in Section 9-14.4(8).

Sand and organic amendment must be thoroughly blended off-site, after samples of sand and amendment have been submitted for testing and approval.

At least 10 Working Days prior to placement of high performance turf soil, the Contractor must submit to the Engineer the following as specified in Section 1-05.3:

1. Compost analysis performed per STA standards, as specified in Section 9-14.4(8);
2. Sand grain size analysis results of the Mineral Aggregate performed by an independent laboratory per ASTM D 422, Standard Test Method for Particle Size Analysis of Soils.
3. Reports of the following mix property values, from an accredited independent lab. Testing and recommendations will be at the Contractor’s expense.
   a. pH
   b. Organic Matter: Using the Walkley-Black Method.
   c. Nutrients: Total Nitrogen, NO-3 and NH-3, Phosphorus, Potassium, Calcium, Sulfur, Magnesium, Boron.
   d. Conductivity.
   e. Weed Seeds: High performance turf mixes must be free of viable weed seeds or propagules, as determined by bioassay using TMECC 05.09-A, Shields Rinse Method.
   f. Amendment Recommendations: Fertilizer and amendment recommendations for turf, from an accredited Agronomist or Soil Scientist.
   g. Laboratory Information: Name, address, phone, and e-mail contact information, and qualifications of laboratory and personnel including a copy of current certification by STA, AAHTO, or approved equal.

At least 10 Working Days prior to placement of high performance turf soil, the Contractor must submit to the Engineer two 5 gallon samples of the high performance turf mix, along with the following information:

1) The manufacturer’s certificate of compliance as specified in Section 1-06.3 accompanying the test results from the Supplier of the high performance turf mix, and (if different) the Suppliers of the Mineral Aggregate and compost components, including their name and address;
2) A description of the equipment and methods to mix the Mineral Aggregate and compost to produce high performance turf mix.

The Contractor must not place high performance turf soil until the Engineer has reviewed and confirmed the following:

a) Soil mix delivery tickets. Delivery tickets must show that the full delivered amount of high performance turf soil matches the product and manufacturer named in the submittals.
b) Visual match with submitted samples. Delivered product will be compared to the submitted 5 gallon sample, to verify that it matches the submitted sample.

The Engineer may inspect the high performance turf soil on delivery and stop placement if the delivered soil does not appear to match the submittals. The Engineer may also require sampling and testing of the delivered soil before authorizing soil placement. All testing conducted is at the Contractor’s expense.

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9-14.1(8) BIORETENTION POLISHING LAYER MEDIA

The bioretention polishing layer media must be a blend of the following components in the following ratios.

Component	Ratio (by volume)
Filter Sand	91% (+/- 1%)
Activated Alumina	6.5% (+1% / -0%)
Iron Aggregate	2.5% (+0% / -0.25%)

Blending must not commence until the Engineer accepts the complete list of submittals in 9-14.1(1)C. The Engineer will issue written acceptance or rejection within 5 Business Days of receiving the complete list of required submittals.

9-14.1(8)A FILTER SAND

The filter sand must be Mineral Aggregate Type 6 per Section 9-03.1(2)C and meet the requirements of Section 9-03.10(6). It must be thoroughly cleaned and free of dirt, clay, silt, asphalt, organic material, or other foreign matter and all aggregate passing the No. 200 sieve size must be non-plastic.

The sand must meet the following requirements for quality:

Test / Method[1]	Criterion	Requirement
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and EPA Method 200.8 UCT-KED	Copper	10 µg/L (Max.)
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and EPA Method 353.2	NO3+NO2	0.15 mg/L (Max.)
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and NEMI Method SM 4500-P E-99	Orthophosphorus	0.15 mg/L (Max.)

NOTE:

1. The Synthetic Precipitation Leaching Protocol testing referenced above must be modified to use deionized water as the extraction fluid in lieu of the diluted acid described in EPA Method 1312. The lab must conduct one extraction per media sample and never conduct serial extractions on the same sample.

9-14.1(8)B ACTIVATED ALUMINA

The activated alumina must meet the following requirements for quality and grading:

Test / Method[1]	Criterion	Requirement
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and EPA Method 200.8 UCT-KED	Copper	10 µg/L (Max.)
Producer Analysis	Alumina (Al2O3) content	90% (Min.)
	Bulk density	760 Kg/m3 (Min.)
	Surface area	300 m2/g (Min.)
Gradation (ASTM D422) or Producer Analysis	#16 US Standard Sieve (#14 Tyler Mesh)	100% Passing
	#30 US Standard Sieve (#28 Tyler Mesh)	0% Passing

NOTE:

1. The Synthetic Precipitation Leaching Protocol testing referenced above must be modified to use deionized water as the extraction fluid in lieu of the diluted acid described in EPA Method 1312. The lab must conduct one extraction per media sample and never conduct serial extractions on the same sample.

Suppliers who have demonstrated they meet the qualifications for this component in the past are provided at: https://www.seattle.gov/utilities/your-services/sewer-and-drainage/for-our-waters/green-stormwater-infrastructure.

9-14.1(8)C IRON AGGREGATE

Iron aggregate must be ground standard, industrial, grey cast iron. The iron aggregate must be cleaned to remove all oil, grease, and other organics. The iron aggregate must meet the following requirements for quality and grading:

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Test / Method[1]	Criterion	Requirement
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and EPA Method 200.8 UCT-KED	Copper	10 µg/L (Max.)
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and EPA Method 353.2	NO3+NO2	0.15 mg/L (Max.)
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and NEMI Method SM 4500-P E-99	Orthophosphorus	0.15 mg/L (Max.)
Producer Analysis	Iron Content by weight	80% - 97%
Gradation (ASTM D422) or Producer Analysis	#4	100% passing
	#8	95 -100% passing
	#16	75-90% passing
	#30	25-45% passing
	#50	0-10% passing
	#100	0-5% passing
	#200	0-2.5% passing

NOTE:

1. The Synthetic Precipitation Leaching Protocol testing referenced above must be modified to use deionized water as the extraction fluid in lieu of the diluted acid described in EPA Method 1312. The lab must conduct one extraction per media sample and never conduct serial extractions on the same sample.

Suppliers who have demonstrated they meet the qualifications for this component in the past are provided at: https://www.seattle.gov/utilities/your-services/sewer-and-drainage/for-our-waters/green-stormwater-infrastructure.

9-14.2 SEED

9-14.2(1) GENERAL

Grasses, legumes, or cover crop seed of the type specified must conform to the standards for certified grade seed or better as outlined by the State of Washington Department of Agriculture Rules for Seed Certification, current edition.

Seed must be furnished in standard sealed containers and must include:

1. Common name of seed;
2. Name of variety, when applicable;
3. Lot number;
4. Net weight;
5. Percentage of purity;
6. Percentage of germination (in case of legumes percentage of germination to include hard seed);
7. Percentage of weed seed content and inert material clearly marked for each kind of seed per applicable state and federal law; and
8. Germination test date.

Upon request, the Contractor must furnish to the Engineer duplicate copies of a statement signed by the Materialperson certifying that each lot of seed has been tested by a recognized and accredited seed testing laboratory within 6 months before the date of delivery to the Project Site. Seed which has become wet, moldy, or otherwise damaged in transit or storage will not be accepted.

Turf varieties must include only those ranked ”Best” by the 2011 or most current succeeding year’s WSU Turfgrass Cultivars Evaluated In Western Washington/Oregon In Recent Years list. (Puyallup.wsu.edu/turf)

9-14.2(2) SEED MIX #1 (EROSION MIX)

The seed mixture and rate of application must be as follows:

Kind and Variety of Seed in Mixture	Percent by Weight
Turf type Perennial Rye Blend (2 or more varieties)	50%
Creeping Red Fescue	20%
Chewings Fescue	20%

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Kind and Variety of Seed in Mixture	Percent by Weight
Hard Fescue	10%

The rate of application must be 5 pounds per 1000 square feet.

The seed mixture must be no less than 98 percent pure, must have a minimum germination rate of 90 percent, and contain less than 1.5 percent inert material. No noxious weeds will be permitted. Seed must be certified grown in Washington, Oregon or Idaho and tagged with the information specified in Section 9-14.2(1).

9-14.2(3) SEED MIX #2 (NON IRRIGATED LAWN SEED MIX)

The seed mixture and rate of application must be as follows:

Kind and Variety of Seed in Mixture	Percent by Weight
Turf type Perennial Rye Blend (2 or more varieties)	50%
Chewings Fescue	30%
Hard Fescue	20%

The rate of application must be 6 pounds per 1000 square feet.

The seed mixture must be no less than 98 percent pure, and must have a minimum germination rate of 90 percent, and contain less than 1.5 percent inert material. No noxious weeds will be permitted. Seed must be certified grown in Washington, Oregon or Idaho and tagged with the information specified in Section 9-14.2(1).

9-14.2(4) SEED MIX #3 (IRRIGATED LAWN OR ATHLETIC TURF AREA)

The seed mixture and rate of application must be as follows:

Kind and Variety of Seed in Mixture	Percent by Weight
Turf type Perennial Rye Blend (3 approved varieties)	100%

The rate of application must be 6 pounds per 1000 square feet.

The seed mixture must be no less than 98 percent pure, and must have a minimum germination rate of 90 percent, and contain less than 1.5 percent inert material. No noxious weeds will be permitted. Seed must be certified grown in Washington, Oregon or Idaho and tagged with the information specified in Section 9-14.2(1).

9-14.2(5) SEED MIX #4 (BIOFILTRATION SWALE MIX)

The seed mixture and rate of application must be as follows:

Wet Biofiltration Swale Mix		Biofiltration Swale Mix	
Kind and Variety	**Percent by Weight**	**Kind and Variety**	**Percent by Weight**
Tall fescue or meadow fescue *Festuca arundinacea or Festuca elatior*	60-70%	Tall or meadow fescue *Festuca arundinacea* or *Festuca elatior*	75-80%
Seaside/Colonial bentgrass *Agrostis palustris*	10-15%	Seaside/Colonial bentgrass *Agrostis palustris*	10-15%
Meadow foxtail *Alepocurus pratensis*	10-15%	Redtop bentgrass *Agrostis alba* or *A. gigantea*	5-10%
Alsike clover *Trifolium hybridum*	6-10%	--	--
Redtop bentgrass *Agrostis alba*	1-6%	--	--

The rate of application must be:

1. Wet Biofiltration Swale Mix: 4 pounds per 1000 square feet.
2. Biofiltration Swale Mix: 6 pounds per 1000 square feet.

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The seed mixture must be no less than 98 percent pure, and must have a minimum germination rate of 90 percent, and contain less than 1.5 percent inert material. No noxious weeds will be permitted.

9-14.2(6) SEED MIX #5 (LOW GROWING, DROUGHT TOLERANT GRASS AND HERBACEOUS MIX)

The seed mixture and rate of application must be as follows:

Kind and Variety	Percent by Weight
Dwarf Perennial Rye	50-70%[1]
Hard Fescue	0-20%[1]
Strawberry Clover (*Trifolium fragiferium*)	5%
Dutch White Clover (*Trifolium repens*)	5%
Microclover	5%
Dwarf Yarrow, *Achillea millefolium* or *Achillea X Lewisii vars.*	5%
Sweet Alyssum, *Lobularia maritima*	5%
English Daisy, *Bellis perennis*	5%

NOTE:

1. Dwarf Perennial Rye and Hard Fescue must make up a combined 70% of mix.

The seed mix must be no less than 98 percent pure and must have a minimum germination rate of 90 percent, and contain less than 1.5 percent inert material. Seed must be tagged with the information required in Section 9-14.2(1).

The Contractor must submit, and receive approval from the Engineer at least 3 Working Days before ordering, all species included in the wildflower mix and the Materialperson's written directions on how to apply the seed mix. Written directions must include rate of application and the incorporation of specific species of grass seed components when appropriate to achieve adequate erosion control protection while maximizing flower display and regeneration.

Noxious weeds (Chapter 16-750 WAC) and invasive species listed by the Washington State Noxious Weed Control Board will not be allowed.

9-14.3 FERTILIZER

9-14.3(1) GENERAL

Fertilizers must be applied in a form and at a rate recommended by a Certified Agronomist or Soil Scientist, based on soil analysis by an independent accredited laboratory, as specified in Section 9-14.1(1).

A minimum of 50 percent of nitrogen fertilizer must be applied in a slow- or controlled-release form; such as sulfur- or polymer-coated urea, IBDU, trinitromethane (Nitroform), or organic forms.

All fertilizers must be furnished in standard sealed and unopened containers with weight, name of plant nutrients and manufacturer's guaranteed statement of analysis clearly marked, all per state and federal law.

The Contractor must submit to the Engineer for approval at least 5 Working Days in advance, an analysis of the proposed fertilizer, a 5 pound sample, and manufacturer's certificate of compliance indicating all Specifications are met.

9-14.3(2) LIME

Lime composition (dolomitic or non-dolomitic) must be determined based on laboratory analysis and recommendations submitted as specified in Sections 9-14.1(4) and 9-14.1(5).

Lime application rate must be determined based on laboratory analysis and recommendations submitted as specified in Sections 9-14.1(4) and 9-14.1(5).

Lime form (prill type or flour) will be determined based on laboratory analysis and recommendations submitted as specified in Sections 9-14.1(4) and 9-14.1(5).

9-14.4 MULCHES AND AMENDMENTS

The following mulches and amendments are shown on the Drawings or specified by the Engineer, according to project needs, and may be subject to testing as specified in other sections:

1. Straw Mulch: Section 9-14.4(1). Generally used as a temporary mulch to cover seed for erosion control seeding.
2. Wood Fiber Mulch: Section 9-14.4(2). Used to protect seed and soil in turf and erosion control hydroseeding applications.
3. Bark Mulch: Section 9-14.4(3). Used in woody plant beds to protect soil, conserve moisture, and provide long-term nutrients.
4. Arborist Wood Chip Mulch: Section 9-14.4(4). Clean recycled wood chip from tree-trimming, composting operations, or wood reclamation operations, used as the standard mulch for woody plants.

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5. Peat: Section 9-14.4(5). An amendment typically only used for moisture management in potting mixes and container plantings. More widespread use of peat has been replaced with compost and related products.
6. Vermiculite, Perlite and Pumice: Section 9-14.4(6). Specialty materials typically only used to improve moisture management in potting mixes, container plantings, and green roofs.
7. Tackifier: Section 9-14.4(7). An amendment used in hydroseeding mixtures to hold seed and mulch in place.
8. Compost: Section 9-14.4(8). An amendment used in soil mixes to supply organic matter, nutrients, and moisture management properties. Also used in mulches, potting soils, and erosion control applications such as socks and berms. For Project Sites located within the City limits of Seattle, procure compost manufactured by facilities which have an active solid waste handling permit from the local jurisdictional Health Department as per WAC 173-350-220 or WAC 173-308.

9-14.4(1) STRAW MULCH

All straw mulch Material must be in an air dried condition free of noxious weeds and other materials detrimental to plant life. Straw must be seasoned before baling or loading and must be suitable for spreading with mulch blower equipment.

9-14.4(2) WOOD FIBER MULCH

Wood fiber mulch must be specially processed 100 percent wood fiber in which 30 percent of the fibers must be 0.15 inches long or longer and which must have tackifier added to the mulch during the manufacturing process. Mulch must contain no growth or germination inhibiting ingredients and must be dyed a suitable color to facilitate inspection of placement of the Material. It must be manufactured in such a manner that after addition and agitation in slurry tanks with water, the fibers in the Material become uniformly suspended to form a homogenous slurry. When hydraulically sprayed on the ground, the Material must allow the absorption and percolation of moisture.

Each package of cellulose fiber must be marked by the manufacturer to show the air dry weight content.

Tackifier must not be applied at temperatures below 50°F nor in wet or rainy weather. A minimum of 4 to 6 hours of curing time is required for acceptance of the application. See Section 9-14.2(5) for specifications on the addition of tackifier for biofiltration swale seed mix.

Terrain that is steeper than 2 horizontal to 1 vertical, areas that exceed 10,000 square feet, and areas having a vertical drop greater than 15 feet must be treated with a supplemental tackifier as specified in Section 9-14.4(7).

Mulch must be applied at the following rates depending on the slope of the terrain:

1. 35 pounds per 1000 square feet, or 1500 pounds per acre, for areas having zero to 4 horizontal to 1 vertical slope.
2. 50 pounds per 1000 square feet, or 2000 pounds per acre, for areas having between 2 horizontal to 1 vertical and 4 horizontal to 1 vertical slope.
3. 60 pounds per 1000 square feet, or 2500 pounds per acre, for areas having a slope greater than 2 horizontal to 1 vertical.

9-14.4(3) BARK MULCH

Bark mulch must consist of freshwater Douglas fir, pine, or hemlock bark. It must be ground so that on a loose volume basis, a minimum of 95 percent passes a 1-1/2-inch sieve and no more than 55 percent passes a 1/4-inch sieve. The bark mulch must not contain salts, resin, tannin, or any other deleterious material in quantities that would be detrimental to plant life.

Wood chips salvaged from clearing and grubbing activity may be approved as a substitute for bark mulch, if found acceptable by the Engineer prior to application. Arborist wood chip mulch, Section 9-14.4(4), may also be used as a substitute for bark mulch when approved by the Engineer.

9-14.4(4) ARBORIST WOOD CHIP MULCH

Arborist Wood Chip Mulch (AWCM) must be coarse ground wood chips (approximately 1/2 inch to 6 inches along the longest dimension) derived from the mechanical grinding or shredding of the above-ground portions of trees. It may contain wood, wood fiber, bark, branches, and leaves; but may not contain visible amounts of soil. It must be free of weeds and weed seeds Including but not limited to plants on the King County Noxious Weed list available at: http://www.kingcounty.gov/weeds, and must be free of invasive plant portions capable of resprouting, including but not limited to horsetail, ivy, clematis, and knotweed. It may not contain more than 1/2 percent by weight of manufactured inert material (such as plastic, concrete, ceramics, or metal).

Arborist Wood Chip Mulch, when tested, must meet the following loose volume gradation:

Sieve Size	Percent Passing	
	Minimum	Maximum
2”	95	100
1”	70	100
5/8”	0	50

Sieve Size	Percent Passing	
	Minimum	Maximum
1/4”	0	40

No particles may be longer than 8 inches.

Prior to delivery, the Contractor must provide the following upon request:

1. The source of the product and species of trees included in it;
2. A sieve analysis verifying the product meets the above size gradation requirement;
3. A 5 gallon sample of the product, for the Engineer’s approval.

9-14.4(5) PEAT

Peat must be derived from 100 percent sphagnum, and must conform to ASTM D 2607 unless otherwise specified in the Contract. Peat must be shredded and granulated to pass a 1/2-inch sieve and conditioned in storage piles for at least 6 months after excavation. The peat must not contain substances harmful to plant life.

9-14.4(6) VERMICULITE / PERLITE / PUMICE

Vermiculite, perlite, and pumice must be horticultural grade and free of any toxic materials.

9-14.4(7) TACKIFIER

Tackifier used to stabilize mulch must provide a liquid soil bonding agent which provides immediate erosion protection and remains effective for a minimum of one full year on an undisturbed site.

9-14.4(8) COMPOST

For Project Sites located in the City of Seattle, the Contractor must only procure compost from approved vendors found here: https://www.seattle.gov/utilities/protecting-our-environment/sustainability-tips/landscaping/for-professionals/soil-and-compost. For all other Project Site locations, procure Compost manufactured by facilities which have an active solid waste handling permit from the local jurisdictional Health Department per WAC 173-350-220 or WAC 173-308.

Compost production and quality must comply with Chapter 173-350 WAC, and with the criteria below:

Compost products must be the result of the biological degradation and transformation of feedstocks as specified below, under controlled conditions designed to promote aerobic decomposition, per WAC 173-350-220, which is available at http://apps.leg.wa.gov/wac/default.aspx?cite=173-350-220.

The Contractor must submit the following information and samples to the Engineer for approval:

1. A copy of the Solid Waste Handling permit issued to the Supplier by the Jurisdictional Health Department as per WAC 173-350 (Minimum Functional Standards for Solid Waste Handling).
2. A copy of the producer’s current Seal of Testing Assurance (STA) certification as issued by the U.S. Composting Council.
3. Two 1-gallon samples of the compost, gathered per STA protocol available from the U.S. Composting Council, Phone: (631) 737-4931, http://www.compostingcouncil.org.
4. A written statement from the producer and lab analysis reports from an independent STA Program certified lab, demonstrating that the Materials comply with the processes, testing, and standards specified in WAC 173-350 and the parameters listed below.

Acceptance will be based upon a satisfactory Test Report from an independent STA program certified laboratory and the sample submitted to the Engineer. The Engineer may inspect any loads of compost on delivery and stop placement if it is determined that the delivered compost does not appear to match the submitted sample and documentation, and require sampling and testing of the delivered compost, before authorizing compost placement. If testing demonstrates the delivered compost does not match the submitted material, or is not as specified in 9-14.4, the Contractor is responsible for all testing costs.

The compost Supplier must test all compost products within 90 Calendar Days prior to application, at the Suppliers expense.

Required test parameters to be reported in the submittal documentation include:

1. Compost must meet the following size gradations when tested per the U.S. Composting Council Testing Methods for the Examination of Compost and Composting (TMECC) Test Method 02.02-B, Sample Sieving for Aggregate Size Classification:
   a. Fine Compost, typically used for soil amendment, must meet the following gradation by dry weight:

	Min.	Max.
Percent passing 2”	100%	--

	Min.	Max.
Percent passing 1”	99%	100%
Percent passing 5/8”	90%	100%
Percent passing 1/4”	75%	100%

b. Medium Compost, typically used either for soil amendment, erosion control, or surface mulching, must meet the following gradation by dry weight:

	Min.	Max.
Percent passing 1”	100%	100%
Percent passing 5/8”	85%	100%
Percent passing 1/4”	70%	85%

c. Coarse Compost, typically used for erosion control or surface mulching, must meet the following gradation by dry weight:

	Min.	Max.
Percent passing 3”	100%	--
Percent passing 1”	90%	100%
Percent passing 3/4”	70%	100%
Percent passing 1/4”	40%	60%

2. The pH must be between 6.0 and 8.5 when tested per TMECC 04.11-A; 1:5 Slurry pH.
3. Manufactured inert material (such as concrete, ceramics or metal) must be less than 1.0 percent by weight as determined by TMECC 03.08-A percent dry weight basis. Film plastics must be 0.1 percent or less, by dry weight. The Engineer may approve use of Medium or Coarse Compost up to 0.25 percent film plastic, subject to the limitations in WAC 173-350-220.
4. Salmonella must be less than 3 MPN (Most Probable Number) per 4 grams of total solids, by dry weight.
5. Metals must be at levels below those specified in WAC 173-350-220, table 220B
6. Minimum organic matter content must be 40 percent by dry weight basis as determined by TMECC 05.07A; Loss-On-Ignition Organic Matter Method.
7. Soluble salt contents must be less than 5.0 mmhos/cm tested per TMECC 04.10-A; 1:5 Slurry Method, Mass Basis.
8. Maturity must be greater than 80 percent per TMECC 05.05-A; Germination and Vigor. The Engineer may also evaluate compost for maturity using the Solvita Compost Maturity Test at time of delivery. Compost must score a number 6 or above on the Solvita Compost Maturity Test.
9. Stability must be 7 or below per TMECC 05.08-B; Carbon Dioxide Evolution Rate.
10. The compost product must originate from a minimum of 65 percent by volume from recycled plant waste as defined in WAC 173-350-100 as yard debris, wood waste, crop residues, and bulking agents. A maximum of 35 percent by volume of pre- or post-consumer food waste as defined in WAC 173-350-100 may be substituted for recycled plant waste. The Engineer may approve compost products containing up to 35 percent biosolids or manure feedstocks for specific projects or soil blends, but these feedstocks are not allowed unless specified, and not allowed in compost used for bioretention soils. When allowed, feedstock sources by percentage must be reported.
11. Fine compost must have a carbon-to-nitrogen ratio of less than 25:1 as determined using TMECC 04.01 Total Carbon and TMECC 04.02D; Total Kjeldhal Nitrogen. Medium compost must have a carbon-to-nitrogen ratio between 18:1 and 25:1. Coarse Compost must have a carbon-to-nitrogen ratio between 25:1 and 45:1. The Engineer may specify a carbon-to-nitrogen ratio in medium or coarse Compost of up to 35:1 for projects where the plants selected are entirely Puget Sound native species. Compost may be mixed with fir or hemlock bark as specified in Section 9-14.4(3), or clean wood chips or sawdust, to raise the carbon-to-nitrogen ratio above 25:1.

9-14.5 MATTING AND STAKES

9-14.5(1) JUTE MATTING

9-14.5(1)A JUTE MATTING FOR NON-STREAM APPLICATIONS

Jute matting must be of a uniform open plain weave of unbleached, single jute yarn treated with a fire retardant chemical. The yarn must be of a loosely twisted construction and must not vary in thickness by more than half of its nominal diameter.

Jute matting must be furnished in rolled strips approximately 50 yards in length. Matting width must be 48 inches with an average weight of 0.92 pound per square yard. A tolerance of ± 1 inch in roll width and ± 5 percent in weight per square yard will be allowed.

9-14.5(1)B JUTE MATTING FOR IN-STREAM APPLICATIONS

Jute matting must be of a uniform open plain weave of unbleached 100 percent jute yarn. Plastic or any geosynthetic netting must not be used for stream bank construction or restoration.

The following table specifies acceptable product applications:

Slope	Minimum Criteria	Test Method
Slope ≥ 1:1	25 oz/sy <40% open area	ASTM D-3776 Corp of Engineers COE CW002215
3:1 < slope < 1:1	14 oz/sy <60% open area	ASTM D-3776 Corp of Engineers COE CW002215
4:1 < slope < 3:1	9 oz/sy <65% open area	ASTM D-3776 Corp of Engineers COE CW002215
Slope < 4:1	No matting required unless otherwise specified in the Contract	

9-14.5(2) COIR MATTING FOR IN-STREAM APPLICATIONS

Coir matting must be of a uniform open plain weave of unbleached 100 percent coir fabric from coconut husk. Plastic or any geosynthetic netting must not be used for stream bank construction or restoration.

Coir matting must comply with and be installed per the following table:

Slope	Minimum Criteria	Test Method
Slope ≥ 1:1	25 oz/sy <40% open area	ASTM D-3776 Corp of Engineers COE CW002215
3:1 < slope < 1:1	14 oz/sy <60% open area	ASTM D-3776 Corp of Engineers COE CW002215
4:1 < slope < 3:1	9 oz/sy <65% open area	ASTM D-3776 Corp of Engineers COE CW002215
Slope < 4:1	No matting required unless otherwise specified in the Contract	

9-14.5(3) EXCELSIOR MATTING

Excelsior matting must be a machine produced mat of wood excelsior covered on one side with a biodegradable plastic netting or twisted paper composition. The excelsior matting must have a wood fiber minimum dry weight of 0.8 pound per square yard ± 5 percent, and must be of uniform thickness with the fiber evenly distributed over the entire area of the mat.

The width of a single roll of matting and net must be a minimum 36 inches, and the length of the roll must be approximately 150 feet.

The Contractor must submit to the Engineer for approval at least 10 Working Days in advance of proposed Material application, manufacturer's certificate of compliance stating that the excelsior matting is environmentally safe and acceptable. This submittal must be accompanied by a sample at least 3 square feet in area.

9-14.5(4) CLEAR AND BLACK PLASTIC COVERING

Plastic covering must comply with the Specifications of the NIST Voluntary Product Standard, PS 17 69, for polyethylene sheeting having a minimum thickness of 6 mil.

9-14.5(5) STAKES FOR EROSION CONTROL MATTING

Stakes may be wire staples, steel pins, steel spikes, or wooden stakes.

Stakes for securing erosion control matting to earth surfaces must be a minimum 12 inches in length, and must have sufficient strength to withstand pounding the stakes into soil flush with the surface.

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9-14.6 PLANT MATERIALS

9-14.6(1) DEFINITIONS

Bareroot plants are grown in the ground and harvested without soil or growing medium around their roots. Roots must be protected in transit with moist media such as peat or sawdust.

Container plants are grown in pots or flats that prevent root growth beyond the sides and bottom of the container.

Balled and burlapped plants are grown in the ground and harvested with soil around a core of undisturbed roots. This rootball is wrapped in burlap and tied or placed in a wire basket or other supportive structure.

Live cuttings or live stakes are freshly cut stems (sometimes roots) taken from live plant material without a previously developed root system. Cuttings produce clones that are (usually) nearly identical to the source plants. Source plants for cuttings must be vigorous, disease-free specimens. Acceptable sources, lengths, and diameters of cuttings must be as specified on the Drawings or plant schedules.

Rhizomes are a prostrate or subterranean stem, usually rooting at the nodes and becoming erect at the apex. Rhizomes must have a minimum of two growth points. Tubers must be a thickened and short subterranean branch having numerous buds or eyes.

Whips are bareroot trees, generally unbranched, and are sized typically in 1 foot height increments ranging from 2 feet to 6 feet not including the root.

Seedlings are plants propagated from seeds. Seedlings of woody plants demonstrate variability in appearance, size and other growth characteristics that are not acceptable in many landscape situations. Seedling variability is often desirable in native and low-maintenance landscapes where diversity may provide disease resistance.

9-14.6(2) QUALITY

All plant Material furnished by the Contractor must conform to the current issue of American Standard for Nursery Stock (ASNS).

All plant Material must comply with state and federal requirements with respect to plant health and absence of diseases and insect infestation. Inspection certificates required by law must accompany each shipment of plant Material and must be filed with the Engineer prior to planting. All plant Material specified must be first class representatives of their normal species or varieties in healthy growing condition with normal well developed branch system and vigorous root systems. They must be free from disease and insect infestation, disfiguring knots, sun scalds, abrasions of the bark, broken tops, and torn roots.

All plants must be nursery grown stock unless otherwise specified in the Contract.

Plants must not have cuts over 3/4-inch diameter which are not satisfactorily callusing over. Leader must be intact on each plant. Large plants cut back to comply with specified sizes will not be accepted. Trees must be self-supporting, with straight trunks and with single straight leaders. Trees having damaged or missing leader, multiple leaders, or Y crotches will be rejected.

Plants furnished in pots or other containers must be acclimated to outside conditions and equal to field grown stock.

Collected Plant Material (including cuttings) must come from approved legal locations. Contractor is responsible for securing any required permits and permissions from property owners. Collected plant Material must conform in quality, size, and grade to standards for nursery stock and must be listed along with source location (see Section 1-06.1) for approval at least 5 Working Days in advance of digging by the Supplier or Contractor.

Any plant Material that is to be replaced must be of the same species, cultivar, and equal size to the specified plant Material.

Root balls must be solidly held together by a fibrous root system and must be composed only of the soil in which the plant has been actually growing. Broken or “made” balls will not be accepted. The ball must be securely wrapped with nontreated jute burlap or other packing material not injurious to the plant life. Root balls must be free of weed or foreign plant growth.

Container grown plants must be plants transplanted into a container and grown in that container sufficiently long for new fibrous roots to have developed so that the root mass keeps its shape and holds together when removed from the container. Plant Material which is rootbound will be rejected. Container sizes for plant Material of a larger grade than provided for in the container-grown Specifications of the American Standard for Nursery Stock (ASNS) must be determined by the volume of the root ball specified in the ASNS for the same size plant Material.

All bare root plant Materials must have a heavy fibrous root system. All plants must be dormant at the time of planting. Roots must be protected from drying in transit by wrapping, and stored in moist media in a shaded location if not planted immediately upon receipt. Additional environmental controls may be required to prevent drying or breaking dormancy if plants must be scored more than 48 hours.

Average height to spread proportions and branching must be per the applicable sections, illustrations, and accompanying notes of the American Standard for Nursery Stock. Plants that have suffered damage as the result of girdling of the roots, stem, or a major branch; have deformities of the stem or major branches; have a lack of symmetry; have dead or defoliated tops or branches; or have any defect, injury, or condition which renders the plant unsuitable for its intended use, will be rejected.

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Trees intended for installation as street trees must have been grown with sufficient spacing to allow for symmetrical branch development which reflects the natural characteristics of the species. Trunks must not be noticeably imperfect in vertical alignment, and there must be no included bark in the crotches between the trunk and side branches.

9-14.6(3) HANDLING AND SHIPPING

Handling and shipping must be done in a manner that is not detrimental to the plants. The root system of all plant Material must not be permitted to dry out at any time.

To acclimate plant Materials to Northwest conditions, all plant Materials used must be grown continuously outdoors north of the 42nd Latitude (Oregon California Border) for 60 days prior to delivery.

Plant Material must be packed for shipment in accordance with prevailing practice for the type of plant being shipped, and must be protected at all times against drying, sun, wind, heat, freezing, and similar detrimental conditions both during shipment and during related handling. When transported in closed vehicles, plants must receive adequate ventilation. When transported in open vehicles, plants must be protected by tarpaulins or other suitable cover material.

Ball and Burlap:

1. Balled and burlapped plants must be handled by the ball of earth and not the plant. Unless otherwise specified in the Contract, plants may be supplied in suitable containers acceptable to the Engineer should the Contractor so desire.
2. Balled and burlapped trees must, as a minimum, be installed with all wrapping material, wire cages, twine, burlap and other material reinforcement removed from the top 2/3 of root ball. Unless deemed detrimental to the stability of the rootball and health of the tree, all wrappings and support materials must be removed.

All container grown plants must be handled only by the container.

9-14.6(4) RECORDS

The nursery must furnish a notice of shipment in triplicate at the time of shipment of each carload or other lot of plant Material. The original copy must be mailed to the Engineer, the second copy to the consignee and the third copy must accompany the shipment to be furnished to the Engineer at the Project Site. The notice must contain the following information:

1. Name of shipper.
2. Date of shipment.
3. Name of commodity (including all names as specified in the Contract).
4. Consignee and delivery point.
5. Owner Contract number.
6. Point from which shipped.
7. Quantity contained.
8. Manufacturer's certificate of compliance of grade (statement that Material conforms to the Specifications).
9. Size (height, runner length, caliper, as required).
10. Statement of root pruning (date pruned and size of pruning).
11. Signature of shipper by authorized representative.
12. Growing history of plant.

All plants must have legible labels attached to each individual plant delivered as a separate unit or to each box, bundle, bale, or container containing one or more plants. Plant Material with illegible or missing tags will be rejected by the Engineer.

a. Labels must provide the necessary detailed information as to horticultural name, size, age, caliper, or other data required to identify as conforming to Specifications.
b. When the label is attached to a bundle, box, or container containing more than one plant, information on the label must show the quantity together with the other required information. Exception: All trees, whether furnished singly or bundled, must be individually tagged with names and size or caliper, needed as shown above. Contractor may refer to State of Washington Department of Agriculture, Orders 1229 and 1230, Nursery Stock Standards, regarding labeling of plant Material.
c. All plants that are patented or trademarked must have an individual tag on each plant.
d. Plant Material tagged in the field (nursery) by the Landscape Architect must be delivered with tags in place.

9-14.6(5) INSPECTION

The Contractor must, as soon as practical, inform the Engineer as to the source of plant Materials for the project as specified in Section 1-06.1.

The Contractor must notify the Engineer not less than 48 hours in advance of delivery of plants from the nursery to allow inspection at the nursery before delivery.

Pre-Planting Inspection:

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1. All trees will be inspected by the Engineer at the Project Site prior to planting. Plants not complying with these Specifications must be immediately removed from the project and replaced by the Contractor at the Contractor's sole expense.
2. Root condition of plants furnished in containers must be determined by removal of the plant from the container. Plants not fully rooted through media to create an intact rootball, and rootbound plants with circling roots, must be removed from the Project Site and replaced with acceptable specimens of the same variety.
3. Plant Material delivered, inspected, and approved for planting must be planted immediately. Plants not immediately planted by the Contractor may be temporarily stored after receiving approval from the Engineer as specified in 9-14.6(7).

9-14.6(6) SUBSTITUTION OF PLANTS

No substitution of plant Material, species or variety, will be permitted unless evidence is submitted in writing to the Engineer that a specified plant cannot be obtained and has been unobtainable since the Award. Substitution can be made only with written approval by the Engineer as specified in Section 1-05.3(6). The nearest variety, size, and grade as approved by the Engineer must then be furnished.

9-14.6(7) TEMPORARY STORAGE

Plant Material delivered and accepted must be planted immediately. Plants that cannot be planted within 1 Day after arrival must be heeled in per accepted horticultural practice, as follows:

1. Bare root plants must be placed in trenches with roots covered with moist earth, sawdust or other acceptable material and be kept moist. All bare root Material supplied in bundles must have the bundle broken and the plants placed in the trenches separately.
2. Balled and burlapped plants must have the root ball protected by earth, sawdust, or other material acceptable to the Engineer and the material must be kept continuously moist.
3. Live cuttings may be stored for up to 7 Days, provided they are protected against loss of moisture by a minimum 6-inch thick layer of earth, sawdust, or other acceptable material and be kept moist. Adequate ventilation with an ambient temperature maintained at or near 40 °F must be provided above the cuttings to prevent fungus growth. Cuttings taken in November, December, or January may be stored if wrapped to produce an airtight condition with temperature maintained between 33 °F and 40 °F.

The Contractor is responsible for all plants stored under temporary conditions.

Plants stored in any location for use on the project must be protected at all times from extreme weather conditions by insulating the root balls with sawdust, soil, or other approved material and by keeping the roots moist at all times.

9-14.6(8) SOD

Sod must be mature, densely rooted grass; free of weeds and objectionable grasses. All sod must comply with state and federal law, including guaranty, with respect to inspection, plant diseases, and insect infestation. Sod must be cut to a 1-inch mowing height prior to lifting from the field.

Sod must be either un-netted, or use biodegradable or degradable plastic netting.

Sod must be grown in Western Washington or Oregon. Sod shipments must have a certificate of origin and certification of approved treatment when shipment originates in known infected areas.

Turf varieties must include only those ranked ”Best” by the 2011 or most current succeeding year’s WSU Turfgrass Cultivars Evaluated In Western Washington/Oregon In Recent Years list. (Puyallup.wsu.edu/turf). Alternative varieties may be substituted only if evidence is provided by Contractor that sod made up of these varieties is not available from local sources.

Turf type must be determined by the Engineer, depending on the intended turf use:

1. High Performance – 100 percent perennial rye. 3 or more varieties from approved list.
2. Ornamental and Passive Recreation. 3 or more varieties from approved list, in a mix meeting the following proportions:

Approved Turf Types	Proportion
Turf-type perennial rye grass	>50%
Kentucky bluegrass	<30%
Fine fescue	>20%

9-14.7 TREE STAKES, GUYS, AND WRAPPING

Stakes must be 8-foot long 2-inch diameter pressure treated lodgepole pine wood stakes, with chamfered tops and 6-inch long conical points (see Standard Plan 100a). The Contractor must be prepared to provide No. 5 deformed steel reinforcing bar as a substitute stake for compatibility with tree grates. The stakes must be installed as shown in the Standard Plans unless the Contract indicates otherwise.

Guys must be pre-manufactured adjustable ties made of plastic Material such as No. 2 Chainlock or approved equal. The guys must be installed as shown in the Standard Plans unless the Contract indicates otherwise. Guys must be adjusted at the end of the first growing season to prevent constriction of growth, bark ringing, or other conditions detrimental to optimal growth of the trees. Guys must be removed one year after planting, except when noted otherwise in the Contract.

Wrap. Tree wrap must be as specified in the Contract.

9-14.8 SHEAR BOARDS

Shear boards must be 2” x 8” x 8’ non-treated, rough finished lumber. When conditions require a length less than 8 feet, the Contractor must plan the layout so that no individual length of cut shear board is less than 4 feet.

9-14.9 PAVER BLOCKS AND INTERLOCKING CONCRETE PAVERS

9-14.9(1) PAVER BLOCKS

Paver blocks must be exposed aggregate concrete of the size shown on the Drawings. Pavers must be made from the following mix:

Material	Quantity per cubic yard
gray cement	564 lbs
5/8 inch minus gravel	2,400 lbs
building sand	1,030 lbs

A sample of exposed aggregate showing the desired amount of exposure is available at the SPU Materials Laboratory at 707 South Plummer Street.

Exposed aggregate surface of all concrete paver units must be sealed with a heavy-duty concrete enamel containing a 10 percent methylacrylate solution or approved equal. On request by the Engineer, the Contractor must provide a 1 pint sample of sealant for testing. Sealant Material must be approved by the Engineer prior to application.

The Contractor must submit two sample paver blocks representative of those to be used in the Project for the Engineer’s approval.

9-14.9(2) INTERLOCKING CONCRETE PAVERS

The manufactured product must comply with the following Specifications in color, materials, physical properties configuration, and tolerances:

1. The color of the unit concrete paver must be natural conforming to samples available from the Engineer.
2. The nominal dimensions must be:

Dimension	Requirement
length	9”
width	4-1/2”
thickness	2-3/8”

3. Shape:
   a. The length sides of the paver must have two projections and two recessions per side. The projection on one side must correspond to a recession on the opposite side. The projections and recessions must be 3/8 inch when measured from the extension of the nominal width lines for the length of the paver.
   b. The width sides of the paver must have one projection and one recession per side. The projection on one side must correspond to a recession on the other side. The projections and recessions must be 3/8 inch when measured from the extension of the nominal length lines for the width of the paver.
   c. The top and bottom surfaces must be flat and parallel. The top side edge must be chamfered 1/4 inch. The sides must be perpendicular to the top and bottom surfaces. Full size edging pavers must have one width side flat. Half size edging pavers must be 1/2 the nominal length with one width side flat.
   d. Length or width of paver unit must not differ by more than 0.059 inches and heights must not differ by more than 0.11 inches from the specified dimensions.

9-14.9(3) CEMENTITIOUS MATERIALS

Materials must conform to the following:

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Material	Standard
Portland Cement	ASTM C 150
Blended Cement	ASTM C 595, Type 1S or 1P
Hydrated Lime	ASTM C 207, Type S
Pozzolan	ASTM C 618

9-14.9(4) AGGREGATES AND OTHER CONSTITUENTS

Aggregates must conform to the following, except that grading requirements may not necessarily apply:

Weight	Requirement
Normal weight	ASTM C 33, for Concrete Aggregates
Lightweight	ASTM C 331, for Lightweight Aggregates for Concrete Masonry Units

Air entraining agents, color pigments, integral water repellents, and finely ground silica must be previously established as suitable by the Engineer for use in concrete and must conform to ASTM Standards where applicable, or must be shown by test or experience to not be detrimental to concrete.

9-14.9(5) PHYSICAL REQUIREMENTS

At the time of delivery to the Project Site, the average compressive strength of test samples must not be less than 8000 psi with no individual paver unit less than 7200 psi.

The average absorption must not be greater than 5 percent, with no individual unit greater than 7 percent.

The manufacturer must satisfy the Owner by proven field performance of the laboratory freeze-thaw test that the paving units have adequate durability when subject to a freeze-thaw environment. See freeze-thaw test in this Section.

Acceptable field performance is achieved when units similar in composition and produced by the same manufacturing process exhibit no objectionable deterioration for at least 3 years. The paver units used as the basis for proven field performance must have been exposed to the same general type of environment, temperature, range, and traffic volume.

When tested per Section 8 of ASTM C 67, specimens must not have breakage or greater than 1.0 percent loss of dry weight of any individual paver unit when subjected to 50 cycles of freezing and thawing. This test must be conducted not more than 12 months prior to delivery of units. When tested per ASTM C 418, Abrasion Resistance of Concrete By Sandblasting, specimens must not have volume loss greater than 0.915 cubic inch per 7.75 square inch. The average thickness loss must not exceed 1/8 inch.

9-14.9(6) PERMISSIBLE TOLERANCE IN DIMENSIONS

Length or width of paver unit must not differ by more than 0.059 inches and heights must not differ by more than 0.11 inches from the specified dimensions.

9-14.9(7) VISUAL INSPECTION

All paver units must be sounded and free of defects that would interfere with the proper placing of the unit or impair the strength of the construction. Minor cracks or chips due to the usual method of manufacture and customary method of handling in shipment and delivery may be allowed subject to the discretion of the Engineer. Paver units identified as unacceptable by the Engineer must be replaced.

9-14.9(8) SAMPLING AND TESTING

The Contractor must submit 3 samples of the paver unit to the SPU Material Laboratory for approval.

Sample units will be tested per ASTM C 140.

9-14.9(9) BASE COURSE

The base course must be 6 inches in depth, must be as specified in Section 9-03.7(3), and must consist of Mineral Aggregate Type 2, 1-1/4 inch minus crushed rock, as describe in Section 9-03. 20 percent “ISOLITE” CG2 must be incorporated into the base course in paver areas extending the width of the sidewalk adjacent to tree pits (an 8’ x 7” surface area per pit).

9-14.9(10) TOP COURSE OR KEYSTONE

The top course must be 2 inches in depth, must be as specified in Section 9-03.7(3), and must consist of Mineral Aggregate Type 1, 5/8 inch minus crushed rock, as describe in Section 9-03. 20 percent “ISOLITE” CG2 must be incorporated into the base course in paver in areas extending the width of the sidewalk adjacent to tree pits (an 8’ x 7” surface area per pit).

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9-14.9(11) LEVELING COURSE

The leveling course must be as specified in Section 9-03.9, except as modified in this Section. The Material must be 3/8 inch minus chip rock with the following gradation:

Sieve Size	Percent Passing
3/8”	98
1/4”	50-90
No. 4	25-55
No. 6	0-20
No. 10	0-10
No. 40	0-5
No. 200	0-3

Material passing the No. 200 sieve size must be brought to the Project Site bagged and dry.

9-14.9(12) BEDDING SAND

The bedding sand must be as specified in Section 9-03.10(6) and must consist of Mineral Aggregate Type 6, washed sand, as specified in Section 9-03.

9-14.9(13) JOINT FILLING SAND

The joint filling sand must have the following grading:

Sieve Size	Percent Passing
US No. 8	95-100
US No. 16	60-70
US No. 30	15-25
US No. 50	0-5
US No. 100	0-2
US No. 200	0-1

The fracture must be 100 percent. This Material is crushed sand.

9-14.9(14) EDGING

Edging must be installed to separate all unit paver installations from adjacent planting or turf areas. Product must be as shown on the Drawings and approved by Engineer.

9-14.10 TURF REINFORCEMENT

Turf reinforcement product must be as shown on the Drawings and approved by Engineer.

9-14.11 CEDAR EDGING

Material for edging must be 2” x 4” cedar, construction grade or better with tight knots.

9-14.12 BOLLARDS

9-14.12(1) WOOD BOLLARDS

Bollards must be nominal 8” x 8”, 90 Day stack dry, select Douglas Fir. Bollards must be pressure treated (by closed cylinder method) with Pentachlorophenol after cutting and predrilling. Tops and 4 sides of bollards must be painted above the notch with 2 coats of white marine enamel as manufactured by Inter Lux or approved equal applied per manufacturer’s recommendations.

All metal parts, such as bolts, nuts, and washers, must be hot dipped galvanized.

9-14.12(2) CONCRETE BOLLARDS

Concrete bollards must be made of Class 3000 cement concrete as specified in Section 6-02, and must be reinforced with four No. 4 deformed steel bars placed 1 inch clear below the concrete surface and held in place with No. 8 gauge wire ties. After forms are removed, concrete must show a smooth, dense face. Any surface irregularities showing above grade must be scraped or stoned off. The surface must then be washed and a 1:1 mortar must be brushed on. After the initial set but

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before the final set, the excess mortar must be rubbed off using burlap sacking or pieces of carpeting. The bollards must then be cured by being kept damp with water for not less than 2 Days.

9-14.12(3) PADLOCKS FOR REMOVABLE BOLLARDS

The padlock must be as manufactured by Best Lock Company, Lock number 2B672 with bronze body, 2-inch stainless steel shackle, and equipped with construction core, or approved equal.

9-14.13 BENCHES

Benches must be of the type specified in the Contract.

9-14.14 TREE GRATES

Tree grates must be manufactured in 2 equal sized sections made of gray iron conforming to ASTM A 536, GR80 56 06. Grates must have a 3/4-inch nominal thickness and cover an area not less than 24 square feet. To accommodate tree growth, the grates must have 3 or 4 centrally located concentric break out rings allowing a 12-inch minimum to 30-inch maximum opening in diameter. Break out rings must have no more than 6 points of attachment per grate section and must be scored to allow ease of expansion for tree growth. Grates must be designed to not fail under a wheel load of up to 4000 pounds except at the break out rings.

Alternative Material use in the design and manufacturing of tree grates is subject to approval by the Engineer based on a submittal provided by the Contractor providing data on performance standards adequate to meet the public safety, sustainability, functional, and visual objectives of the project. Submittals must include documentation of product use and performance over a minimum of 3 years on installations for public use in areas with comparable climactic conditions typical in the Pacific Northwest.

9-14.15 IN-STREAM LOGS

In-stream logs must consist of tree shoot with or without limb, and tree root and rootwad. In-stream log may include the use of on-site trees identified for removal. The shoot portion of the tree must not contain any root and may have any alignment unless the Contract specifies otherwise. The logs must not be limbed; however, they may require trimming of limbs to dimensions as specified in the Contract.

In-stream log must be Cedar, Douglas Fir, or other species tree as specified in the Contract.

Logs must be of sound quality; must not be split or cracked; and must be clean and free of insects, rot, decay, soil, rock, and other deleterious material.

The Contract will specify log length and diameter, and may specify a range of butt and tip diameters. The root section dimension will contain a minimum and/or maximum diameter and may require trimming approximating a plane.

9-14.16 WATTLES OR COMPOST SOCKS

Wattles must act as a screen or filter and must consist of biodegradable plant material such as any combination of twigs, wicker, bamboo, other withes, straw, coir, and wood shavings; or for compost socks, in the shape of cylinders typically ranging from 8-inch to 16-inch diameter and of any length. The wattle must be encased within biodegradable netting. Where not otherwise specified, compost socks must be used.

9-14.17 VERTICAL ROOT BARRIER

Root barriers must be an injection molded or extruded modular component made of high density polypropylene or polyethylene plastic with a minimum of 30 percent recycled materials. Panels must have a minimum thickness of 0.080 inches. Each panel must have a minimum of 4 molded vertical ribs and locking strips, integral male/female sliding locks, and an intergraded zipper joining system. Vertical root-deflecting ribs or channels must be between 1/2 inch and 0.008 inches high, perpendicular to the panel, and between 5.91 inches to 7.87 inches apart. Panels must be a minimum of 24” wide x 18” or 24” deep, or as shown on Drawings. The Contractor must submit for approval a catalogue cut for the material and installation.

9-14.18 SLOW RELEASE WATERING BAGS

Slow release watering bag must be UV-stabilized polyethylene bag with nylon webbing, black polypro straps, and nylon zippers. Each bag must have at least 2 water release points. Each bag must have a water capacity of at least 15 gallons. For a double bag installation, water capacity must be at least 22.75 gallons. The fill opening must fit up to a 3-inch diameter hose.

Slow release watering bags must be Treegator Original, TreeCOVEr, Oasis Tree Watering Bags, or approved equal.

9-14.19 POLYACRYLAMIDE (PAM)

PAM is used as a tie-down for soil, compost, or seed, and is also used as a flocculent. PAM products must meet ANSI/NSF Standard 60 for drinking water treatment with an AMD content not to exceed 0.05 percent. PAM must be anionic and must be linear, and not crosslinked. The minimum average molecular weight must be greater than 5-mg/mole. The charge density must be no less than 15 percent and no greater than 30 percent. The product must contain at least 80 percent active ingredients and have a moisture content not exceeding 10 percent by weight. PAM must be delivered in a dry granular or powder form.

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9-14.20 SOIL CELL

9-14.20(1) SOIL CELLS

Soil cells must be modular, structural systems capable of supporting loads up to AASHTO HL-93 when used with accepted pavement profiles. Each module must be structurally independent from adjacent soil cells to allow for utility installations and future repairs.

Soil cells must be open on all vertical faces and, for stacked cells, horizontal planes with no interior walls or diaphragms, providing a contiguous soil volume that allows:

1. Placement and compaction of specified soil in 6-inch lifts;
2. Movement and growth of tree roots within the soil volume;
3. Movement of water, including lateral capillary movement, within the soil volume; and
4. Installation and maintenance of utilities within, adjacent to, or below the soil cell.

At least 20 days prior to the start of installation, the Contractor must submit to the Engineer for acceptance the manufacturer's product literature with technical data sufficient to demonstrate that the product meets these requirements.

9-14.20(2) AGGREGATE SUBBASE

Aggregate subbase must comply with the requirements of Mineral Aggregate, Type 22 per Section 9-03.14 unless otherwise specified in the Drawings.

9-14.20(3) PAVEMENT BASE COURSE

Pavement base course must comply with the requirements of Mineral Aggregate, Type 2 per Section 9-03.14.

9-14.20(4) ANCHORS

Soil cell base anchors must be as specified by the soil cell manufacturer.

9-14.20(5) GEOGRID

Geogrid used for soil cells must be uniaxial or biaxial woven polyester fabric with PVC coating, inert to biological degradation and resistant to naturally occurring chemicals, alkalis, and acids.

Geogrid must meet the following properties or meet the manufacturer's recommendations, whichever is more stringent:

Property	Value	Test Method
Tensile strength at ultimate	1850 lbs/ft minimum	ASTM D6637
Creep reduced strength	1000 lbs/ft minimum	ASTM D5262
Long-term allowable design load	950 lbs/ft minimum	GRI GG-4
Grid aperture size (MD)	0.8 inch minimum	N/A
Grid aperture size (CD)	1.28 inch maximum	N/A
Roll Size	6-foot width preferred, up to 18 feet	N/A

Geogrid must be as manufactured or distributed by:

1. Miragrid 2XT from Ten Cate Nicolon, Norcross, GA, http://www.tencate.com (Distributed by Geosynthetic Systems in Ontario);
2. Fortrac 35 Geogrid from Huesker, Charlotte, NC, http://www.hueskerinc.com/;
3. SF 20 Biaxial Geogrid from Synteen, Lancaster, SC, http://www.synteen.com;
4. Stratagrid SG 150 from Strata, Cumming, GA, http://www.geogrid.com;
5. Or approved equal.

The Contractor must submit to the Engineer for acceptance at least 20 days in advance, the manufacturer's technical datasheets indicating all Specifications are met.

9-14.20(6) GEOTEXTILE

Geotextile must be composed of high tenacity polypropylene yarns woven into a network to retain relative position, inert to biological degradation, and resistant to naturally occurring chemicals, alkalis, and acids.

Geotextile must meet the following properties or meet the manufacturer's recommendations, whichever is more stringent:

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Property	Test Method	Unit	Minimum Average Roll Value	
			Machine Direction (MD)	Cross Direction (CD)
Tensile strength at ultimate	ASTM D4595	lbs/ft	5100	5100
Tensile strength at 2% strain	ASTM D4595	lbs/ft	960	1560
Tensile strength at 5% strain	ASTM D4595	lbs/ft	2400	3600
Tensile strength at 10% strain	ASTM D4595	lbs/ft	5040	
Factory Seam Strength	ASTM4884	lbs/ft	3000	
Flow Rate	ASTM D4491	gal/min/ft^2	30	
Apparent Opening Size	ASTM D4751	U. S. Sieve	30	
UV Resistance (at 500 hours)	ASTM D4355	% strength retained	80	

Geotextile must be manufactured or distributed by:

1. Mirafi 180 N from Ten Cate Nicolon, Norcross, GA, http://www.tencate.com;
2. Geotex 801 from Propex Geosynthetics, Chattanooga, TN, http://www.geotexile.com;
3. Or approved equal.

The Contractor must submit to the Engineer for acceptance at least 20 days in advance, the manufacturer's technical datasheets indicating all Specifications are met.

9-14.20(7) IMPERMEABLE MEMBRANE

Geomembrane must be composed of a smooth High Density Polyethylene (HDPE) sheeting material and must conform to the following:

Property	ASTM	High Density Polyethylene (HDPE)
		HDPE 60
Thickness (Minimum Average)	D5199 / D5994	60 mil (1.5 mm)
Density	D792	≥0.94 g/cc
Tensile Yield Strength (Minimum Average)	D6693 (Type IV Die)	22 N/mm2 (3,192 psi)
Tensile Break Strength	D6693 (Type IV Die)	228 N/mm2 (33,070 psi)
Tensile Elongation at Yield	D6693	≥12%
Tensile Elongation at Break	D6693	≥700%
Tear Resistance	D1004	187 N (42 lbs)
Puncture Resistance	D4833	400 N (90 lbs)
Stress Crack Resistance	D5397	≥400 Hours
Permeability	D543	<10 -12 cm/s
OIT (High Pressure)	D5885	400 mins
Oven Aging (85° Celsius, 90d)	D5721	≥80% retained
UV Resistance (1600 hrs)	D5885	≥50% retained
Max Continuous Use Temp	D5885	60° Celsius (140° F)

9-14.20(8) BACKFILL

Gravel backfill must comply with the requirements of Mineral Aggregate Type 22 per Section 9-03.14, unless otherwise specified in the Drawings.

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9-14.20(9) PLANTING SOIL

Planting soil must be as specified in Section 9-14.1(5).

9-14.20(10) ROOT BARRIER

Root barrier must be as specified in Section 9-14.17.

9-14.20(11) OTHER MATERIALS

Plastic cable ties tensioning devices to secure materials must be per manufacturer's requirements.

SECTION 9-15 IRRIGATION SYSTEM

9-15.1 PIPE AND FITTINGS

9-15.1(1) GENERAL

Pipe must be galvanized iron, PVC, or polyethylene, as specified in the Contract.

9-15.1(2) GALVANIZED PIPE AND FITTINGS

Pipe must be standard weight, hot dipped galvanized iron or steel pipe, threaded and coupled. Pipe must comply with ASTM A 120.

9-15.1(3) POLYVINYL CHLORIDE PIPE AND FITTINGS

PVC pipe upstream of the control valves must be schedule 40 and conform to ASTM D 1785.

PVC pipe downstream of the control valves must be pressure rated for 200 psi and conform to ASTM D 2241, SDR 21.

Fittings must be of the solvent weld type except where risers or valves require threaded transition fittings. Fittings must conform to ASTM D 2466.

PVC pipe and fittings must be nontoxic, free from taste and odor, and self-extinguishing.

Pipe must be homogenous throughout and free of defects cracks, holes, foreign materials, wrinkles, dents, and blisters.

PVC pipe must be continuously and permanently marked with the following information: manufacturer's name, kind of pipe, National Sanitation Foundation (NSF) approval, and schedule number.

9-15.1(4) POLYETHYLENE PIPE

Polyethylene pipe must be Class 80, SDR 15, medium density polyethylene pipe; comply with ASTM D 2239; conform to U.S. Commercial Standard CS 255; and be National Sanitation Foundation (NSF) approved.

9-15.2 CONTROL TUBING

Control tubing must be copper refrigerator tubing complying with ASTM B 280 in the size shown on the Drawings. Tubing and fittings must be capable of withstanding a 300 psi operating pressure, and must be of the size shown on the Drawings.

9-15.3 SLEEVE

Pipe sleeves must be PVC schedule 40. Sizes and installation must be as shown on the Drawings and Standard Plan 128.

Conduit must be as specified in Section 9-34.

9-15.4 IRRIGATION AUTOMATIC CONTROLLERS

Automatic controllers must be installed in electrical controller cabinets on a concrete base as shown on Standard Plan 129. The dimensions and details of the controller cabinet must be as shown on Standard Plan 129 unless otherwise dimensioned and detailed in the Contract. A manufacturer of acceptable irrigation controller cabinets is Skyline Electric and Manufacturing Co., Seattle, Washington.

The controller must be an electrically timed device for automatically opening and closing control valves for predetermined periods of time and mounted so that all normal adjustments are conveniently located for use by the operator. Controllers must be enclosed in a weatherproof metal enclosure. The Contractor must submit a Shop Drawing of the padlock secured enclosure sized adequately to hold all specified equipment. The enclosure must include a modified free standing shelf measuring 12" x 12" x 15" high to hold the Controller, and one GFCI outlet with 15 amp circuit breaker (10,000 amp AIC) located in the upper right hand corner. All 120 volt wiring must be behind a dead front panel. The controller must be solid state, capable of operating the irrigation system as designed and constructed, and include these operating features:

1. Each controller station must be adjustable for setting to remain open for any desired period of time - from 5 minutes or less to at least 1 hour.
2. Adjustments must be provided whereby any number of Days may be omitted and whereby any one or more positions on the controller can be skipped. When adjustments are made, they must continue automatically within a 14 Day cycle until the operator desires to make new adjustments.

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3. Controls must allow any position to be operated manually, either on or off, whenever desired.
4. Controls must provide for resetting the start of the irrigation cycle at any time and advancing from one position to another.
5. Controllers must contain an on-off switch and fuse assembly.
6. Controller adjustments must be such that the open cycle may be doubled or repeated not less than 3 times during the complete watering cycle.
7. Controller must have a power failure cutout.
8. Controller must be UL approved and marked accordingly.

Contractor must provide an outdoor rated padlock by Best Manufacturing Company with a removable blue core.

9-15.5 SPRINKLER HEADS

Sprinkler heads must be of the type, pattern, and coverage shown on the Drawings at rated operating pressure specified, discharging not more than the amount of gallons per minute specified.

Sprinkler heads must be designed so that spray adjustments can be made by either an adjustment screw or interchangeable nozzles. Watering cores must be easily removed without removing the housing from the pipe.

All turn heads must be designed with turf flanges having 2 gripping holes to facilitate removal of the head.

When the Contract does not specify irrigation system spacing, or does not specify irrigation head make or model, then the Contractor must submit the missing information to the Engineer for approval at least 10 Working Days in advance of ordering materials. Approval, and request for approval of substitution, of sprinkler heads will be based on compatibility of materials with other Owner systems at the Project Site as specified ins 1-02.4(1) and 1-05.3(6). The Contractor must design the layout of such systems incorporating efficient and adequate coverage without overspray.

9-15.6 ELECTRICAL WIRE

Wire from controller to valves must be #14 UF direct burial (UL approved), red or black for the hot side, white for neutral (solid copper). The auxiliary wires, where required, must be any third color (except green). UF and UL designations must be clearly marked on the insulation jacket of all wires.

9-15.7 IRRIGATION VALVES

9-15.7(1) GATE VALVES

Gate valves, when shown on the Drawings, must be heavy-duty bronze conforming to the Specifications of ASTM B 62. Valves must be of the same size as the pipes on which they are placed and must have union or flange connections. Service rating (for non-shock cold water) must be 300 psi. Valves must be of the double disk, taper seat type, with rising stem, union bonnet, and handwheel. Manufacturer's name, type of valve, and size must be cast on the valve.

9-15.7(2) CONTROL VALVES

9-15.7(2)A MANUAL CONTROL VALVES

Manual valves must be bronze or brass, angle type, with hex brass union. Service rating must be not less than 150 psi nonshock cold water. Valves must be designed for underground installation with suitable cross wheel for operation with a standard key. The Contractor must furnish 3 suitable operating keys per Contract. Valves must have removable bonnet and stem assembly with adjustable packing gland and must house long acme threaded stem to ensure full opening and closing. Valve discs must be full floating with replaceable seat washers.

9-15.7(2)B AUTOMATIC CONTROL VALVES

Automatic remote control valves must be globe pattern with flanged or screwed connections as required. The valve must be constructed to allow all internal parts to be removable from the top of the valve without disturbing the valve installation. Screwed valves must be provided with union connections.

Valves must be of a normally closed design and must be electric solenoid operated, having maximum rating of 6.5 watts utilizing 24 volts AC power. Solenoids must be directly attached to the valve bonnets or body with all control parts and ports completely internal. Valves must be of 150 psi brass or bronze, or iron body bronze mounted combination. The time interval for valve closing operation must be a minimum of 5 seconds for complete closure at constant rate of closing and a minimum of 3 seconds to completely open at a constant rate of opening. A manual control bleed cock must be included on the valve to operate the valve without electric current. A manual shutoff stem with cross handle for wrench operation is required for manual adjustment from fully closed to wide open. Once the manual adjustment is set, the valve can be operated automatically in the adjusted position. Water flow must be completely stopped when the control valve is closed either manually or automatically. Automatic control valves and automatic controllers need not be of the same manufacturer.

All automatic control valves must be pressure reducing valves unless otherwise specified in the Contract.

9-15.7(2)C AUTOMATIC CONTROL VALVES WITH PRESSURE REGULATOR

The automatic control valve with pressure regulator must be similar to the automatic control valve and must also reduce the inlet pressure to a constant lower pressure regardless of supply fluctuations. The regulator must be fully adjustable.

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9-15.7(3) QUICK COUPLER VALVES

Quick coupler valves must have a service rating not less than 125 psi for nonshock cold water. The body of the valves must be of cast leaded semi red brass alloy No. C84400 conforming to ASTM B 584. The base of the valve must have standard female pipe threads. The design of the valve must be such that it opens only upon inserting a coupler key and closes as the coupler is removed from the valve. Leakage of water between the coupler and valve body when in operation will not be accepted. The valve body receiving the coupler must be designed with double worm slots to allow smooth action in opening and closing of the valve with a minimum of effort. Slots must be notched at the base to hold the coupler firmly in the open position. Couplers must be of the same material as the valve body with stainless steel double guide lugs to fit the worm slots. Couplers must be of one piece construction with steel reinforced side handles attached. All couplers must have standard male pipe threads at the top. Couplers must be furnished with all quick coupler valves unless otherwise specified in Contract. See Standard Plan 121.

9-15.7(4) DRAIN VALVES

The Contractor must install a 3/4-inch male automatic ball check drain valve at the low point in the system. The drain valve must be drained to a pocket containing a minimum of 1/2 cubic yard of Mineral Aggregate Type 4. See Standard Plan 122.

9-15.7(5) CHECK VALVES

Check valves must be heavy-duty bronze or steel. The valves must function by means of a hinged disc suspended from the body and able to close of its own weight. Valves must be of the same size as the pipes on which they are placed, unless otherwise specified in the Contract, and must have union or flanged connections. Service rating for nonshock cold water must be 300 psi. Manufacturer's name, type of valve, and size must be cast on the valve.

9-15.7(6) PRESSURE REDUCING VALVES

Pressure reducing valves must have a minimum of 150 psi working pressure with an adjustable outlet range of 20 to 70 psi. The valves must be factory set as shown on the Drawings.

Pressure reducing valves must be rated for safe operation at 175 psi non-shock cold water.

9-15.7(7) THREE WAY VALVES

Three way valves must be tight closing, three port, ball or plug type, and constructed to permit straight through and 90 degree flow only. The valve must be of bronze or approved corrosion resistant body Materials and must have a minimum of 150 psi working pressure. The head of the valve, or handle when applicable, must be permanently marked to indicate port position. Whenever handles are included as an integral part of the valve, the Contractor must remove the handles and submit them to the Engineer for ultimate distribution to the maintenance division.

9-15.7(8) FLOW CONTROL VALVES

Valve body materials must be plastic or metal. Internal parts must be stainless steel. Valves must be factory set to design flows. Valves must have no external adjustment and be tamper proof when installed. 1/4-inch and smaller flow control valves must have a minimum pressure absorption range of 2 to 32 psi. 1-1/2-inch and larger flow control valves must have a minimum pressure absorption range of 3 to 50 psi.

Flow must be controlled to 5 percent of design volumes.

9-15.7(9) AIR RELIEF VALVE

The air relief valve must automatically relieve air and break a vacuum in the serviced pipe. Body Materials must be installed exactly at all high points.

9-15.8 VALVE BOXES

All automatic control valves, flow control valves, and pressure reducing valves must be provided with valve boxes. Valve boxes must be sized as appropriate to allow efficient access to components and must be approved by the Engineer prior to installation. Valve boxes must be extendable to obtain the depth required. Where 1-inch diameter Schedule 80 PVC braces are required for quick coupler valves as shown on Standard Plan 121, the box must have holes adequately sized to securely snug fit the brace. All manual drain valves and manual control valves must be equipped with a protective sleeve and cap as shown in the Standard Plans.

9-15.9 BACKFLOW PREVENTION ASSEMBLIES

Backflow prevention assemblies must be as specified in Section 9-30.13.

9-15.10 HOSE BIBS

Hose bibs must be constructed of bronze or brass, angle type threaded to accommodate a 3/4-inch hose connection, and must be key operated. Design must be such as to prevent operation by wrench or pliers.

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9-15.11 DETECTABLE MARKING TAPE

Detectable marking tape must consist of inert polyethylene plastic that is impervious to all known alkalis, acids, chemical reagents, and solvents likely to be encountered in the soil, with a metallic foil core to provide the most positive detection and pipeline locators.

The tape must be color coded and must be imprinted continuously over its entire length in permanent black ink. The message must convey the type of line buried below and must also have the word “Caution” prominently shown. Color coding of the tape must be as follows:

Utility	Tape Color
Water	Blue
Sewer	Green
Electrical	Red
Gas-Oil	Yellow
Telephone-CATV	Orange
Non-Potable Water	Purple
Irrigation, Potable Water Source	Blue
Irrigation, Non-Potable Water Source	Purple

The width of the tape must be as recommended by the manufacture for the depth of installation.

SECTION 9-16 FENCE AND GUARDRAIL

9-16.1 CHAIN LINK FENCE AND GATES

9-16.1(1) GENERAL

All material used in the construction of chain link fence and gates must be new. Iron or steel Material must be galvanized; however, exceptions to galvanizing are listed in various Standard Plans and other Standard Specifications. Imperfectly galvanized Material or Material upon which serious abrasions of galvanizing occur will not be acceptable.

The base material for the manufacture of steel pipes used for posts, braces, top rails, and gate frames must conform to the Specifications of ASTM F 1083. The base material for the manufacture of steel H columns must comply with the Specifications of ASTM A 663 or ASTM A 675.

Roll formed posts, braces, and rails must be made from sheet steel and must conform with the details as shown on the Drawings or Standard Plan 450b. The Material for end, corner, and pull posts must have a minimum yield strength of 35,000 psi. The minimum yield strength for Alternate A roll formed line posts must be 40,000 psi and for Alternate B roll formed line posts 45,000 psi. Top rail and braces to be used with Alternate A or B line posts must conform to the minimum yield strength as required for either post respectively.

All posts, braces, top rails, and gate frames must be hot dip galvanized. They must have a minimum average of 1.8 ounces zinc coating per square foot of surface area with no individual test being below 1.6 ounces zinc coating per square foot of surface area. In the case of members made from pipe, this area is defined as the total area inside and outside. A sample for computing the average weight of coating is defined as a 12-inch piece cut from each end of the galvanized member. Fittings must be galvanized per ASTM F 626. Other Materials must be galvanized per ASTM A 153.

9-16.1(2) POSTS

All posts for chain link fence must be of the shape, size, and weight per foot shown on Standard Plan 450b. Roll formed end, corner, and pull posts must be made from 0.1345-inch minimum thickness sheet steel and must have integral fastening loops to connect to the fabric for the full length of each post. Roll formed line posts must be made from 0.110-inch minimum thickness sheet steel for Type 3 and Type 4 fences and must be made from 0.120-inch minimum thickness sheet steel for Type 1 and Type 6 fences.

An acceptance tolerance for posts for chain link fence allows for deviation from the weight per linear foot specified in the Standard Plans. This tolerance must be applied on an individual post basis and must be ± 5 percent for tubular and H section posts and ± 6 percent for roll form sections. Materials that exceed the weight per foot or wall thickness Specification may be accepted, providing they do not interfere with the proper construction of the fence.

9-16.1(3) TOP RAIL, BRACES, AND TRUSSES

Top rail and compression braces must be of the type and size shown on Standard Plan 450b. Tension truss rods must be 3/8-inch round galvanized rods with drop forged turnbuckles or other approved type of adjustment. Couplings for tubular sections must be outside sleeve type and at least 6 inches long. Roll formed top and brace rails must be made from 0.0747-inch thick sheet steel and must be an open rectangular section with internal flanges. The acceptable thickness tolerance for sheet steel members is ± 0.006 inch.

9-16.1(4) TENSION WIRE AND ATTACHMENTS

Top and bottom wire must be 7 gage coil spring steel wire of good commercial quality and must have a zinc coating averaging 0.8 ounce per square foot of surface area. All tension wire attachments must be hot dip galvanized steel. Eye bolts must be 3/8-inch diameter and of sufficient length to fasten to the type of posts used.

9-16.1(5) FITTINGS

All fittings and miscellaneous hardware must be malleable cast iron or pressed steel. Fittings must be galvanized per ASTM F 626. Galvanizing of miscellaneous hardware not covered by ASTM F 626 must be in conformance with ASTM A 153. Fittings for any particular fence must be those furnished by the manufacturer of the fence.

9-16.1(6) CHAIN LINK FENCE FABRIC

Chain link fabric must consist of 11 gage wire (0.120-inch diameter) for Types 3, 4, and 6 fence; and 9 gage wire (0.148-inch diameter) for Type 1 fence. The fabric wire may be one of the following Materials provided that only one type is selected for use in any one Contract:

1. Galvanized steel wire conforming to ASTM A 392. Galvanizing must be Class I performed by the hot dip process.
2. Aluminum coated steel wire conforming to ASTM A 491.
3. Class II aluminum wire conforming to 6061 T94 alloy.

The wire must be woven into approximately 2-inch diamond mesh. The width and top and bottom finish of the fabric must be as shown in Standard Plans 450a and 450c.

9-16.1(7) FABRIC BANDS AND STRETCHER BARS

Fabric bands must be 1/8” x 1” nominal and stretcher bars 3/16” x 3/4” nominal. Nominal dimensions must be construed to be the area of the cross-section of the shape obtained by multiplying the specified width by thickness. A variation of ± 5 percent from this theoretical area must be construed as “nominal” size. Both must be hot dip galvanized to comply with the Specifications of ASTM F 626.

9-16.1(8) TIE WIRE

Tie wire must be 9 gage aluminum wire complying with the ASTM B 211 or 9 gage galvanized wire complying with the Specifications of AASHTO M 279. Galvanizing must be Class 1. Hog rings must comply with the Specifications of AASHTO M 279. Galvanizing must be Class 1.

9-16.1(9) CHAIN LINK GATES

Gate frames must be constructed of not less than 1-1/2 inch inside diameter hot dip galvanized pipe with nominal weight of 2.72 pounds per linear foot. The corners of the gate frame must be fastened together and reinforced with a malleable iron or pressed steel fitting designed for the purpose, or they may be welded. Welding must be as specified in Section 6-03.3(25). All welds must be ground smooth and painted with a high zinc dust content paint per MIL P 21035. The paint must be applied in one or more coats to provide a dry film thickness of 3.5 mil minimum.

Cross trussing must be 3/8-inch galvanized steel adjustable rods.

Chain link gate fence fabric Material must be the same as used for the chain link fence as specified in 9-16.1(6).

Each gate must be furnished complete with necessary hinges, latch, and drop bar locking device designed for the type of gate posts and gate used on the Project. Gates must have positive type latching devices with provisions for padlocking.

Gate frames constructed of steel sections, except pipe, that are fabricated in such a manner as to form a gate of equal or better rigidity may be used provided they are approved by the Engineer.

9-16.1(10) MISCELLANEOUS

All concrete must be Class 3000 as specified in Section 6-02.3.

9-16.2 WIRE FENCE AND GATES

9-16.2(1) GENERAL

All materials used in the construction of the wire fence must be new. All iron or steel material must be galvanized. Imperfectly galvanized material or material upon which serious abrasions of galvanizing occur must not be used.

9-16.2(2) STEEL FENCE POSTS AND BRACES

All posts for chain link fence must be of the shape, size, and weight per foot shown in Standard Plan 450b. Roll formed end, corner, and pull posts must be made from 0.1345-inch minimum thickness sheet steel and must have integral fastening loops to connect to the fabric for the full length of each post. Roll formed line posts must be made from 0.110-inch minimum thickness sheet steel for Type 3 and Type 4 fences, and must be made from 0.120-inch minimum thickness sheet steel for Type 1 and Type 6 fences.

Line posts may be channel, T, U, Y, or other approved shape, manufactured solely for use as fence posts. One type of line post must be used throughout the Project. Line posts must be studded, slotted, or properly adapted for attaching either

wire or mesh in a manner that does not damage the galvanizing of posts, wire, or mesh during the fastening. Line posts must have a minimum weight of 1.33 pounds per linear foot and must be provided with a tapered steel anchor plate, attached securely having a minimum weight of 0.67 pounds, and having a surface area of 20 square inches ± 2 square inches.

End, corner, gate, and pull posts must comply with the Specifications for line posts, except that the posts must have a minimum weight of 3.1 pounds per linear foot; must have anchor plates; and special studs, slots, or adapters for the attachment of wires will not be required.

Braces must have a minimum weight of 3.1 pounds per linear foot.

All posts, braces, anchor plates, and hardware not covered by ASTM F 626 must be galvanized per ASTM A 123, or ASTM A 153.

A tolerance of minus 5 percent on the weight of individual posts, braces, or anchor plates will be permitted.

9-16.2(3) WOOD FENCE POSTS AND BRACES

Douglas Fir, Western Red Cedar, Hemlock, or Larch must be used in the construction of wood fence posts and braces. The material must be of good quality and approved by the Engineer before use. Peeler cores must not be used for round posts. Wood fencing materials must have sufficient sapwood in the outer periphery to obtain the specified penetration of preservative. Western Red Cedar does not require preservative treatment. Fencing materials must be cut to the correct length before pressure treatment.

Line posts must be 3-inch minimum diameter round posts or nominal 3” x 3” square sawed posts. If the posts are to be pointed for driving, they must be pointed before treatment. Line posts must be at least 7 feet in length.

Pull posts and brace posts must be 6-inch diameter round posts or nominal 6” x 6” material not less than 7 feet in length.

End, gate, and corner posts, and posts at an intersecting fence must be 6-inch diameter round posts or nominal 6” x 6” material not less than 7’-10” in length.

All sawed posts and timbers must comply with the requirements in the tables in Section 9-09.2.

The preservative treatments used to pressure treat wood fencing materials must be as specified in Section 9-09.3.

The retention and penetration of the preservative must be as follows:

Minimum Retention in Pounds per Cubic Foot

Preservative	Sawed Posts	Round Posts
ACA	0.40	0.40
ACZA	0.40	0.40

Minimum Penetration

Material Size	Minimum Penetration
5” or less	0.40” penetration and 90% of sapwood
5” or greater	0.50” penetration and 90% of sapwood

9-16.2(4) BRACE WIRE

Brace wire must be 9 gage galvanized wire complying with the Specifications of ASTM A 116, galvanizing Class 3.

9-16.2(5) STAPLES AND WIRE CLAMPS

The staples used to attach the wire fencing to wood posts must be galvanized 9 gage, 1-1/2 inches long complying with the Specifications of AASHTO M 279, galvanizing Class 1.

The wire clamps used to attach the wire fencing to steel posts must be galvanized 11 gage wire complying with the Specifications of AASHTO M 279, galvanizing Class 1.

9-16.2(6) BARBED WIRE

Barbed wire must conform to the Specifications of AASHTO M 280, and must consist of two strands of 12-1/2 gage wire, twisted with 4 point 14 gage barbs with the barbs spaced an average of 5 inches apart. Galvanizing must be Class 3.

9-16.2(7) WIRE MESH

Wire mesh must conform to the Specifications of AASHTO M 279, and must consist of 7 horizontal wires with vertical stays spaced 6 inches apart. The top and bottom wires must be 10 gage, and the intermediate wires and vertical stays must be 12-1/2 gage. The mesh must have a total width of 26 inches (Design No. 726-6-12-1/2). Galvanizing must be Class 3. The zinc coated wire as represented by the test specimens must be capable of being wrapped in a close helix at a rate not exceeding 15 turns/minute around a cylindrical steel mandrel having a diameter the same as the specimen being tested, without cracking or flaking the zinc coating to such an extent that any zinc can be removed by rubbing with the bare fingers.

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9-16.2(8) VERTICAL CINCH STAYS

Vertical cinch stays must be 9-1/2 gage galvanized wire complying with the Specifications of AASHTO M 279, except that the minimum weight of zinc coating must be 0.3 ounce per square foot of uncoated wire surface.

9-16.2(9) WIRE GATES

Gate frames must be constructed of galvanized standard weight pipe with a nominal diameter of not less than 1 inch. The pipe must conform to the Specifications of ASTM A 53. Wire gates must be not less than 48 inches in height and must be designed to fit openings of the widths called for in the Contract. Each gate must be provided with two upright braces of the same material as the frame, spaced at 1/3 points in the gate. All gates must be provided with adjustable 3/8-inch diameter diagonal truss rods from corner to corner.

The gate frame must be provided with wire mesh as specified in Section 9-16.2(7), except that it must consist of 10 horizontal wires and have a total width of 47 inches (Design No. 1047-6-12-1/2).

Each gate must be furnished complete with necessary hinges and latch designed for use with the type of gate posts used on the Project. The hinges must be designed to be securely attached to the gate post and to enable the gate to be swung back against the fence.

Double gates must be hinged in the same manner as single gates and must be provided with an approved drop bar locking device.

9-16.2(10) MISCELLANEOUS

Bolts, nuts, and hinges used in the construction of fence and gates must be galvanized per AASHTO M 232.

All concrete must be Class 3000 as specified in Section 6-02.3.

9-16.3 NON-WEATHERING STEEL BEAM GUARDRAIL

9-16.3(1) RAIL ELEMENT

The W beam or thrie beam rail elements, backup plates, reducer sections, and end sections must conform to "A Guide to Standardized Highway Barrier Hardware" published by AASHTO, AGC, and ARTBA. All rail elements must be formed from 12 gage steel except for thrie beam used for bridge rail retrofit and Design F end sections that must be formed from 10 gage steel.

The rail splices must have a minimum total ultimate strength of 80,000 pounds at each joint.

The 6-inch channel rails and splice plates must conform to ASTM A 36. All fabrication must be complete before galvanizing.

The holes in the plate must be slotted to facilitate erection and to permit expansion and contraction. The edges of the rail must be rolled or rounded so they present no sharp edges. Where the rail is on a curve, the plates at the splice must make contact throughout the area of splice. When the radius of curvature is less than 150 feet, the rail must be shaped in the shop.

9-16.3(2) POSTS AND BLOCKS

Posts and blocks may be of ammoniacal copper arsenate (ACA), or ammoniacal copper zinc arsenate (ACZA), treated timber or galvanized steel; except only treated timber posts and blocks may be used for weathering steel beam guardrail. Blocks made from alternate materials that comply with the NCHRP Report 350 criteria may be used per the manufacturer's recommendations. Except for terminal or anchor assemblies, all posts for any one project must be of the same type (wood or steel). Posts and blocks must be of the size and length shown on the Drawings and complying with these Specifications. Posts and blocks may be S4S or rough sawn.

Timber posts and blocks must conform to the grade specified in Section 9-09.2, except pine lumber No. 1 grade may be used for the blocks. Timber posts and blocks must be fabricated as specified in the Drawings before being treated. Timber posts and blocks must be treated by the empty cell process to provide a minimum retention, depending on the treatment used, according to the following:

1. ACA 0.50 lbs. pcf.
2. ACZA 0.50 lbs. pcf.

Treatment must be as specified in Section 9-09.3.

Steel posts, blocks, and base plates, where used, must conform to either ASTM A 36 or ASTM A 992, and must be galvanized per AASHTO M 111. Welding must conform to Section 6-03.3(25). All fabrication must be completed prior to galvanizing.

9-16.3(3) GALVANIZING

Beam rail elements and terminal sections must be galvanized per AASHTO M 180, Class A, Type 2, except that the rail must be galvanized after fabrication, with fabrication to include forming, cutting, shearing, punching, drilling, bending, welding, and riveting. In addition, the minimum average weight of zinc coating must be 2 ounces per square foot of surface (not sheet), the average to be determined on the basis of 3 individual tests, no one of which may be less than 1.8 ounces per square foot of surface (not sheet). The aluminum content of the zinc bath during actual galvanizing operations must not exceed 0.01 percent. Channel rails, splice plates, WF steel posts, and base plates must be galvanized per ASTM A 123. Anchor cables

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must be galvanized per Federal Specification RR W 410, Table II, galvanized at finished size. Bolts, nuts, washers, plates, rods, and other hardware must be galvanized per ASTM A 153.

9-16.3(4) HARDWARE

Bolts, unless otherwise specified in other Standard Specifications or in the Standard Plans, must comply with ASTM A 307, Grade A Specifications. High strength bolts must conform to the Specifications of AASHTO M 164. Nuts must comply with ASTM A 563, Grade A Specifications. Washers, unless specified or shown otherwise, must comply with ASTM F 844 Specifications. The Contractor must submit a manufacturer's certificate of compliance for the bolts, nuts, and washers prior to installing any of the hardware.

9-16.3(5) ANCHORS

Welding must conform to Section 6-03.3(25).

All welding must be at least equal in strength to the parent metal.

All fabrication must be complete and ready for assembly before galvanizing. No punching, drilling, cutting, or welding will be permitted after galvanizing unless authorized by the Engineer.

Foundation tubes must be fabricated from steel conforming to the Specifications of ASTM A 500, Grade B, or ASTM A 501.

The anchor plate assembly must develop a minimum tensile strength of 40,000 pounds.

The anchor plate, W200 x 27 and metal plates must be fabricated of steel conforming to ASTM A 36.

Anchor cable must be 3/4-inch preformed, 6 x 19 wire strand core or independent wire rope core (IWRC), galvanized, right regular lay manufactured of improved plow steel with a minimum breaking strength of 42,800 pounds. Two certified copies of mill test reports of the cable used must be furnished to the Engineer.

Swaged cable fittings must develop 100 percent of the specified breaking strength of the cable. One swaged fitting attached to 3 feet of cable must be furnished to the Engineer for testing.

The swaged fitting and stud assembly must be of steel conforming to the requirements of American Iron and Steel Institute C 1035 and must be annealed and galvanized suitable for cold swaging.

Welded wire fabric for Type 1 anchor must conform to ASTM A 185.

All metal components of the anchor and cable assembly and not less than the top 14 inches of the W8 x 17 for the Type 2 anchor must be hot dip galvanized as specified in Section 9-16.4(3).

Cement concrete of the class specified, must be as specified in Section 6-02.3.

Cement grout must consist of one part Portland cement and two parts sand.

9-16.3(6) INSPECTION AND ACCEPTANCE

The Contractor must provide at least 3 Working Days advance notice to the Engineer before the rail elements are fabricated in order that inspections may be provided. The Contractor must arrange for all facilities necessary for the inspection of material and workmanship at the point of fabrication of the rail element, and inspectors must be allowed free access to necessary parts of the premises.

The inspector must have the authority to reject materials or workmanship which do not fulfill conform to these Specifications. In cases of dispute, the Contractor may appeal to the Engineer, whose decision will be final.

The inspector may accept a mill test report certifying that the steel used in fabricating the rail element complies with the Specifications. The Owner reserves the right, however, to require the Contractor to furnish samples of the steel proposed for use and to determine to its satisfaction that the steel complies with the Specifications. Steel rail elements, fittings, terminal section hardware, and bolts may be accepted by the Engineer based on the Manufacturer's Certification of Compliance.

9-16.4 WIRE MESH SLOPE PROTECTION

9-16.4(1) GENERAL

All metal material used in the construction of wire mesh slope protection must be new and galvanized. Imperfectly galvanized material or material upon which serious abrasion of galvanizing occurs will not be acceptable.

9-16.4(2) WIRE MESH

The galvanized wire mesh must consist of No. 9 gage (0.148-inch diameter) commercial quality zinc coated steel wire, 3-1/2" x 5-1/2" diamond mesh chain link conforming to the Specifications of AASHTO M 181. Galvanizing must conform to the Specifications of ASTM A 392 except the weight of zinc coating must be 0.80 ounce per square foot minimum, of uncoated wire surface. Galvanizing must be done before weaving.

The wire mesh fabric must have knuckled selvages.

Alternate wire mesh for slope protection must be double twisted mesh. The mesh must be of nonraveling construction and consist of a uniform double twisted hexagonal mesh of hot-dip galvanized steel wire having a diameter of 0.120 inches after galvanization. The wire must be galvanized prior to weaving into the mesh and must conform to ASTM A 641, Class 3, Finish 5, Soft temper. The minimum tensile strength must be 60,000 psi when tested per ASTM A 370. Openings must be

hexagonal in shape and uniform in size measuring not more than 3-1/4" x 4-1/2", approximately 9 square inches. Lacing wire must use the same Specifications as the wire used in the wire mesh except that its diameter must be 0.0866 inches after galvanization.

Edges must be mechanically selvaged in such a manner as to prevent unraveling, and must develop the full strength of the mesh. The wire used for the selvage must have a nominal diameter of 0.1535 inch.

9-16.4(3) WIRE ROPE

Wire rope must be 5/8-inch diameter zinc coated steel structural wire rope per ASTM A 603, Class A.

9-16.4(4) HARDWARE

All rings must be drop forged steel, heat treated after forging. Lightweight wire rope thimbles weighing approximately 13.8 pounds per hundred must be used with the 1/2-inch diameter wire rope. Wire rope clips may be drop forged steel or cast steel for use with 1/2-inch wire rope. All rings, thimbles, wire rope clips, and U bolts must be galvanized per AASHTO M 232, Class C, except castings must be Class A, and forgings must be Class B.

9-16.4(5) HOG RINGS AND TIE WIRE

Hog ring fasteners and tie wire must be manufactured of 9 gauge steel wire complying with Federal Specification QQ W 461 (AISI numbers 1010 and 1015) finish 5; medium hardness and tensile strength; Class 3 coating.

9-16.4(6) GROUT

When required, grout for anchors must consist of 1 part Portland cement and 3 parts of clean sand. The Portland cement must be as specified in Section 9-01.2(1).

9-16.4(7) ANCHOR RODS

Anchor rods must be steel. The eye may be drop forged or formed with a full penetration weld and must develop 100 percent of the rod strength. The anchor rod must be galvanized per ASTM A 153.

9-16.5 RESERVED

9-16.6 WEATHERING STEEL BEAM GUARDRAIL

9-16.6(1) RAIL AND HARDWARE

Steel for rail elements and terminal sections must conform to ASTM A 606 or ASTM A 607. Bolts, nuts, and washers for installation of the weathering steel must be manufactured from steel conforming to ASTM A 242M and must not be galvanized. If required, 6-inch channels and fittings must conform to ASTM A 242. In addition, all steel for the guardrail components must conform to one of the following chemical compositions, percent (ladle):

Composition

	C	Mn	P	S	Si	Cu	Cr	Ni	Zr
No. 1	0.12 Max.	0.20-0.50	0.07-0.15	0.05 Max.	0.25-0.75	0.25-0.55	0.30-1.25	0.65 Max.	--
No. 2	0.12 Max.	0.50-1.00	0.12 Max.	0.05 Max.	0.20-0.90	0.50 Max	0.40-1.00	1.00 Max.	0.10 Max.

Blast cleaning or pickling to remove mill scale will not be required. All fabricated steel parts must be handled with care to avoid gouges, scratches, and dents. The steel must be kept clean of all foreign material, such as paint, grease, oil, chalk marks, crayon marks, concrete spatter, or other deleterious substances. Natural oxidation of the steel will not be considered foreign material. Storage in transit, in open cars and trucks, for an extended period will not be permitted. Steel parts stored outside in yards or at Job Sites must be positioned to allow free drainage and air circulation.

9-16.6(2) ANCHORS

Guardrail anchors may either be furnished as provided in Section 9-16.4(5) or they may be nongalvanized and fabricated from steel conforming to ASTM A 242 with the exception that all Type 1 anchors must have galvanized cable and fittings as specified in Section 9-16.4(5).

9-16.6(3) POSTS AND BLOCKS

Posts and blocks for weathering steel beam guardrail must be as specified in Section 9-16.4(2).

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SECTION 9-17 FLEXIBLE GUIDE POSTS

9-17.1 GENERAL

Flexible guide posts must be made of a flexible, nonwarping, nonmetallic, durable plastic material; must be resistant to damage due to impact, ultraviolet light, ozone, hydrocarbons, and other effects of atmospheric weathering; must resist stiffening with age; and must be designed for a minimum life equaling 60 months of outdoor service.

The post system must be designed for permanent installation to resist overturning, twisting, and displacement from wind and impact forces.

Each flexible guide post must be permanently identified with the manufacturer's name, the month and year of fabrication and a mark indicating the recommended burial depth. The letters must be solvent resistant, a minimum of 1/4 inch in height, and permanently affixed to the post unless otherwise specified in the Contract, the color of the guide post must be white or brown as shown on the Drawings. Guide post length must be as specified in Section 8-10.3.

The reflective panel on a flat or elliptical guide post must have a minimum width of 3 inches facing traffic. The reflective sheeting must have a minimum area of 24 square inches (3" x 8"). The reflective panel on a round guide post must have a 9-inch minimum band of reflective sheeting visible for 360 degrees.

9-17.2 LABORATORY TESTS

Ten guide posts of each model must be conditioned in an oven for two hours at 120 °F ± 3 F°. After conditioning, the guide post must be bent backwards at 90 degrees from the vertical to simulate a field impact. The guide post must, without cracking, recover to within 10 degrees of its original position within 5 minutes. Color must remain unchanged. Any appreciable change in color, cracking on more than one face, or not returning to within 10 degrees of vertical, is considered a failure. At least 70 percent of the posts must pass to be considered for preapproval.

The same 10 guide posts tested for heat resistance must be tested for cold resistance. The guide posts must be conditioned for 24 hours at -20 °F, ± 3 °F, then subjected to the same testing as for heat resistance. The guide posts must conform to the same cracking, color, and recovery standards as for heat resistance. At least 70 percent of the posts must pass to be considered for preapproval.

3 guide posts of each model must be subjected to deflection testing. The guide posts must be fixed near the base in such a way that 4 feet of the post is cantilevered. The guide posts must then be loaded 1/2 inch from the free end until collapse is observed. (Collapse is defined as the point at which the guide post can no longer resist any further loading.) The stress at collapse must be calculated as follows:

$$P = K(Q / b)$$

Where:

P = the equivalent stress in pounds per square foot.

Q = the load at collapse in pounds.

b = the post width (diameter of major axis) in inches.

K = is constant equal to 6 inches per square foot.

The value of P must be no less than 3.43 pounds per square foot for round guide posts and 5.30 pounds per square foot for flat or elliptical guide posts. Any load below these values or cracking of more than one face, of any of the guide posts is considered a failure.

The 3 guide posts subjected to deflection testing must be subjected to cyclic loading with an amplitude of 2 inches at the tip, with a cycle testing machine. Each guide post must be cycled 30,000 times at 60 cycles per minute. When the cyclic tests are completed, the 3 guide posts must again be subjected to deflection testing. The average load of the posts after cyclic loading must be a minimum of 80 percent of the average load of the posts tested before cyclic loading. A value below this limit is considered a failure.

3 guide posts of each model must be subjected to a 5.5 pound deflection test. The guide posts must be fixed near the base in such a way that 4 feet of the post is cantilevered. The guide post must then be loaded 1/2 inch from the free end with a 5.5 pound weight. A deflection greater than 29 inches is considered a failure.

A 9-inch specimen from the un-reflectorized portion of each of 3 guide posts must be prepared. The specimens must be cycled at 1000 hours in a weatherometer per ASTM G 53 (3 hr. 60C UV, 3 hr. 50C CON). The specimens must show no signs of delamination, distress, or discoloration. Physical properties of tensile strength and rigidity must be maintained within 80 percent of the unconditioned values.

9-17.3 FIELD TESTS

Ten guide posts of each model, supplied as specified in Section 9-17.4, must be installed by the manufacturer's representative at the SPU Materials Laboratory designated test site. Anchoring Materials must be driven such that the anchor is flush with, or below, the ground level. The test temperature must be at or below 50 °F.

The 10 guide posts must be struck 7 times at 35 mph, then two times at 55 mph, by a car or equivalent hood and bumper device with an 18-inch height. After each impact, the delineators must be inspected for the following criteria:

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1. A minimum of 50 percent of the reflective sheeting must be kept undamaged. An area of damage greater than 50 percent is considered a failure.
2. If the guide post leans more than 10 degrees from vertical it is considered a failure.
3. Any cracking, except surface cracking evident on only one face of the post, is considered a failure.
4. Pullout in excess of 3 inches is considered a failure.

If an individual guide post fails any one of the above criteria in the 35 mph series of impacts, the product is unacceptable. At least 70 percent of the guide posts must pass each criteria in the 55 mph series of impacts to be acceptable.

9-17.4 APPROVAL

The Contractor must submit a manufacturer's certificate of compliance stating all materials meet or exceed Contract requirements. See Section 1-06.3.

SECTION 9-18 PRECAST TRAFFIC CURB AND BLOCK TRAFFIC CURB

9-18.1 PRECAST TRAFFIC CURB

9-18.1(1) AGGREGATES AND PROPORTIONING

The cement, fine and coarse aggregate, and reinforcing steel to be used in the manufacture of precast concrete traffic curb must comply with the following requirements and be submitted to the SPU Materials Laboratory for approval:

1. Aggregates must be as specified in Section 9-03 except they must be uniformly graded up to a maximum size of 3/8 inch and must contain sufficient fine fractions to permit securing the type of surface finish specified. The aggregate must be approved by the SPU Materials Laboratory before it is used.
2. Reinforcing steel must be as specified in Section 9-07.
3. The cement concrete mix must be composed of not less than 1 part Portland cement to approximately 2 parts of fine concrete aggregate and 3-1/4 parts of coarse concrete aggregate adjusted to secure proper workability. The Contractor will be allowed to use a different concrete mix if approved by the Engineer, provided that it develops not less than 4,000 psi compressive strength when tested at the age of 28 Days.

9-18.1(2) MIXING

The mixers must be kept in good repair and must be equipped with an automatic timing device, and a positive device for regulating the quantity of water added to each batch. The latter device must be approved by the Engineer before use.

After all Materials, including water, have been placed in the mixer, the Materials must be mixed for a period of not less than 1-3/4 minutes, or as long as necessary to produce a uniform concrete mix. No water must be added to any batch after completion of the mixing period. Each batch of concrete must be completely emptied from the mixer before placing more Materials in it. Do not use a batch that has not been placed within 30 minutes from the time water was first added.

The amount of water in the concrete must be kept to a minimum, consistent with the manufacture of a dense mix, free from air bubbles and surface defects in excess of the tolerance limits specified.

9-18.1(3) FORMS

Forms for precast traffic curbs must be steel or special concrete mold. The use of forms or molds made of plaster of paris, wood, or other absorptive material will not be permitted.

Bulkheads must be tight fitting so there is no leakage of mortar between the bulkhead and form.

The Materials and methods used for lubricating the forms must not result in discoloration of the curb at any time. A minimum quantity of lubricant must be used and all excess lubricant must be removed.

9-18.1(4) PLACING CONCRETE

The concrete must be consolidated by external vibration, or by other means if approved by the Engineer, to produce a dense concrete throughout, having a minimum of air bubbles and honeycombing.

Reinforcing steel must be placed and maintained in its proper position as shown in the Standard Plans.

Curb or buttons must not be manufactured in an atmospheric temperature of less than 50 °F.

9-18.1(5) REMOVAL OF FORMS

The molds or forms must be removed from the curb using a method acceptable to the Engineer.

The loosening of the curb from the molds must be carefully performed to avoid excessive shock and straining of the curb. When, in the opinion of the Engineer, undue shock is required to remove the curb from the molds, the stripping operation must be deferred until the forms may be removed without breakage.

9-18.1(6) CURING CONCRETE

Immediately after the concrete has been placed and consolidated in the mold, each unit must be placed in a curing room fitted with water sprays and maintained at a relative humidity of not less than 90 percent and a temperature of not less than 60

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°F, nor more than 100 °F. Each unit must remain in the curing room for a period of not less than 10 Days, except that if Type III cement is used, the period in the curing room may be reduced to 5 Days.

9-18.1(7) FINISH

The curb must have a smooth, glassy finish on all exposed surfaces.

Excess honeycombing in the back of the curb may be cause for rejection of the curb. Honeycombing areas in the back of the curb which, in the opinion of the Engineer, are not detrimental to the curb need not be patched. The workmanship of the bottom finish must be such that no mechanical interlocking of the mortar bed and the curb bottom or anchor groove occurs.

9-18.1(8) SURFACE TREATMENT

As soon as the units have been taken out of the curing room and thoroughly surface dried to a depth of at least 1/4 inch, brush apply two coats of a water repellent compound as specified in Section 9-18.3. When the first coat has dried, the second coat of water repellent compound must be applied.

9-18.1(9) DIMENSIONS AND SHAPE

The curb must conform to the dimensions and shape shown on the Standard Plans within a tolerance of 1/4 inch in length and 1/8 inch in alignment.

9-18.1(10) CURB LENGTHS AND ANCHOR HOLES

413a and 413b curb must be made in 3'-0" maximum length sections. Circular curbing must be made only for such radii as called for in the details on the Drawings.

Each 413b curb section must have two 1-inch diameter holes as shown in Standard Plan 413a.

9-18.1(11) DEFECTIVE CURB

Not more than 2 percent of the top area in any one piece of curb may be defective, and not more than 5 percent of the total length of the top corners of reflecting faces in any one piece of curb may be broken or rounded. There must be not more than 30 air holes in any linear foot of curb, nor more than 50 air holes in any 3 linear feet of curb. All curb having defects in excess of any of the listed defects in this Section will be considered defective as specified in Section 1-05.7. Failure to reject such curb at the time of form removal may be waived if and only if 90 percent of the curb laid has less than 10 percent of the maximum allowable number of each type defect specified in this paragraph; however, all defects must be immediately repaired. The Contractor agrees that its refusal to repair defects is grounds for the Engineer to declare the curb defective.

An air hole must be defined as any hole 1/8 inch or larger in diameter or depth.

The sum of the length of the lines of discoloration caused by a cracked mold in any one piece of curb must not exceed 50 percent of the length of the curb, and the maximum length of any single line of discoloration must not exceed 18 inches. 75 percent of the curb laid must be entirely free from lines of discoloration. The employment of heat to obliterate lines of discoloration will not be permitted. The process used to obliterate lines of discoloration is subject to the approval of the Engineer.

The repairing of molds which are chipped or broken must be done in a manner that the broken or chipped areas are not apparent on the curb made in those molds.

All curb in which surface cracking develops during the first 5 Days after manufacture will be rejected.

Hidden air holes at or immediately below the exposed surface of the curb which are in excess of the limits specified and are disclosed by testing the surface by means of a rubber hammer, will be considered defective as specified in Section 1-05.7.

All curb in which cracking is in evidence immediately after removal from the molds will be considered defective. A crack is defined as any continuous separation of the concrete greater than 3 inches in length.

All curb which varies in dimensions, alignment, or surface contour in excess of the tolerance specified will be considered defective.

9-18.1(12) REPAIRING CURB

Curb having defects which are not sufficient cause for its rejection must be neatly repaired immediately after removal from the molds as subject to the approval of the Engineer. However, no patching or other repairs must be made without the permission of the Engineer. Patches must be undercut if, in the opinion of the Engineer, this operation is necessary to achieve an acceptable patch.

All holes larger than 1/16-inch diameter in the exposed surface of acceptable curb or buttons must be filled with cement mortar.

9-18.1(13) IDENTIFICATION MARKING

The date of manufacture, the length, and identification number corresponding to the detail layout must be marked in black paint on the back or end of each piece of curb.

Rejected curb must be marked on the back or end surfaces in a practical and semi-permanent manner to identify each cause of rejection.

9-18.1(14) SHIPPING

No unit of curb must be shipped from the manufacturing facility prior to 21 Days after manufacture, except that if Type III cement has been used, the units may be shipped 14 Days after manufacture.

9-18.1(15) SAMPLING AND INSPECTION

The Contractor must submit, for the approval of the Engineer, an advance sample of curb which must be at least equivalent in color, surface texture, and bottom finish to the standard as set forth in these Specifications. No repairing of any kind must be done on the advance sample. Upon approval, the advance sample must be stored at the facility or site of manufacture in a location readily accessible to the inspector where there is adequate daylight for examination. The advance sample must be protected from damage and discoloration and must be used as a standard of comparison for color, surface texture, and bottom finish for all curb manufactured. All curb furnished must be equivalent to the sample.

The inspection at the facility will be made just prior to shipment, at which time examination will be made of the alignment, contour, color, cracks, surface damage or discoloration, broken corners or edges, and any other defects which may have developed, and to check the laboratory test reports for strength. However, intermediate inspections may be made to determine surface cracking and hidden air holes if it is impractical to examine for these defects at the final inspection.

9-18.2 BLOCK TRAFFIC CURB

Block traffic curb must be as shown on Standard Plan 413b.

The curb units must be made from Portland cement, sand, and gravel, the proportions of which must be left to the discretion of the producer as long as the unit develops a minimum compressive strength of 1,600 psi at 28 Days when tested for end loading.

The proportions of sand, gravel, and cement, the type of forms used, and the method of compacting the concrete in the forms must all be such that as dense, smooth, and uniform a surface as is practicable for a concrete masonry unit is obtained on the finished curb units. The faces that are to be exposed must be free from chips, air holes, honeycomb, or other imperfections, and cracks must be tight, with the following exceptions: not more than 5 percent of each curb unit contains cracks, contains small chips which are not larger than 1/4 inch in any dimension, and air holes which are not larger than 1/4 inch in diameter or depth. The units used in any contiguous line of curb must have approximately the same color and surface characteristics.

9-18.3 WATER REPELLENT COMPOUND

The water repellent compound must be a clear, penetrating type, silicone resin base compound containing no filler or other material that leaves a film on the surface of the masonry after it is applied, and bonds securely to the masonry. It must be of such consistency that it can be applied readily by brush or spray to the masonry at atmospheric temperature down to minus 20°F.

The average absorption of 3 test specimens treated with the water repellent compound, when tested per the methods used in the Laboratory must not exceed 2 percent after being partially immersed in water for 72 hours immediately after curing.

The average moisture vapor transpiration (breathing) of 3 test specimens, when tested per the methods used in the Laboratory, must be not less than 50 percent at 7 Days.

The water repellent compound must be approved by the Laboratory before it is used.

9-18.4 SODIUM METASILICATE

Sodium metasilicate must comply with ASTM D 537.

SECTION 9-19 PRESTRESSED CONCRETE GIRDERS

9-19.1 CONCRETE AGGREGATES AND PROPORTIONING

The concrete for prestressed girders must have the minimum compressive strengths as specified on the Drawings. Aggregates used in the mix must conform to the following:

1. Coarse aggregate must be as specified in Section 9-03.1(3).
2. Fine aggregate must be as specified in Section 9-03.1(2), Class 1 or Class 2.
3. The manufacturer may change the grading of the coarse aggregate provided the concrete mix design is qualified with the modified gradation. An alternative combined gradation conforming to Section 9-03.1(4) may also be used.

The Contractor must submit for review a proposed mix design for each design strength. Included must be evidence acceptable to the Engineer that the proposed mix design complies with design requirements. The mix design review will not preclude any requirements for the concrete placed in the girders.

The concrete mix must be prepared and placed as specified in Section 6-02.

Water used in mixing the concrete must be as specified in Section 9-25.1.

Portland cement and hydraulic cement must be as specified in Section 9-01.

Chemical admixtures and pozzolans must be as specified in Section 9-23.4.

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The total chloride ion (Cl-) content of the mixed concrete, expressed as a percent by mass of cement, must not exceed 0.06 percent.

9-19.2 REINFORCEMENT

Reinforcement must be as specified in Section 9-07 and must be placed as specified in Section 6-02.3(24).

SECTION 9-20 CONCRETE PATCHING MATERIAL, GROUT AND MORTAR FOR STRUCTURES

9-20.1 PATCHING MATERIAL

Concrete patching material will be prepackaged mortar extended with aggregate. The amount of aggregate for extension must conform to the manufacturer's recommendation.

9-20.2 SPECIFICATIONS

Patching mortar and patching mortar extended with aggregate must contain cementitious material and be as specified in Sections 9-20.2(1) and 9-20.2(2). The manufacturer must use the services of an independent laboratory that has an equipment calibration verification system and a technician training and evaluation process per AASHTO R-18 to perform all tests specified in Section 9-20.

9-20.2(1) PATCHING MORTAR

Patching mortar must conform to the following requirements:

	ASTM Test Method	Specification
Compressive Strength		
at 3 hours	C 39	Minimum 3,000 psi
at 24 hours	C 39	Minimum 5,000 psi
Length Change		
at 28 Days	C 157	0.15 percent maximum
Total Chloride Ion Content	C 1218	1 lb/yd^3 maximum
Bond Strength		
at 24 hours	C 882 (As modified by C 928, Section 8.5)	Minimum 1,000 psi
Scaling Resistance (at 25 cycles of freezing and thawing)	C 672 (As modified by C 928, Section 8.4)	1 lb/ft^2 maximum

9-20.2(2) PATCHING MORTAR EXTENDED WITH AGGREGATE

Patching mortar extended with aggregate must comply with the following:

	ASTM Test Method	Specification
Compressive Strength		
at 3 hours	C 39	Minimum 3,000 psi
at 24 hours	C 39	Minimum 5,000 psi
Length Change		
at 28 Days	C 157	0.15 percent maximum
Bond Strength		
at 24 hours	C 882 (As modified by C 928, Section 8.5)	Minimum 1,000 psi
Scaling Resistance (at 25 cycles of freezing and thawing)	C 672	2 Maximum Visual Rating
Freeze thaw	C 666	Maximum expansion 0.10% Minimum durability 90.0%

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9-20.2(3) AGGREGATE

Aggregate used to extend the patching mortar must be as specified in Section 9-03.1(3) and be AASHTO Grading No. 8. A manufacturer's certificate of compliance is required showing the aggregate source and the gradation.

9-20.2(4) WATER

Water must be as specified in Section 9-25.1. The quantity of water must be within the limits recommended by the manufacturer

9-20.3 GROUT

Grout is a mixture of Portland or blended hydraulic cement and water with or without aggregates and with or without admixtures. Grout may also contain pozzolans and/or concrete admixtures. Grout may be a Contractor's submitted mix design or a manufacturer's prepackaged grout product.

All prepackaged grouts must be used per the manufacturer's recommendations, including but not limited to, shelf life, mixing, surface preparation, and curing.

Where required, all 2-inch cube specimens fabricated in the field must be made per WSDOT TM-813. All 2-inch cube specimens fabricated in a laboratory must be made per AASHTO T-106. All 2-inch cube specimens must be tested per AASHTO T-106.

When coarse aggregate is used, specimens must be fabricated per AASHTO T-23 and tested per AASHTO T-22.

9-20.3(1) GROUT TYPE 1 FOR POST-TENSIONING APPLICATIONS

Grout Type 1 must be a Class C prepackaged, pumpable, nonbleed, nonshrink, and high-strength material conforming to AASHTO LRFD Bridge Construction Specifications, Section 10.9.3. The water-cement ratio must not exceed 0.45:1.

9-20.3(2) GROUT TYPE 2 FOR NONSHRINK APPLICATIONS

Grout Type 2 must be a nonshrink, prepackaged material complying with ASTM C-1107. The minimum compressive strength must be 4000 psi at 7 Days.

9-20.3(3) GROUT TYPE 3 FOR UNCONFINED BEARING PAD APPLICATIONS

Grout Type 3 must be a prepackaged material complying with ASTM C 928 – Table 1, R2 concrete or mortar.

9-20.3(4) GROUT TYPE 4 FOR MULTIPURPOSE APPLICATIONS

Grout Type 4 must be a multipurpose grout material for structural and nonstructural applications. The grout must be produced using Portland cement Type I/II. The water-cementitious material ratio must not exceed 0.45:1 and water-reducing admixtures may be used. Multipurpose grout may be extended up to 3 parts fine aggregate to 1 part cement. The minimum compressive strength must be 4000 psi at 7 Days. Substitution of fly ash for cement is allowed up to 20 percent.

9-20.4 MORTAR

Mortar must be material made from Portland or blended hydraulic cement, water, and fine aggregate.

9-20.4(1) FINE AGGREGATE FOR MORTAR

Fine Aggregate for mortar must be per ASTM C 144.

9-20.4(2) MORTAR TYPE 1 FOR CONCRETE SURFACE FINISH

Mortar Type 1 for concrete surface finishing must be either prepackaged or a Contractor-recommended blend of Portland cement Type I/II and fine aggregate conforming to Section 9-20.4(1). If the Class 1 concrete surface finishing mortar is a Contractor-recommended blend, it must conform to the sand-to-cement ratios specified in Section 6-02.3(14)A.

9-20.4(3) MORTAR TYPE 2 FOR MASONRY APPLICATIONS

Mortar Type 2 for masonry must be either prepackaged or a Contractor-recommended blend of Portland cement Type I/II and fine aggregate conforming to 9-20.4(1).

9-20.4(4) MORTAR TYPE 3 FOR CONCRETE REPAIR

Mortar Type 3 must be a prepackaged material that does not include expansive admixtures. Aggregate extension and mixing procedures must be per the manufacturer's recommendation. The minimum compressive strength must be 4000-psi at 7 Days.

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SECTION 9-21 PLASTIC TRAFFIC BUTTONS AND LANE MARKERS

9-21.1 PLASTIC TRAFFIC BUTTON AND LANE MARKER TYPE 1

9-21.1(1) GENERAL

Plastic Traffic Button and Lane Marker Type 1 must be composed of thermosetting resins, pigments, and inert ingredients and must be of uniform composition throughout. The color must be yellow or white to correspond to the delineation line color.

9-21.1(2) PHYSICAL AND CHEMICAL PROPERTIES

The traffic buttons and lane markers must be of uniform composition and free from surface irregularities, cracks, checks, chipping, peeling, spalling, crazing, and other physical defects impairing their appearance, application, or durability.

The molding process must be such that coarse aggregate particles on the curved surface are covered by not less than 1/16 inch of pigmented Material.

The lane marker Type 1 must comply with the following (see Standard Plan 700):

Lane Marker/Traffic Button (Description)	Lane Marker Type 1
Diameter	3-7/8” to 4-1/8”
Weight (lbs)	0.275 min.
State Reflectance	80% min.
Impact Resistance (in-lbs)	15 min.
Planeness of Base:	
Concavity (in)	0.02 max.
Convexity (in)	0.05 max.
Titanium Dioxide (% by weight)	21 min.
Resin Content (% by weight)	20 min.

9-21.1(3) TEST METHODS

Test methods must be as follows:

1. Reflectance: Reflectance will be measured with a photovolt Reflectance Meter or its equivalent by comparing the buttons to a 75 percent brightness standard.
2. Impact Resistance: Impact resistance will be measured by allowing a 1 pound steel ball to fall 15 inches (free fall) onto the lane marker, supported by, but not bonded to, a steel base plate.
3. Titanium Dioxide Content: The titanium dioxide content will be determined by ashing representative portions of the lane marker, treating the ash with a boiling (NH4)2SO4•H2SO4 solution, filtering, and measuring the absorbance of the filtrate at about 410 millimicrons. Calibration must be with known samples per ASTM D 921.
4. Resin Content: Resin content will be determined by ashing and igniting representative portions of the marker.

Additional information on the test methods is available from the SPU materials Laboratory.

9-21.2 LANE MARKERS TYPE 2A AND TYPE 2B

The markers must consist of an acrylic plastic shell filled with a tightly adhering potting compound. The shell must contain prismatic reflective faces as shown in Standard Plan 700 to reflect incident light from opposite directions.

9-21.2(1) PHYSICAL PROPERTIES

The shell must be molded of methyl methacrylate or acrylonitrile butadiene styrene (ABS).

Filler must be a potting compound selected for strength, resilience, and adhesion adequate to pass physical requirements as outlined here.

The outer surface of the shell must be smooth except for purposes of identification and must contain methyl methacrylate reflective faces in the color specified. As an option, thin untempered glass may be bonded to the prismatic reflective faces to provide an abrasion resistant surface.

The base of the marker must be substantially free from gloss or substances that may reduce its bond to adhesive. This must be done by embedding sand or inert granules on the surface of the potting compound prior to its curing.

The markers must be fabricated as follows:

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Lane Marker (Description)	Lane Marker Type 2A	Lane Marker Type 2B
Dimensions of Plastic Shells	See Std Plan 700	See Std Plan 700
Slope of Reflecting Face	20-35 deg	20-30 deg
Area of Each Reflecting Surface	2.60-3.25 square in	1.87 square in

9-21.2(2) OPTICAL REQUIREMENTS

Definitions:

Horizontal entrance angle means the angle in the horizontal plane between the direction of incident light and the normal to the leading edge of the marker.

Observation angle means the angle at the reflector between observer's line of sight and direction of the light incident on the reflector.

Specific intensity (S.I.) means candlepower of the returned light at the chosen observation and entrance angles for each foot candle of illumination at the reflector on a plane perpendicular to the incident light.

Optical Requirements: The S.I. of each crystal reflecting surface at 0.2 degrees observation angle must be at least the following when the incident light is parallel to the base of the marker:

Horizontal Entrance Angle	S.I.
0 degrees	3.0
20 degrees	1.2

Yellow reflectors must be at least 60 percent and red reflectors at least 25 percent of the above values.

Optical Testing Procedure: A random lot of markers will be tested. The markers to be tested must be located with the center of the reflecting face at a distance of 5 feet from a uniformly bright light source having an effective diameter of 0.2 inch.

The photocell width must be 0.05 inch. It must be shielded to eliminate stray light. The distance from light source center to the photocell center must be 0.21 inch. If a test distance other than 5 feet is used, the source and receiver dimensions and the distance between source and receiver must be modified in the same proportion as the test distance.

Failure of more than 4 percent of the samples is cause for rejection of the lot.

9-21.2(3) STRENGTH REQUIREMENTS

Markers must support a load of 2,000 pounds as applied in the following manner:

1. A marker must be centered over the open end of a vertically positioned hollow metal cylinder. The cylinder must be 1 inch high with an internal diameter of 3 inches and wall thickness of 1/4 inch. The load must be slowly applied to the top of the marker through a 1-inch diameter by 1 inch high metal plug centered on the top of the marker.
2. Failure occurs with either a breakage or a significant deformation of the marker at any load of less than 2,000 pounds.

SECTION 9-22 MONUMENT FRAMES AND COVERS

9-22.1 GENERAL

Monument castings must conform to ASTM A 48, Class 30 and must be free of porosity, shrink cavities, cold shuts or cracks, or any surface defects which would impair serviceability. Repair of defects by welding, or by the use of smooth on or similar material, will not be permitted. The manufacturer must certify that the product conforms to these Specifications.

Monument castings must be machine finished or ground on seating surfaces to assure non-rocking fit in any position, and interchangeability. The foundry must make standard frames and covers available to the Engineer to test fit and seating.

SECTION 9-23 CONCRETE CURING MATERIALS, POZZOLANS AND ADMIXTURES

9-23.1 SHEET MATERIALS FOR CURING CONCRETE

Sheet materials for curing concrete must comply with AASHTO M 171, Sheet Materials for Curing Concrete, except that only white reflective type must be used.

9-23.2 LIQUID MEMBRANE FORMING CONCRETE CURING COMPOUNDS

Liquid membrane-forming compounds for curing concrete must be per AASHTO M 148 (ASTM C 309) Type 1D or 2, Class A or B.

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9-23.3 BURLAP CLOTH

Burlap cloth must comply with AASHTO M 182, Class 4.

9-23.4 CHEMICAL ADMIXTURES FOR CONCRETE

Acceptance of chemical admixtures will be based on manufacturer's certificate of compliance. If required by the Engineer, admixtures must be sampled and tested before they are used. A 1 pint (500-mL) sample of the admixture must be submitted to the SPU Materials Laboratory for testing 10 Days prior to use. Chemical Admixtures must contain less than 1 percent chloride ion (Cl-) by weight of admixture.

9-23.4(1) AIR-ENTRAINING ADMIXTURES

Air-Entraining admixtures must be per AASHTO M 154 or ASTM C 260.

9-23.4(2) TYPE A WATER-REDUCING ADMIXTURES

Type A Water-Reducing admixtures must be per AASHTO M 194 Type A or ASTM C 494 Type A.

9-23.4(3) TYPE B RETARDING ADMIXTURES

Type B Retarding admixtures must be per AASHTO M 194 Type B or ASTM C 494 Type B.

9-23.4(4) TYPE C ACCELERATING ADMIXTURES

Type C Accelerating admixtures must be per AASHTO M 194 Type C or ASTM C 494 Type C, and only non-chloride and non-corrosive accelerating admixtures must be used.

9-23.4(5) TYPE D WATER-REDUCING AND RETARDING ADMIXTURES

Type D Water-Reducing and Retarding admixtures must be per AASHTO M 194 TYPE D OR ASTM C 494 TYPE D.

9-23.4(6) TYPE E WATER-REDUCING AND ACCELERATING ADMIXTURES

Type E Water-Reducing and Accelerating admixtures must be per AASHTO M 194 Type E or ASTM C 494 Type E, and only nonchloride accelerating admixtures must be used.

9-23.4(7) TYPE F WATER-REDUCING, HIGH RANGE ADMIXTURES

Type F Water-Reducing, High Range admixtures must be per AASHTO M 194 Type F or ASTM C 494 Type F.

9-23.4(8) TYPE G WATER-REDUCING, HIGH RANGE, AND RETARDING ADMIXTURES

Type G Water-Reducing, High Range, and Retarding admixtures must be per AASHTO M 194 Type G or ASTM C 494 Type G.

9-23.4(9) TYPE S SPECIFIC PERFORMANCE ADMIXTURES

Type S Specific Performance admixtures must be per ASTM C 494 Type S. When a Type S admixture is used, a report on the performance characteristics of the Type S admixture must be submitted along with the concrete mix design. The report must describe the performance characteristics and provide data substantiating the specific characteristics of the Type S admixture per ASTM C 494.

9-23.5 WATERPROOFING

Concrete made with waterproofing admixtures must have a percent absorption after immersion and boiling of less than 5.0 percent at 7 days and a volume of permeable voids less than 11.0 percent at 7 days per ASTM C 642. The Contractor must submit evidence in the form of test results showing compliance with these Specifications, when they submit their concrete mix design.

If the concrete requires air entrainment, the Contractor must also submit evidence to the Engineer that the admixture will not adversely affect the air void system of the hardened concrete. Test results complying with ASTM C 457 must be provided as evidence to satisfy this requirement.

9-23.6 FLY ASH

Fly ash must be per AASHTO M 295 Class C or F including optional chemical requirements as set forth in Table 2 and with a further limitation that the loss on ignition must be a maximum of 1.5 percent.

9-23.7 GROUND GRANULATED BLAST FURNACE SLAG (GGBFS)

Ground granulated blast furnace slag must be per AASHTO M 302, Grade 100 or Grade 120. The grade of the ground granulated blast furnace slag, the source, and type of manufacturing facility must be certified on the cement mill test certificate.

9-23.8 MICROSILICA FUME

Microsilica Fume must be per AASHTO M 307. The optional physical requirement for Reactivity with Cement Alkalies set forth in Table 3 will be required when Microsilica Fume is being used as an ASR mitigation measure.

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9-23.9 METAKAOLIN

Metakaolin must be per AASHTO M 295 Class N, including optional chemical requirements as set forth in Table 2 and with a further limitation that the loss on ignition must be a maximum of 1.5 percent.

9-23.10 LIMESTONE

Limestone for Type IL or Type IT blended hydraulic cement must comply with the specifications of ASTM C 595.

9-23.11 SYNTHETIC FIBERS FOR PERVIOUS CONCRETE

Synthetic Fibers to be included in the mix for pervious concrete pavements must conform to the requirements of ASTM D 7508 or 7508M.

SECTION 9-24 PLASTIC WATERSTOP

9-24.1 MATERIAL

Waterstops must be fabricated from a plastic compound, the basic resin of which must be polyvinyl chloride. The compound must contain such additional resins, plasticizers, inhibitors, or other material that when the Material is compounded, it must comply with the performance requirements in this Specification.

Single pass reworked Material of the same composition generated from the fabricator's waterstop production may be used. Reclaimed polyvinyl chloride is not allowed.

All waterstops must be molded or extruded in such a manner that any cross-section is dense, homogeneous, and free from porosity and other imperfections.

Waterstops must be symmetrical in shape, nominally 4" x 3/16", and have a minimum of 4 ribs on each side of the bulb. The bulb thickness and diameter must be as noted on the Drawings.

9-24.1(1) TESTS OF MATERIAL

The waterstops must meet all of the physical and other test requirements of this material as defined in the Corps of Engineers Specifications for Polyvinyl Chloride Water Stop CRD C572, except that the tear resistance of the material must be not less than 160 pounds per inch. Furnish sample material as required by the Engineer for the purpose of making tests.

SECTION 9-25 WATER

9-25.1 WATER FOR CONCRETE

Water for concrete, grout, and mortar must be clear, apparently clean, and suitable for human consumption (potable). As determined by the Engineer, if the water contains substances that cause discoloration, unusual or objectionable smell or taste, or other suspicious content, the Engineer may require the Contractor to provide test results documenting that the water meets the physical test requirements and chemical limits described ASTM C1602 for nonpotable water.

Water from mixer washout operations may be used in concrete provided it meets or exceeds the above criteria as well as the following additional requirements:

1. Concrete with water from mixer washout operations must not be used in bridge roadway deck slabs, flat slab bridge superstructures, modified concrete overlays, or prestressed concrete,
2. Specific gravity must not exceed 1.07,
3. Alkalies, expressed as [Na2O + 0.658 K2O] must not exceed 600 ppm,
4. Free of coloring agents,
5. If the wash water contains admixtures from different manufacturers, the Contractor must provide evidence that the combination of admixtures are compatible and do not adversely affect the air void system of the hardened concrete as per Section 6-02.3(3), and
6. All tests to verify that the physical and chemical requirements are met, must be conducted on the following schedule:
    a. The physical requirements must be tested on weekly intervals for 4 weeks and thereafter on monthly intervals,
    b. The chemical requirements must be conducted on monthly intervals, and
    c. The specific gravity must be determined daily per ASTM D 1429, Test Method D.

The Contractor must utilize the services of a laboratory complying with the specifications in Section 1-06.5.

9-25.2 WATER FOR IRRIGATION

Water for irrigation must not contain dissolved or suspended matter which is harmful to the plant Material on which it is to be used.

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SECTION 9-26 EPOXY RESINS

9-26.1 EPOXY BONDING AGENTS

9-26.1(1) GENERAL

Epoxy bonding agents must be 2-component epoxy resin-base systems per ASTM C 881; must be furnished in the type, grade, and class specified; and must be as specified in this Section. When not specified, an appropriate grade and class must be selected for the particular application. Epoxy bonding agents for patching external concrete must be concrete-gray in color.

9-26.1(1)A TYPE I AND TYPE IV

Epoxy bonding agents used for bonding hardened concrete to hardened concrete and other materials must be Type I for non-load bearing applications and Type IV for load bearing applications.

9-26.1(1)B TYPE II AND TYPE V

Epoxy bonding agents used for bonding freshly mixed concrete to hardened concrete must be Type II for non-load bearing applications and Type V for load bearing applications.

9-26.1(1)C TYPE III

Epoxy bonding agents used for bonding skid-resistant materials to hardened concrete and as a binder in epoxy mortars and epoxy concretes used on traffic bearing surfaces must be Type III.

9-26.1(2) PACKAGING AND MARKING

The components of the epoxy system furnished under these Specifications must be supplied in separate containers that are non-reactive with the materials contained. The contents of each container must be such that when the container contents are combined, a properly proportioned final mixture results.

Containers must be identified as “Component A” (Contains the Epoxy Resin) and “Component B” (Contains the Curing Agent) and must show the type, grade, class, and mixing directions as defined by these Specifications. Each container must be marked with the name of the manufacturer, the lot or batch number, the date of packaging, and the quantity contained in pounds or gallons.

Potential hazards must be so stated on the package per the Federal Hazardous Products Labeling Act and State of Washington, Department of Labor and Industries Regulations for Shipment of Hazardous Products.

9-26.1(3) CERTIFICATION

If requested by the Owner, the manufacturer of the epoxy system must certify that components A and B comply with this Specification before a sample will be accepted for testing by the Owner. The manufacturer’s certificate of compliance must be furnished as specified in Section 1-06.3.

9-26.1(4) REJECTION

Except as noted otherwise, the entire lot of both components may be rejected if samples submitted for test fail to comply with this Specification.

9-26.1(5) ACCEPTANCE

Acceptance of the Epoxy Bonding Agents for use on the project must be based on a passing test report from the SPU Materials Laboratory.

9-26.2 EPOXY ADHESIVE FOR LANE MARKERS

9-26.2(1) GENERAL

Epoxy adhesives for lane markers must comply with AASHTO M 237 for Type II - Standard Setting, High Viscosity, Epoxy Adhesive. In lieu of the square base test specimen molds for the Slant Shear Strength test specified in AASHTO M 237, cylindrical molds per ASTM C 882 may be used.

9-26.2(2) PACKAGING AND MARKING

Packaging and Marking of Epoxy Adhesive for Lane Markers must be as specified in Section 9-26.1(2).

9-26.2(3) CERTIFICATION

Certification of Epoxy Adhesive for Lane Markers must be as specified in Section 9-26.1(3).

9-26.2(4) REJECTION

Rejection of Epoxy Adhesive for Lane Markers must be as specified in Section 9-26.1(4).

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9-26.2(5) ACCEPTANCE

Acceptance of each lot of the Epoxy Adhesive for Lane Markers for use on the project must be based on a manufacturer's certificate of compliance.

9-26.3 EPOXY GROUT/MORTAR/CONCRETE

9-26.3(1) GENERAL

Epoxy grout, epoxy mortar, and epoxy concrete for traffic and non-traffic bearing applications must consist of an epoxy bonding agent and an aggregate component.

Prepackaged epoxy grout/mortar/concrete must be prepared from a ready-to-mix epoxy bonding agent/aggregate system supplied by a manufacturer in kit form.

Non-prepackaged epoxy grout/mortar/concrete must be prepared from an epoxy bonding agent and an aggregate component that is clean, surface dry and inert and that is of a quality and gradation suitable for Portland cement mortar or concrete. Aggregate as specified in Section 9-03.1(2) will be satisfactory. Epoxy grout/mortar/concrete for patching external concrete must be concrete-gray in color.

9-26.3(1)A TRAFFIC BEARING APPLICATIONS

Epoxy grout/mortar/concrete for traffic bearing applications must have a 7-day compressive strength of not less than 4000 psi when tested per ASTM C579. Epoxy bonding agent must be Type III as described in Section 9-26.1(1)C.

9-26.3(1)B NON-TRAFFIC BEARING APPLICATIONS

Epoxy grout/mortar/concrete for non-traffic bearing applications must have a 7-day compressive strength of not less than 4000 psi when tested per ASTM C579. Epoxy bonding agent must be Type I, II, IV, or V as appropriate for intended use as described in Section 9-26.1(1)A and Section 9-26.1(1)B.

9-26.3(2) PACKAGING AND MARKING

Packaging and Marking of the epoxy bonding agent component of epoxy grout/mortar/concrete must be as specified in Section 9-26.1(2).

9-26.3(3) CERTIFICATION

Certification of the epoxy bonding agent component of epoxy grout/mortar/concrete must be as specified in Section 9-26.1(3).

9-26.3(4) REJECTION

Rejection of the epoxy bonding agent component of epoxy grout/mortar/concrete must be as specified in Section 9-26.1(4).

9-26.3(5) ACCEPTANCE

Acceptance of the epoxy grout/mortar/concrete material for use on the project must be based on a passing test report from the materials Laboratory.

SECTION 9-27 CRIBBING

9-27.1 GABION CRIBBING

9-27.1(1) GABION FABRIC

Gabions may be fabricated from either hexagonal twisted wire mesh or from welded wire mesh. Only one type of mesh and protective coating must be used throughout a structure.

Baskets must be furnished in the required dimensions with a dimensional tolerance of ± 5 percent.

Wire for construction of gabions must be either galvanized steel wire conforming to ASTM A 641, Class 3, Soft Temper, or aluminized steel wire conforming to ASTM A 809, Soft Temper. The wire must have a minimum tensile strength of 60,000 psi when tested per ASTM A 370.

9-27.1(2) GABION BASKETS

Gabion baskets 1 foot or greater in the vertical dimension must have mesh openings with nominal dimensions not to exceed 4-1/2 inches and the maximum area of any mesh opening must not exceed 10 square inches.

1. Hexagon Twisted Wire Mesh:
    a. Wire for galvanized or aluminized hexagonal twisted wire mesh must be nominal sized 0.120-inch galvanized steel wire or aluminized steel wire.
    b. Hexagonal wire mesh must be formed from galvanized or aluminized wire in a uniform hexagonal pattern with nonraveling double twist. The perimeter edges of the mesh for each panel must be tied to a selvage wire of the

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same composition as the body mesh and have a minimum diameter of 0.150 inches so the selvage is at least the same strength as the body of the mesh.

2. Welded Wire Mesh:
   a. Welded wire mesh must be fabricated from galvanized steel wire having a diameter of 0.106 inches. Wire must be galvanized prior to fabrication.
   b. Welded wire mesh must be formed in a uniform square pattern with openings 3” x 3” with a resistance weld at each connection per ASTM A 185.
   c. If required, a PVC coating must be fusion bonded onto the welded wire mesh to provide a nominal coating thickness of 0.0216 inches per side with a minimum of 0.0150 inches.
3. PVC Coating (for welded wire mesh only):

   Acceptance of PVC coating material must be by certified test reports of an independent laboratory. The initial properties of PVC coating material must have a demonstrated ability to conform to the following requirements:
   a. Specific Gravity — In the range of 1.2 to 1.4, when tested according to ASTM D 792.
   b. Tensile Strength — Not less than 2,275 psi, when tested according to ASTM D 638.
   c. Modulus of Elasticity — Not less than 1,980 psi at 100 Strain, when tested according to ASTM D 638.
   d. Hardness — Shore “A” not less than 75 when tested according to ASTM D 2240.
   e. Brittleness Temperature — Not higher than 15°F when tested according to ASTM D 746.
   f. Resistance to Abrasion — The percentage of the mass loss must be less than 12 percent when tested according to ASTM D 1242, Method B at 200 cycles, CSI-A Abrader Tape, 80 Grit.
   g. Salt Spray Exposure and Ultraviolet Light Exposure – The PVC must show no effect after 3,000 hours of salt spray exposure according to ASTM B 117. The PVC must show no effect of exposure to ultraviolet light with test exposure of 3,000 hours using apparatus Type E and 63°C, when tested according to Practice D 1499 and Practice G 23. After the salt spray test and exposure to ultraviolet light as specified above, the PVC coating must not show cracks, blister, split, nor show a noticeable change of color. In addition, the specific gravity, tensile strength, modulus of elasticity, and resistance to abrasion must not change more than 6, 25, 25, and 10 percent respectively from their initial values.

9-27.1(3) GABION MATTRESSES

Gabion baskets less than 1 foot in the vertical dimension must have mesh openings with nominal dimensions not to exceed 3.3 inches, and the maximum area of any mesh opening must not exceed 6 square inches.

1. Hexagonal Twisted Wire Mesh:
   a. Wire for galvanized or aluminized hexagonal twisted wire mesh must be nominal sized 0.086-inch galvanized steel wire or aluminized steel wire.
   b. Hexagonal wire mesh must be formed from galvanized or aluminized wire in a uniform hexagonal pattern with nonraveling double twists. The perimeter edges of the mesh for each panel must be tied to a selvage wire of the same composition as the body mesh and have a minimum diameter of 0.1062 inches so the selvage is at least the same strength as the body of the mesh.
2. Welded Wire Mesh:
   a. Welded wire mesh must be fabricated from galvanized steel wire having a diameter of 0.080 inches. Wire must be galvanized prior to fabrication.
   b. Welded wire mesh must be formed in a uniform rectangular pattern with openings 1-1/2” x 3” with a resistance weld at each connection per ASTM A 185.
   c. If required, a PVC coating must be fusion bonded onto the welded wire mesh to provide a nominal coating thickness of 0.0216 inches per side with a minimum of 0.0150 inches. The PVC coating must be in conformance with Section 9-27.1(2).

9-27.1(4) FASTENERS FOR BASKET ASSEMBLY

The lacing wire must be a nominal sized 0.0866-inch galvanized steel wire or aluminized steel wire. Lacing wire must have the same coating as the basket mesh.

Spiral binders, if used for joining welded wire panels must be formed from 0.106-inch nominal diameter steel wire with a 3-inch pitch having the same Specifications and coating as the wire mesh. Lacing wire may be used in lieu of spiral binders.

Alternate fasteners for basket assembly must remain closed when subjected to a 600 pound tensile force when confining the maximum number of wires to be confined. Installation procedures and test results for alternate fasteners must be submitted for approval.

Internal connecting wires must be the same as required for lacing wire. Alternate stiffeners acceptable to the gabion manufacturer may be used if found acceptable to the Engineer.

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9-27.1(5) NONRAVELING CONSTRUCTION

The wire mesh must be fabricated as to be nonraveling. This is defined as the ability to resist pulling apart at any of the connections forming the mesh when a single strand in a section of mesh is cut.

9-27.1(6) STONE

Stone for filling gabions must have a Degradation Factor of at least 30. The stone must be dense enough to pass the unit weight test specified in Section 6-09.3(6)F. Stone must meet the following requirements for gradation:

Sieve Size	Percent Passing
8” square	100
6” square	75-90
4” square	0-10
% Fracture	75 min.

SECTION 9-28 SIGNING MATERIALS AND FABRICATION

9-28.1 SIGNS

9-28.1(1) GENERAL

All permanent signs must be constructed of sheet aluminum and, unless noted otherwise in the Drawings, must be reflectorized. Temporary signs may be constructed of High Density Overlay plywood.

See ASTM D4956 for reflective sheeting type designations. All signs mounted higher than 18 feet above the roadway surface, and signs specified as fluorescent yellow green, must have Type XI reflective sheeting. All guide, regulatory and warning signs mounted 18 feet or less above the roadway surface must have Type IV reflective sheeting.

STOP, YIELD and DO NOT ENTER sign backs and edges must have red reflective sheeting to match the red on the sign face.

Regulatory and warning signs must have rounded corners with the exception of STOP signs. All other signs must have square cut corners. Borders for signs having square cut corners must have a corner radius approximately 1/8 of the lesser side dimension of the sign up to a maximum radius of 12 inches. For signs with rounded corners, the borders must be concentric with the rounded corners.

9-28.1(2) PLYWOOD

Plywood signs must be constructed of High Density Overlay plywood, complying with the requirements of Products Standard PS 1 83 for Softwood Plywood, Construction and Industrial published by the Product Standards Section of the U.S. Department of Commerce. The plywood must be free of contaminants which would adversely affect the application or life of the sheeting to be applied. Face veneers must be Grade B or better.

Core and crossband veneers must be solid. Core veneers must be jointed, and core gaps must not exceed 1/8 inch in width. The entire area of each contacting veneer surface must be bonded with a waterproof adhesive that complies with U.S. Department of Commerce Specifications for exterior type plywood.

The overlay must be of the high density type. It must have a minimum weight of 60 pounds per thousand square feet of surface and must be at least 0.012 inches thick before pressing. The overlay must have a sufficient resin content to bond itself to the plywood, with a minimum resin content of 45 percent based on the dry weight of the impregnated fiber.

Thickness Single Panel Plywood Signs:

Sign Size	Thickness
Up to 18 inches inclusive in width	3/8”
Over 18 inches to 36 inches inclusive in width	5/8”
Over 36 inches in width	3/4”
Overhead signs	3/4”

Street designation signs and signs mounted on span wires or mast arms must have the sign back and edges primed with 1 coat of white exterior enamel undercoat and finished with 1 coat of International Green (Forest Green) exterior enamel. All other plywood signs must have only the edges primed with 1 coat of white exterior enamel undercoat and finished with 1 coat of white exterior enamel. The primer must be as recommended by the Supplier of the finish coat. The finish enamel must comply with Federal Specification TT E 489.

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9-28.1(3) SHEET ALUMINUM SIGNS

Sheet aluminum signs must be constructed of Material conforming to ASTM B209, alloy 6061T6, or alloy 5052-H36 or H38. Alloy 50D5-H34 may be used for sign refacing.

After the aluminum sheet panel has been fabricated, the surface of each panel must be protected from corrosion. The corrosion protection must comply with ASTM B-449 Class II Specification for Chromates on Aluminum. Aluminum signs over 12' wide x 5' high must be comprised of vertical panels in increments of 2, 3, or 4 feet wide. No more than one 2-foot and/or 3-foot panel may be used per sign. The Contractor must use the widest panels possible. All parts necessary for assembly must be constructed of aluminum, galvanized steel, or stainless steel as shown on the Drawings. Sheet thickness must be as follows:

Maximum Horizontal Dimension	Sheet Aluminum Thickness
Overlay panels	0.050"
Up to 20 inches	0.063"
20 inches to 36 inches, inclusive	0.080"
Over 36 inches (Permanent Signs)	0.125"

The side dimension for a diamond shaped warning sign is considered to be the maximum horizontal dimension.

Before placing aluminum in contact with untreated steel, the steel surfaces must be protected by proper cleaning and painting with one coat of paint conforming to Section 9-08.2 Item 3 Formula A-9-73 and two coats of aluminum paint.

Metal must be handled by device or clean canvas gloves between all cleaning and etching operations and the application of reflective sheeting.

Sheet aluminum edges must be filed smooth to eliminate sharp edges and burrs.

9-28.1(4) REFLECTIVE SIGN FACE SHEETING

Reflective sheeting must consist of spherical lens elements embedded within a transparent plastic or adhered to a synthetic resin and encapsulated by a transparent plastic. The sheeting must have a flat, smooth outer surface, be weather resistant, and have a precoated adhesive backing with a protective liner.

The sheeting must have the following minimum brightness values expressed as average candle power per foot candle per square foot of Material. Measurements must be conducted per standard testing procedures for reflex reflectors in Federal Specification L-S-300.

The brightness of the reflective sheeting, totally wet by rain, must be not less than 90 percent of the above values. Wet performance measurements must be conducted in conformance with the Standard Rainfall Test specified in Federal Specification L-S-300C.

The diffuse day color of the reflective sheeting must be visually evaluated by comparison with the applicable Highway Color Tolerance Chart. Color comparisons must be made under north daylight or a scientific daylight having a color temperature of from 6500 K to 7500 K. Color must be illuminated at 45 degrees and viewed at 90 degrees.

The sheeting surface must be smooth and facilitate cleaning and wet performance and exhibit 85 degree glossmeter rating of not less than 50 (ASTM D 523). The sheeting surface must be readily processed and compatible with transparent and opaque process colors and show no loss of the color coat with normal handling, cutting, and application. The sheeting must permit cutting and color processing at temperatures of 60 °F to 100 °F and 20 to 80 percent relative humidity.

The sheeting surface must be solvent resistant such that it may be cleaned with gasoline, VM&P Naptha, mineral spirits, turpentine, methanol, or xylol.

The embedded lens sheeting, when applied according to manufacturer's recommendations to cleaned and etched 0.020" x 2" x 8" aluminum, conditioned 24 hours, and tested at 72 °F and 50 percent relative humidity, must be sufficiently flexible to show no cracking when bent around a 3/4-inch diameter mandrel.

Conditioned for 48 hours, the tensile strength of the embedded lens sheeting must be 5 to 20 pounds per inch width when tested per ASTM D 828. Following liner removal, the sheeting must not shrink more than 1/32 inch in 10 minutes nor more than 1/8 inch in 24 hours in any dimension per 9-inch square at 75 °F and 50 percent relative humidity.

The encapsulated lens sheeting, with liner removed, conditioned for 24 hours at 72 °F and 50 percent relative humidity, must be sufficiently flexible to show no cracking when bent around a 1/8-inch diameter mandrel with adhesive side contacting the mandrel.

The protective liner attached to the adhesive must be easily removable by peeling without soaking in water or other solvents.

The pre coated adhesive backing must be a tack free heat activated type or a pressure sensitive type, either of which must adhere to the sheeting without the necessity of additional coats of adhesive.

The adhesive must form a durable bond to smooth the corrosion-resistant and weather resistant surfaces and permit the reflective sheeting to adhere securely 48 hours after application at temperatures of 30°F to 200°F. The adhesive bond must be

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sufficient to render the applied sheeting vandal resistant and prevent its shocking off when jabbed with a spatula at 10°F. The sheeting must resist peeling from the application surface when a 5 pounds per inch width force is applied as outlined in ASTM D 903.

With Embedded Lens Elements:									
	Div. Ang.			Div. Ang.			Div. Ang.		
	0.2 degrees	0.5 degrees	1.50 degrees	0.2 degrees	0.5 degrees	1.5 degrees	0.2 degrees	0.50 degrees	1.5 degrees
Inc. Ang.	**Silver White #1**			**Silver White #2**			**Yellow**		
-4 degree	70.0	30.0	4.0	80.0	41.0	4.0	50.0	25.0	5.0
40 degree	14.5	8.5	1.5	16.5	9.5	2.0	11.5	7.0	1.5
Inc. Ang.	**Red**			**Blue**			**Green**		
-4 degrees	14.5	7.5	1.0	4.0	2.0	0.6	9.0	4.5	1.0
40 degrees	3.0	1.5	0.3	0.9	0.4	0.08	1.8	1.5	0.2
Inc. Ang.	**Orange**			**Brown**					
-4 degrees	25.0	13.5	1.5	1.0	0.35	0.1	--		
40 degrees	1.0	0.8	0.1	0.2	0.1	0.01			

With Encapsulated Lens Elements:						
	Div. Ang.			Div. Ang.		
	0.2 degrees	0.5 degrees	1.5 degrees	0.2 degrees	0.5 degrees	1.5 degrees
Inc. Ang.	**Silver White**			**Yellow**		
-4 degrees	250.0	95.0	4.0	170.0	62.0	3.0
40 degrees	120.0	54.0	2.0	80.0	35.0	1.5
Inc. Ang.	**Orange**			**Green**		
-4 degrees	70.0	25.0	1.1	30.0	12.0	0.5
40 degrees	33.0	14.0	0.5	14.0	6.8	0.2
Inc. Ang.	**Red**			--		
-4 degrees	35.0	13.0	0.7			
40 degrees	16.0	7.4	0.3			

9-28.1(5) NON REFLECTIVE SIGN FACE SHEETING

The nonreflective sheeting must consist of a white plastic film having a smooth, flat outer surface. The sheeting must be weather resistant and have a protected pre-coated adhesive backing.

9-28.1(6) SHEETING APPLICATION

Plywood sign faces must be cleaned with lacquer thinner, heptane, benzene, or solvent recommended by the sheeting manufacturer. The surface must be sanded with light sandpaper or steel wool and wiped dry and clean with clean cloth. Aluminum sign faces must be cleaned with a solvent recommended by the sheeting manufacturer.

Sign face sheeting must be applied by a vacuum applicator recommended by the sheeting manufacturer, or by a continuous roll applicator.

Heat activated adhesive backed sheeting must be applied by the vacuum method. The adhesive on the back of the sheeting must be activated by a minimum temperature of 185 °F and with a minimum vacuum pressure of 25 inches of mercury. This operation must be in effect for a minimum of 3 minutes on plywood and 5 minutes on metal. After aging for 48 hours at 75 °F, the adhesive must form a bond equal to or greater than the strength of the sheeting.

Pressure sensitive adhesive backed sheeting must be applied by a continuous roll applicator. The process must be in conformance with the recommendation of the sheeting manufacturer.

Edges and splices of sign face sheeting must be coated with an edge sealer recommended by the sheeting manufacturer.

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9-28.1(7) LETTERS, ARROWS, AND SYMBOLS

Letters, arrows, and symbols must be of the type, size, and color specified on the Drawings, in the Specifications or WSDOT Sign Fabrication Manual, and the "Standard Highway Signs" by United States Department of Transportation.

Letters, arrows, and symbols must be of Material compatible with the sign surface Material, as recommended by the sign surface manufacturer or approved by the Engineer.

9-28.1(8) HARDWARE

Bolts, nuts, and washers must be of the same Material for each attachment. All parts necessary for assembly must be constructed of the following Materials:

Hardware	Specification
Bolts	ASTM B 209, 2024 T4 Aluminum
	ASTM A 307 Steel
	ASTM F 593 Stainless Steel
Washers	ASTM B 209, 2024 T4 Aluminum
	ASTM A 36 Steel
	ASTM A 240 Stainless Steel
Nuts	ASTM B 209, 6061 T6 Aluminum
	ASTM A 307 Steel
	ASTM F 594 Stainless Steel
Locknuts	ASTM B 211, 2017 T4 Aluminum
	ASTM A 307 Steel
	ASTM F 594 Stainless Steel
Rivets	ASTM B 209, 6061 T6 Aluminum
	ASTM B 316, 6053 T61 Aluminum
Post Clips	ASTM B 179, 356 T6 Aluminum
Wind Beams	ASTM B 209, 6061 T6 Aluminum
Angle and Z Bar	ASTM B 209, 6061 T6 Aluminum
	ASTM A 36 Steel
Strap and Mounting Bracket	ASTM A 276 Stainless Steel

All steel parts must be galvanized per ASTM A 123. Steel bolts and related connecting hardware must be galvanized per ASTM A 153.

9-28.2 POSTS

9-28.2(1) RESERVED

9-28.2(2) SIGN POST AND POST ANCHOR

Sign posts must be Telespar Qwik-Punch, Trinity Highway SQR-LOC EZ-Out, or approved equal, Tube Size 2" x 2", Gauge 14. Unless otherwise specified, the length of the post must be specified in the Standard Plans with a length tolerance of ± 0.25 inch. The finished members must be straight and have a smooth uniform finish. Post must be in-line galvanized per AASHTO M-120.

Light-duty and heavy-duty post anchors must be Telespar Qwik-Punch, Trinity Highway SQR-LOC EZ-Out, or approved equal, one size larger than the sign post, with gauge and length as specified on Standard Plan 621b.

Surface-mounted post anchors must be gauge 12 Telespar Qwik-Punch, Trinity Highway SQR-LOC EZ-Out, or approved equal, galvanized tube welded to a 1/4-inch thick, 7" x 7" steel base plate. Four, 3/4-inch holes must be drilled in the base plate, one at each corner centered 1.06 inches from each edge of the plate; centered 4.88 inches apart. The tube length as specified on Standard Plan 621b, one size larger than the sign post. The tube must be tube centered on the plate as shown on Standard Plan 621b and fillet welded on all 4 sides where the tube meets the plate. All welds must develop the full strength of the parent metal. After fabrication, the base plate and welds of the anchors must be hot-dip galvanized per AASHTO M111 or ASTM 123. The tube portion of the anchors must not be hot-dipped as not to impede the insertion of the sign post.

Telespar Qwik-Punch, Trinity Highway SQR-LOC EZ-Out, or approved equal Sign Post and Post Anchor must have 7/16-inch prepunched holes on 1-inch centers.

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Corner bolts, nuts, and washer for attaching post to anchors must be Telespar Qwik-Punch, Trinity Highway SQR-LOC EZ-Out, or approved equal. Surface mounting bolts must be as shown on Standard Plan 621b.

9-28.2(3) REFLECTIVE SLEEVE

The reflective sleeve must be 0.032-inch gauge 5052-H32 alodine treated aluminum. The size of the aluminum must be a signal aluminum piece with a dimension of 48" x 6".

The aluminum piece must be covered with white high intensity prismatic ASTM type 4 sheeting. The sheeting must be applied using manufacturers high pressure interstate roller per the manufacturer's instructions.

The reflective sleeve must be screen printed with stop sign red transparent ink from the sheeting manufacturer with two 12-inch bands alternating red and white, creating a striped appearance. The reflective sleeve must be formed into a "U" shape to fit a standard City of Seattle sign post on three sides. See Standard Plan 620.

SECTION 9-29 PAVEMENT MARKING

9-29.1 GENERAL

Pavement marking materials in this Section consist of paint, plastic, tape or raised pavement markers as described in Section 8-22 and Section 8-23 as listed below:

1. Low VOC Solvent Based Paint
2. Low VOC Waterborne Paint Temporary Pavement Marking Paint
3. Type A – Liquid Hot Applied Thermoplastic
4. Type B – Pre-formed Fused Thermoplastic
5. Type C – Cold Applied Pre-Formed Tape
6. Type D – Liquid Cold Applied Methyl Methacrylate Glass Beads
7. Temporary Pavement Marking Tape
8. Temporary Raised Pavement Markings

9-29.2 PAINT

White and yellow paint must comply with the Specifications for low VOC (volatile organic compound) solvent-based paint or low VOC waterborne paint. Blue paint for "Access Parking Space Symbol with Background" and black paint for contrast markings must be chosen from a WSDOT QPL-listed manufacturer for white and yellow paint.

Blue and black paint must comply with the Specifications for yellow paint in Section 9-29.2(3) and Section 9-24.2(5), with the exception that blue and black paints do not need to meet the requirements for titanium dioxide, directional reflectance, and contrast ratio.

9-29.2(1) COLOR

Paint draw-downs must be prepared according to ASTM D 82. For white, the color must closely match Federal Standard 595, color number 37875. For yellow, the color must closely match Federal Standard 595, color number 33538. For blue, the color must closely match Federal Standard 595, color number 35180. For black, the color must closely match Federal Standard 595, color number 37038.

9-29.2(2) PROHIBITED MATERIALS

Traffic paint must not contain mercury, lead, chromium, toluene, chlorinated solvents, hydrolysable chlorine derivatives, polychlorinated biphenyls (PCBs), ethylene-based glycol ethers and their acetates, nor any other ingredient that would designate as an EPA hazardous waste material over the regulatory levels per CFR 40 Part 261.24.

9-29.2(3) LOW VOC SOLVENT BASED PAINT

Paint Properties	Test Method	Low VOC Solvent-Based Paint			
		White		Yellow	
		Min.	Max.	Min.	Max.
Density of Paint (lb/gal)	ASTM D 1475	11.8	--	11.8	--
Viscosity, KU	ASTM D 562	--	--	--	--
@35 °F	--	--	--	--	--
@50 °F	--	--	105	--	105
@77 °F	--	75	85	75	85
@90 °F	--	--	--	--	--
@120 °F	--	65	--	65	--

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Paint Properties	Test Method	Low VOC Solvent-Based Paint			
		White		Yellow	
		Min.	Max.	Min.	Max.
Nonvolatile Content, % by weight	ASTM D 2369	65	--	65	--
Pigment Content, % by weight	ASTM D 2698	--	53	--	53
Titanium Dioxide Content (lb/gal), Rutile Type II	ASTM D 5381	1.0	--	--	0.2
Volatile Organic Content (VOC) g/L	ASTM D 3960	--	150	--	150
Directional Reflectance %, @ 15 mils wet	WSDOT T 314	80	--	50	--
Package Stability	ASTM D 1849	6	--	6	--
Bleeding, %	ASTM D 868[1]	90	--	90	--
Flexibility	ASTM D 522[2]	No cracking, flaking, or loss of adhesion			
Settling Properties during Storage, Inch	ASTM D 1309[3]	--	8	--	8
Skinning	ASTM D 154	The paint must not skin within 48 hours in a 3/4 filled, tightly closed container			

NOTES:

1. The reflectance of the paint over asphalt paper must be a minimum of 90 percent of the reflectance measurement of the paint over a taped (nonbleeding) surface.
2. The paint must be applied at a wet film thickness of 6 mils to a 3" x 5" panel that has been solvent cleaned and lightly buffed with steel wool. With the panel kept in a horizontal position, the paint must be allowed to dry for 18 hours at 77 °F ± 2 °F, and then baked for 3 hours at 140 °F ± 2 °F. The panel must be cooled to 77 °F ± 2 °F for at least 30 minutes, bent over a 0.25-inch mandrel, and then examined without magnification. The paint must show no cracking, flaking, or loss of adhesion.
3. The sample must show no more than 0.5 inches of clear material over the opaque portion of the paint and there must be no settling below a rating of 8.

9-29.2(4) LOW VOC WATERBORNE PAINT

Paint Properties	Test Method	Standard Waterborne Paint				High-Build Waterborne Paint				Cold Weather Waterborne Paint			
		White		Yellow		White		Yellow		White		Yellow	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Density of Paint (lb/gal)	ASTM D 1475	Within ± 0.3 of qualification sample				Within ± 0.3 of qualification sample				12.5	--	12.5	--
Viscosity, KU	ASTM D 562	--	--	--	--	--	--	--	--	--	--	--	--
@35 °F	--	--	--	--	--	--	--	--	--	--	95	--	95
@77 °F	--	80	95	80	95	80	95	80	95	--	87	--	87
@90 °F	--	--	--	--	--	--	--	--	--	60	--	60	--
Nonvolatile Content, % by weight	ASTM D 2369	75	--	75	--	77	--	77	--	70	--	70	--
Pigment Content, % by weight	ASTM D 3723	--	68	--	68	62	--	62	--	50	--	50	--
Nonvolatile Vehicle (NVV), % by weight	ASTM D 2369 ASTM D 3723[1]	40	--	40	--	43	--	43	--	40	--	40	--
Volatile Organic Content (VOC) g/L	ASTM D 3960	--	150	--	150	--	150	--	150	--	150	--	150

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Paint Properties	Test Method	Standard Waterborne Paint				High-Build Waterborne Paint				Cold Weather Waterborne Paint			
		White		Yellow		White		Yellow		White		Yellow	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Fineness of Grind, (Hegman Scale)	ASTM D 1210	3	--	3	--	--	--	--	--	3	--	3	--
Contrast Ratio, @ 15 mils wet	WSDOT T 314	0.98	--	0.96	--	0.98	--	0.96	--	0.99	--	0.98	--
Flash Point, °F	ASTM D 93	100°	--	100°	--	--	--	--	--	--	--	--	--
pH	ASTM E 70	9.5	--	9.5	--	9.5	--	9.5	--	9.5	--	9.5	--
Laboratory Dry Time (Minutes)	ASTM D 711	--	10	--	10	--	--	--	--	--	10	--	10
Vehicle Composition	ASTM D 2621	100% acrylic emulsion or approved equal				100% acrylic emulsion or approved equal				100% acrylic emulsion or approved equal			
Freeze-Thaw Stability, KU	ASTM D 2243 and D 562	@ 5 cycles show no coagulation or change in viscosity greater than ± 5 KU				@ 5 cycles show no coagulation or change in viscosity greater than ± 5 KU				@ 3 cycles show no coagulation or change in viscosity greater than ± 10 KU			
Heat Stability	ASTM D 562[2]	± 10 KU from the initial viscosity				± 10 KU from the initial viscosity				± 10 KU from the initial viscosity			
Low Temperature Film Formation	ASTM D 2805[3]	--	--	--	--	--	--	--	--	No Cracks			

NOTES:

1. Use the following formula for calculating nonvolatile in vehicle (NVV): NVV = N - P / 100 - P) x 100. Where: N = percent of nonvolatile content as determined by ASTM D 2369 and P = percent of pigment content as determined by ASTM D 3723.
2. Put approximately 15 fluid ounces of paint in a 1 pint lined container, close the container, seal it with tape and put it in an oven maintained at 140 °F ± 2 °F for 7 days. Equilibrate the paint at 77 °F ± 2 °F and mix thoroughly with gentle stirring. Perform consistency test as specified in ASTM D 562. Consistency must not vary by ± 10 KU from the initial viscosity.
3. Apply paint at 15 mils wet per ASTM D 2805 over a 2A Leneta Chart. Immediately and carefully lay the applied film horizontally in a refrigerator that maintains a temperature of 35 °F. After 24 hours, remove the applied film and inspect. Paint film must show no cracks when held at arm's length and observed by the naked eye.

9-29.2(5) TEMPORARY PAVEMENT MARKING PAINT

Paint used for temporary pavement marking must be as specified in Section 9-29.2.

9-29.3 PLASTIC

White and yellow plastic pavement marking materials must comply with the Specifications for:

1. Type A – Liquid hot applied thermoplastic
2. Type B – Pre-formed fused thermoplastic
3. Type C – Cold applied pre-formed tape
4. Type D – Liquid cold applied methyl methacrylate

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For black, the color must closely match Federal Standard 595, color number 37038, and must be chosen from a WSDOT QPL-listed manufacturer for white or yellow plastic. Black plastic must comply with Sections 9-29.3(2), 9-29.3(3), and 9-29.3(4) for yellow, except for retroreflectance.

9-29.3(1) TYPE A – LIQUID HOT APPLIED THERMOPLASTIC

Type A material consists of a mixture of pigment, fillers, resins, and glass beads that is applied to the pavement in the molten state by extrusion or by spraying. The material can be applied at a continuously uniform thickness or it can be applied with a profiled pattern. Glass beads, intermixed and top dress, must conform to the manufacturer's recommendations necessary to meet the retroreflectance requirements. Type A material must conform to AASHTO M 249 and the following:

1. Resin – The resin must be an alkyd or other non-halogenated hydrocarbon.
2. Retroreflectance – ASTM E 1710

   Newly applied pavement markings must have a minimum initial coefficient of retroreflective luminance of 250 $mcd \cdot m^{-2} \cdot lx^{-1}$ for white and 175 $mcd \cdot m^{-2} \cdot lx^{-1}$ for yellow per ASTM E 1710 when measured with a 30-meter retroreflectometer. Retroreflectivity will be measured for compliance with a Delta LTL-X retroreflectometer.
3. Skid Resistance – ASTM E 303

   45 BPN units minimum

The material will have a thickness of 125 mils. A thickness tolerance not exceeding 10 percent will be allowed.

9-29.3(2) TYPE B – PRE-FORMED FUSED THERMOPLASTIC

Type B material consists of a mixture of pigment, fillers, resins, and glass beads that is factory produced in sheet form. The material is applied by heating the pavement and top heating the material. The material must contain intermixed glass beads. The material must conform to AASHTO M 249, with the exception of the relevant differences for the materials being applied in the pre-formed state and the following:

1. Resin – The resin must be an alkyd or other non-halogenated hydrocarbon.

   The sample material submitted for approval must be fused to a suitable substrate prior to performing the following tests.
2. Retroreflectance – ASTM E 1710

   The fused samples must have a minimum initial coefficient of retroreflective luminance of 250 $mcd \cdot m^{-2} \cdot lx^{-1}$ for white and 175 $mcd \cdot m^{-2} \cdot lx^{-1}$ for yellow per ASTM E 1710 when measured with a 30-meter retroreflectometer. Retroreflectivity will be measured for compliance with a Delta LTL-X retroreflectometer.
3. Skid Resistance – ASTM E 303

   60 BPN units minimum

The blue color must match Federal Standard 595, color number 35180, and the tolerance of variation must match that shown in the FHWA Highway Blue Color Tolerance Chart.

The red color must match Federal Standard 595, color number 11136, and the tolerance of variation must match that shown in the FHWA Highway Red Color Tolerance Chart.

The green color must match the requirements in the FHWA Interim Approval 14 (IA-14) Memorandum and the FHWA Official Interpretation #9(09)-86 (I) on Chromaticity Requirements for Green-Colored Pavement letter.

All Type B material pavement markings must have a thickness of 125 mil and include heat indicators. Heat indicators must be included on the top surface of the material (bead side) and must have regularly spaced indents. These indents will act as indicators for determining the correct amount of heat application and will close upon application when heated to the proper molten state. Type B material must be slip resistant. An approved Type B Material Supplier is PreMark® material with ViziGrip®, manufactured by Ennis-Flint, 115 Todd Court, Thomasville, NC 27360.

9-29.3(3) TYPE C – COLD APPLIED PRE-FORMED TAPE

Type C material consists of plastic pre-formed tape that is applied cold to the pavement. The tape must be capable of adhering to new and existing hot mix asphalt or cement concrete pavement. If the tape manufacturer recommends the use of a surface primer or adhesive, use a type approved by the pavement marking manufacturer. The tape must also be capable of being inlaid into fresh hot mix asphalt during the final rolling process. The material is identified by the following designations:

Type C-1 tape has a surface pattern with retroreflective elements exposed on the raised areas and faces and intermixed within its body and must conform to ASTM D 4505, Reflectivity Level I, Class 2 or 3, Skid Resistance Level A.

Type C-2 tape has retroreflective elements exposed on its surface and intermixed within its body and must conform to ASTM D 4505, Reflectivity Level II, Class 2 or 3, Skid Resistance Level A.

9-29.3(4) TYPE D - LIQUID COLD APPLIED METHYL METHACRYLATE

Type D material consists of a two part mixture of methyl methacrylate and a catalyst that is applied cold to the pavement. The material can be applied at a continuously uniform thickness or it can be applied with profiles (bumps). The material is classified by Type designation, depending upon the method of application. Type D-1 material is to be applied by hand

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operated extrusion device, pouring or hand troweling. Type D-2 and D-5 material must be applied by spraying. Type D-3 and D-4 material must be applied by machine extrusion.

Glass beads must conform to the manufacturer's recommendations necessary to meet the retroreflectance requirements. Type D-1, D-2, D-3, D-4, and D-6 material must have intermixed glass beads in the material prior to application. Type D-5 material must have glass beads injected into the material at application and a second coating of top dressing beads applied immediately after material application.

Type D materials must conform to the following:

Type D – Liquid Cold Applied Methyl Methacrylate Properties					
		White		Yellow	
Property	Test Method	Min.	Max.	Min.	Max.
Adhesion to PCC or HMA, psi	ASTM D4541[1]	200 or substrate failure	--	200 or substrate failure	--
Chemical Resistance	[2]	No Effect		No Effect	
Hardness	ASTM D2240[3]	50	--	50	--
No Track Time	ASTM D711[4]	--	30	--	30
Skid Resistance, BPN	ASTM E303	45	--	45	--
Tensile Strength, psi	ASTM D638	125	--	125	--

NOTES:

1. Part A and B mixed, applied at 60 mils thickness.
2. Cured markings must be resistant to calcium chloride, sodium chloride, fuels, oils, and UV effects. Cure 3 days for motor oil, gas, diesel, ATF, salt, and anti-freeze.
3. Shore Durometer Type D and measurement made after 24 hours.
4. Sample applied at 40 mils.

Type D liquid cold-applied methyl methacrylate must comply with the following formulations:

1. 4:1 Formulation Type D – Liquid Cold Applied Methyl Methacrylate
   a. Type D-1 – 1 gallon of methyl methacrylate and 3 fluid ounces of benzoyl peroxide powder (by weight).
   b. Type D-2, D-3, D-4, and D-5 – 4 parts methyl methacrylate and 1 part liquid benzoyl peroxide (by volume).
2. 98:2 Formulation Type D – Liquid Cold Applied Methyl Methacrylate
   a. Type D-1 – 1 gallon of methyl methacrylate and 3 fluid ounces of benzoyl peroxide powder (by weight).
   b. Type D-2, D-3, D-4, D-5, and D-6 – 98 parts methyl methacrylate and 2 parts liquid benzoyl peroxide (by volume).

Type D liquid cold applied methyl methacrylate must meet the following requirements for viscosity:

4:1 Formulations Type D – Liquid Cold Applied Methyl Methacrylate													
		D-1		D-2		D-3		D-4		D-5 White		D-5 Yellow	
Property	Test Method	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Viscosity cP @ 77°F, 50-rpm, spindle #7	ASTM D2196 Method B, LV Model	11,000	15,000	26,000	28,000	17,000	21,000	--	--	--	--	--	--
Viscosity cP @ 77°F, 50-rpm, spindle #4	ASTM D2196 Method B, LV Model	--	--	--	--	--	--	8,000	10,000	5,000	8,000	7,000	11,000

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98:2 Formulations Type D – Liquid Cold Applied Methyl Methacrylate													
Property	Test Method	D-1		D-2		D-3		D-4		D-5		D-6	
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Viscosity Daniel Scale	Daniel Method[1]	12	14	6	12	12	14	13	15	--	--	--	--
Viscosity cP @ 77°F, 50-rpm, spindle #4	ASTM D2196 Method B, LV Model	--	--	--	--	--	--	--	--	100	118	--	--

NOTE:

1. Follow Daniel Gauge method; measure flow at 60-seconds.

9-29.4 GLASS BEADS FOR PAVEMENT MARKING MATERIALS

Glass beads for traffic marking paint must be coated with silicone for moisture resistance and a silane to promote adhesion. The beads must be transparent, clean, colorless glass; smooth and spherically shaped; and free from milkiness, pits, or excessive air bubbles.

Glass beads used with plastic traffic markings must be per the manufacturer's recommendations.

The glass beads for paint and plastic traffic markings must not contain any metals in excess of the following established total concentration limits when tested per the listed test methodology:

Metal Concentration Limits		
Element	Test Method	Max. Parts Per Million
Arsenic	EPA SW846 6010C	5.0
Barium	EPA SW846 6010C	100.0
Cadmium	EPA SW846 6010C	1.0
Chromium	EPA SW846 6010C	5.0
Lead	EPA SW846 6010C	50.0
Selenium	EPA SW846 6020A	1.0
Silver	EPA SW846 6010C	5.0
Mercury	EPA SW846 7471B	0.20

Glass beads for pavement marking materials must meet the following requirements for quality:

Glass Bead Property	Test Method	Type A		Type B[1]	
		Min.	Max.	Min.	Max.
Refractive Index @ 77 ± 9 °F	AASHTO M 247 Section 5.2.3	1.50	1.55	1.50	1.55
Moisture Resistances	AASHTO M 247 Section 5.3.2	Flow Without Stopping		Flow Without Stopping	
Adherence	AASHTO M 247 Section 5.3.4	Pass		Pass	
Roundness, %	ASTM D1155	70	--	80[2]	--
	FLHT 520	--	--	80[3]	--
Appearance	TT-B-1325D Section 4.3.1	--	--	Beads must be transparent, clean, dry, and free from bubbles and foreign matter.	
Resistance to Acid	TT-B-1325D Section 4.3.6	--	--	Beads must not develop any surface haze or dulling.	
Resistance to Calcium Chloride	TT-B-1325D Section 4.3.7	--	--	Beads must not develop any surface haze or dulling.	

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Glass Bead Property	Test Method	Type A		Type B[1]	
		Min.	Max.	Min.	Max.
Resistance to Sodium Sulfide	TT-B-1325D Section 4.3.8	--	--	Sodium sulfide must not darken the beads.	
Water Resistance	TT-B-1325D Section 4.3.9	--	--	Water must not produce haze or dulling of the beads.	

NOTES:

1. WSDOT Type B Glass Beads are high-performance glass beads for improved retroreflectivity and durability for high-performance pavement markings. A minimum of 50 percent of the glass beads must be made from the direct-melt molten kiln process.
2. Roundness will be determined on material < No. 30 sieve.
3. Roundness will be determined on material ≥ No. 30 sieve.

Glass beads for pavement marking materials must meet the following grading requirements when tested per ASTM D1214:

Percent Passing				
Sieve Size	Type A[1]		Type B	
	Min.	Max.	Min.	Max.
No. 14			100	
No. 16	100			
No. 18			65	80
No. 20	95	100		
No. 30	75	95	30	50
No. 50	15	35	0	5
No. 100	0	5		

NOTE:

1. Same gradation as AASHTO M 247 Type 1.

9-29.5 TEMPORARY PAVEMENT MARKING TAPE

Temporary pavement marking tape must be pressure sensitive, reflective type, conforming to ASTM D 4592, designed for application on asphalt or concrete pavement. Biodegradable tape with paper backing must not be allowed. Surface preparation and application must be in conformance with all the manufacturer's recommendations.

9-29.6 TEMPORARY RAISED PAVEMENT MARKERS

Temporary flexible raised pavement markers must consist of an L shaped body with retroreflective tape on the top of one face for one-way traffic and reflective tape on the top of both faces for two-way traffic. The marker body must be made from 0.060-inch minimum thick polyurethane. The top of the vertical leg must be between 1.75 and 2.0 inches high and must be approximately 4 inches wide. The base width must be approximately 1.125 inches wide. The base must have a pressure sensitive adhesive material, a minimum of 0.125 inches thick with release paper. The reflective tape must be a minimum of 0.25" x 4" wide. The reflective tape must have a minimum reflectance of 3.5 candlepower per foot-candle for white and 2.5 candlepower per foot-candle for yellow measured at 0.2-degree observation angle and 0-degree entrance angle.

Temporary raised pavement markers except temporary flexible raised pavement markers must be as specified in Section 8-08.2.

9-29.7 FIELD TESTING

9-29.7(1) REQUIREMENTS

Field performance evaluation is required for low VOC solvent-based paint per Section 9-29.2(3), standard waterborne paint and high-build water borne paint per Section 9-29.2(4), Type A – liquid hot applied thermoplastic per Section 9-29.3(1),

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Type B – preformed fused thermoplastic per Section 9-29.3(2), Type C – cold applied preformed tape per Section 9-29.3(3), and Type D – liquid applied methyl methacrylate per Section 9-29.3(4).

Testing on a northern AASHTO National Transportation Product Evaluation Program (NTPEP) pavement marking test deck is recommended. Test decks conducted by other public entities may be considered provided they produce data similar to a northern NTPEP test deck. Retroreflectivity, Durability, and Auto No-Track must conform to the following requirements after being installed on a northern NTPEP test deck for a minimum of 12 months.

Successful use of a product in 5 other States may be considered in lieu of the field test requirement.

Cold weather waterborne traffic paint per Section 9-29.2(4) will be accepted based solely on the laboratory testing.

9-29.7(1)A RETROREFLECTIVITY

Retroreflectivity is measured as a coefficient of retroreflective luminance (RL) per ASTM E 1710 for 30-meter geometry. The minimum initial retroreflectivity is 250 mcd·m-2·lx-1 for white and 175 mcd·m-2·lx-1 for yellow, except Type C preformed tape must meet the minimum initial values in ASTM D 4505. The minimum retroreflectivity after 12 months is 150 mcd·m-2·lx-1 for white and 100 mcd·m-2·lx-1 for yellow, when measured in the skip line area. However, the Engineer will review the results of each test deck to determine the minimum value in effect for that deck, in order to approve only the better-performing materials.

9-29.7(1)B DURABILITY

Durability rating must be a minimum of 7 in the skip line area and 6 in the wheel paths after 12 months. The rating system used will be as indicated by NTPEP procedures. However, the Engineer will review the results for each test deck to determine the minimum value in effect for that deck, in order to approve only the better-performing materials.

9-29.7(1)C AUTO NO-TRACK TIME

Auto No-Track Time will only be required for low VOC solvent-based paint per Section 9-29.2(3), and standard waterborne paint and high-build water borne paint per Section 9-29.2(4).

No-track time must be determined per NTPEP procedures by passing over an applied test line with a standard size passenger car without tracking of the line when viewed from a distance of 50 feet. Standard paint must have a no-track time of 90 seconds or less when applied at a wet film thickness of 15 ± 1 mL, with glass beads applied at a minimum rate of 6 pounds per gallon of paint. High-build paint must have a no-track time of 120 seconds or less when applied at a wet film thickness of 20 to 30 mL, with glass beads applied at a minimum rate of 10 pounds per gallon of paint. The maximum no-track time must not be exceeded when the pavement temperature is between 50 °F and 120 °F, with relative humidity less than 85 percent, and the pavement is dry.

9-29.7(1)D APPROVAL

The Engineer will evaluate the results of laboratory and test deck data. This information will be reviewed for each material by color and roadway surface to determine compliance with this Specification. Approved product formulas will remain active for a period of approximately 5 years after completion of the NTPEP evaluation; afterwards, the product will need to be reevaluated.

SECTION 9-30 WATER DISTRIBUTION AND TRANSMISSION MATERIALS

9-30.0 GENERAL

All Materials for water distribution and transmission must be new. Materials used for temporary Water Main and for temporary service connection purposes may be either new or previously used materials and are subject to SPU's Water Operations inspection and approval prior to installation.

Prior to ordering any pipe to be used in a potable water supply, the Contractor must submit the Material source as required by Section 1-06.1 and must obtain the Engineer's approval.

All direct and indirect drinking water system components which come in contact with potable water must have National Sanitation Foundation certification.

9-30.1 PIPE

All pipe and fittings must be clearly marked with the manufacturer's name, type, class, and thickness as applicable and must be marked on the component at the place of manufacture. Marking must be legible and permanent under normal conditions of handling and storage.

9-30.1(1) DUCTILE IRON PIPE

1. Ductile iron pipe must be centrifugally cast in 18 or 20-foot nominal lengths and must be marked conforming to AWWA C151. Ductile iron pipe must have a double thick cement-mortar lining conforming to AWWA C104. Ductile iron pipe must be Standard Thickness Class 52.

   Flanged ductile iron pipe must be CL 53 per AWWA C115.

   Thicker Classes are acceptable.

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2. Non-restrained joints must be rubber gasket, push-on type, or mechanical joint conforming to AWWA C111.
3. Restrained joints must be as specified in Section 9-30.2(3).
4. Special coatings must be as specified in Section 9-30.1(4).
5. Ductile Iron pipe must meet SPU's taste and odor test requirements.

9-30.1(1)A EARTHQUAKE RESISTANT DUCTILE IRON PIPE

Earthquake resistant ductile iron pipe (ERDIP) must meet the performance requirements specified in this Section as verified by an independent (third party) testing laboratory:

1. Pipe joints must be able to expand by at least 1 percent of the pipe segment length and must be able to contract by at least 1 percent of the pipe segment length.
2. Pipe joints must be able to resist a pull-out force as determined by the following formula:

$$Fp = 17{,}000d$$

Where:

Fp = Minimum pull-out resistance in pounds.

d = Nominal pipe diameter in inches.

Fittings used on an ERDIP system must also meet the minimum pull-out force requirement.

3. Pipe joints or joint assemblies must be able to deflect in all directions as specified in the table below. Deflections are based on a pipe system reference lay length of 19.7 feet. The pipe system lay length is defined as one full length of pipe plus adapters. The required joint deflection angle may be adjusted by multiplying it by the pipe system lay length and dividing by the reference length.

Nominal Pipe Diameter	Minimum Joint Deflection (degrees)
4" - 16"	8
18" – 36"	7

9-30.1(2) STEEL PIPE

9-30.1(2)A STEEL PIPE LESS THAN 4 INCHES DIAMETER

Steel pipe less than 4 inches in diameter must conform to ASTM A 53, schedule 40 and must be hot dip galvanized inside and out, including the couplings. The pipe sections must be coupled by malleable iron screw coupling per ANSI Specification B16.3.

9-30.1(2)B STEEL PIPE 4 INCH DIAMETER AND LARGER

Steel pipe 4 inches in diameter and larger must conform to AWWA C200. The type of protective coating and lining and other supplementary information required by AWWA C204 will be included in the Contract.

9-30.1(3) PLASTIC PIPE AND ASBESTOS CEMENT PIPE

PVC, polybutylene, and asbestos cement material pipe must not be used as Water Main to convey potable water.

9-30.1(3)A HIGH-DENSITY POLYETHYLENE (HDPE) PIPE

HDPE pipe must be solid wall and must conform to AWWA C906, "Polyethylene (PE) Pressure Pipe and Fittings, 4 in. through 65 in. for Waterworks."

Polyethylene Materials for the manufacture of HDPE pipe and fittings must meet or exceed the requirements of Plastic Pipe Institute (PPI) TR4 designation PE4710 and must have a minimum cell classification of PE445574C.

Pipe must be manufactured in accordance with ASTM D3035 and contain no recycled compounds except that generated in the manufacturer's own plant from the resin of the same specification from the same raw material.

Pipe must be homogenous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects.

Pipe must be rated for use at test pressures of 200 psi; however, the pressure rating table for PE 3406/3408 with a design factor of 0.5 must be utilized for wall thickness design.

Wall thickness design must not be based on the proposed PE4710 design factor of 0.63. The outside diameter of the pipe must be based upon ductile iron pipe size (DIPS) sizing system and nominal diameters are as indicated in the Drawings.

The pipe manufacturer must be ISO 9001 certified and be able to demonstrate experience manufacturing HDPE pipe in similar size and pressure rating and length.

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HDPE pipe joining methods used must be per the manufacturer's recommendations. Unless otherwise indicated or approved by the Engineer butt fusion connections are the only joining method for all HDPE pipe as specified in Section 7-11.3(6)F.

9-30.1(4) PIPE COATINGS

9-30.1(4)A SPECIAL PIPE COATINGS

Special pipe coatings must be as specified in the Contract.

9-30.1(4)B MULTI LAYERED POLYETHYLENE TAPE COATING (MULTI-LAYERED POLYETHYLENE ENCASEMENT)

See Section 9-30.1(4)D for polyethylene (film wrap) encasement.

Acceptable Suppliers of multi layered polyethylene tape coating must be Polyken YGIII as manufactured by Seal For Life Industries, or Tapecoat CT 10/40 W as manufactured by Tapecoat Company, or approved equal. The multi layered polyethylene tape coating must conform to AWWA C214, and must comply with the following:

1. The multi layered polyethylene tape coating system must consist of the following components:
   a. One layer of pipeline coating primer and 20 mil inner wrap.
   b. One layer of pipeline wrap coating, 30 mils minimum thickness.
   c. One additional layer of outer wrap coating, 30 mils minimum thickness.
2. The primer must be fast drying and must form an instantaneous, firm bond when the adhesive on the tape coating comes in contact with the primed pipe surface. Coating primer must be compatible with the adhesive and must be from the same manufacturer.
3. The inner wrap coating must consist of polyethylene backing with a butyl-based adhesive laminated to one side of the backing. The polyethylene backing and adhesive must be made by the calendering process in order to ensure the maximum bonding of the adhesive to the backing. The adhesive must be formulated so that it forms a firm bond upon contact with the primed pipe surface.
4. The pressure sensitive adhesive outer wrap must consist of a polyethylene backing with a butyl-adhesive laminated to one side of the backing. The pressure sensitive adhesive on the outer wrap must form a firm continuous bond to the backing of the tape coating.
5. Cutbacks on the spigot end must be 6 inches or less and must be made with a cutting device that is guided from the end of the pipe to ensure a straight, uniform cutback. Cutbacks must not be made on the bell end of the pipe.
6. Following the application of the outer wrap, the coating must be electrically tested for holidays with a pulse tape holiday detector. The detector voltage range for this coating is 7000-9800 volts. The testing must conform to NACE RP-02-74.

   All defects electrically detected must be repaired by priming and patching with a suitable primer and tape as specified by the manufacturer and approved by the Engineer.
7. Accessory Tape. Accessory tape for fittings and specials must be YG III as manufactured by Seal For Life Industries, or approved equal. The accessory tape must conform to AWWA C209, and must comply with the following:
   a. One layer of pipeline coating primer and 50 mil inner wrap.
   b. One layer of 35 mil outer wrap.

The primer must be fast drying and must form an instantaneous, firm bond when the adhesive on the tape coating comes in contact with the primed pipe surface.

The pressure sensitive adhesive outer wrap must consist of a polyethylene backing with a butyl adhesive laminated to one side of the backing. The pressure sensitive adhesive on the outer wrap must form a firm continuous bond to the backing of the tape coating.

9-30.1(4)C THERMOPLASTIC POWDER COATING

9-30.1(4)C1 GENERAL

The powdered thermoplastic Material must consist of acid modified polyolefin elastomer to which any stabilizers, pigments, or other additives necessary to comply with this Specification have been added by extrusion compounding. The thermoplastic powder must be suitable for factory application by fluid bed dipping, and or elastic/flock deposition method. For on-site application, other application methods such as controlled flame spraying are acceptable if carried out by an approved applicator. When applied to a substrate per the guidelines agreed by the manufacturers and approved applicators, the powder must form a coating that meets or exceeds this Specification.

9-30.1(4)C2 QUALITY OF DUCTILE IRON PIPE

Surface preparation, application, and curing of powder coating, and testing and touch up of coating must be performed by an experienced applicator. An experienced applicator is defined as having working knowledge of and experience with:

1. Surface preparation/blasting of a ductile iron pipe.

2. Application and curing of thermoplastic powder coating.
3. Quality assurance testing including:
    a. Mil thickness measurement,
    b. Profile measurement,
    c. Anchor and adhesion testing,
    d. Holiday testing, and
    e. Temperature monitoring, and
4. Manufacturer approved touch-up repairs.

9-30.1(4)C3 SURFACE PREPARATION

The pipe and fittings must be prepared for coating by blasting the pipe surface to remove impurities and imperfections. The existing pipe surface profile must not change by more than 2 to 3 mils. Preparation must consist of the following:

1. Before blast cleaning, remove all visible grease, asphalt coating, oil, slag, burs, and other protrusions resulting in a smooth substrate conforming to curvature. When a solvent is used, all solvent residue must be removed;
2. Bevel all sharp edges and corners;
3. Do not use steel shot or other non-angular blast material; and
4. Use clean, dry, oil-free air for nozzle blasting.

When surface preparation is complete and the surface is viewed without magnification, staining, oil, grease, dirt, dust, rust, pre-existing coating, loose oxides, and any other contaminant must not be visible. The prepared Material must be maintained clean for the coating.

9-30.1(4)C4 APPLICATION OF POWDER COATING

Powder Coating: Use PPA 571 thermoplastic powder coating as manufactured by Plascoat Systems Limited or an approved equal.

Masking and Plugging: All masking, where required, must be done using a high powder coating masking tape. The ends of pipe and fittings must be plugged both during heating in the oven, and during the coating process to keep the interior mortar lining cooler and to keep the powder coating from passing beyond the groove where the gasket is to be installed in the bell end of the pipe or fitting.

Preheating: All parts must be preheated to a maximum temperature of 240 °F before coating is applied.

A Raytek RAYNGER ST SERIES noncontact infrared temperature measurement tool or similar device must be used for determining coating temperature.

Preheating must be done using a gas fired convection oven or equivalent.

Coating with Electrostatic Deposition: After the part has been preheated to the 240 °F temperature followed by the powder application to the surface of the part using a corona powder coating discharge gun, a negative polarity is required and a voltage of 30kv is recommended. The powder is applied across the total surface of the part, taking care that the powder is applied in a level and homogenous build. The coating must be applied to a dry film thickness of 20 to 25 mils and be totally free of holidays/pinholes.

It is then necessary to convey the part to the oven which must be set between 285 °F and 385 °F in order to complete flowing out of powder.

The coating must be smooth, even and free of runs, sags, streaks, and overspray.

Coating with Fluid Bed Dip System: After the part has been preheated to 240 °F, the part is then dipped into a fluidized bed of powder and left for a prescribed time to accomplish a coating thickness of 20 to 25 mils.

The part must be conveyed to the oven for a complete flowing of the powder.

The coating must be smooth, even, and free of runs, sags, streaks, and overspray.

9-30.1(4)C5 TESTING

Holidays: After completing the coating process, the part must be cooled to ambient temperature and then electrically tested for holidays with a Tinker & Rasor AP/S1 holiday detector or equivalent. The voltage must not exceed 6kv for a 25 mil coating. The testing must conform to NACE RP 02 74. All defects electrically detected must be repaired as specified in Section 9-30.1(4)C6.

Thickness: Each coated part must be tested for coating thickness using an electronic coating thickness gauge such as Qua Nix 1500 or equivalent and the test results as specified in Section 1-06.5 must be submitted to the Engineer within 3 Working Days of the testing.

9-30.1(4)C6 FIELD REPAIR AND TOUCH UP

Damaged coating or repair of cutback areas may be repaired after proper substrate preparation. Exposed substrate must be thoroughly cleaned of corrosion products and contamination to expose bare metal. Abrasive techniques (such as wire brush, sandpaper, and sandblast) followed by cleaning with mineral spirits, acetone, or alcohol are recommended.

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Immediately after cleaning apply heat to the coating adjacent to the damaged area to re-melt and flow the coating over the damaged area. If required, additional PPA571 powder may be added and melted to insure proper installation of a homogenous protective coating of sufficient thickness.

Major repairs (large areas) may require a specialized Subcontractor with proper training and equipment to complete a fault holiday free field repair. If that Subcontractor or the Contractor determine, or if the Engineer determines, that the level of damage is such that a fault holiday free repair cannot be attained, then the Contractor must remove and replace the damaged item.

9-30.1(4)C7 MATERIAL REQUIREMENTS

Test Conditions: The testing conditions must be per ASTM D 3924 at standard Conditions: 73.5 °F ±3.5 °F, 50 percent ± 5 percent relative humidity.

Specific Gravity: Specific gravity of the powder thermoplastic coating Material must be between 0.90 and 0.97. Specific gravity must be determined per method B specified in ASTM D 729.

Color: Color of the thermoplastic powder coating must be specified by the purchaser and evaluated for conformance per ASTM D 1729.

Flexibility: The thermoplastic powder coating must exhibit no cracking, peeling, or loss of adhesion when bent (coated side in tension) 180 degrees over a conical mandrel per ASTM D 522, Test Method B. Panels must be examined immediately after bending.

Adhesion: The thermoplastic powder coating must exhibit a minimum of 1000 psi adhesion to the aluminum and steel substrates per ASTM D 4541.

Thermal Shock Resistance: The applied thermoplastic powder coating must withstand 10 temperature cycles without cracking, checking, or disbonding. Cycles must be from + 104 °F to -40 °F.

Impact Resistance: The applied thermoplastic powder coating must resist minimum direct and reverse impacts of 36 inch pounds without cracking, disbonding, or holiday formation as determined by visual inspection. Test panels must be impacted per ASTM D 2794 using a 2 pound weight with a 0.5-inch diameter indenter dropped from a height of 18 inches.

Abrasion Resistance: Weight loss from the applied thermoplastic powder must not exceed 90 milligrams. Test panels must be tested for 1000 cycles using a Taber Abrader apparatus with CS 17 wheels and 1000 gram weights per ASTM D 4060. Weight loss must be determined immediately after test to 3 significant figures.

Salt Spray Resistance-Unscribed: There must be no blisters, wrinkles or loss of adhesion nor any general surface corrosion or pitting after 1000 hours of salt spray exposure.

Salt Spray Resistance-Scribed: There must be no blisters, wrinkles nor any general surface corrosion or pitting after 1000 hours of salt spray exposure. There must be no more than 10mm loss of adhesion from a scribed line after 1000 hours of salt spray exposure.

Fluid Resistance Properties: The applied thermoplastic powder coatings must exhibit no objectionable alteration to the surface such as discoloration, change in gloss, blistering, softening, loss of adhesion, or formation of holidays or special phenomena after immersion for 7 Days per ASTM D 1308 in the following fluids.

1. Distilled water.
2. Type III hydrocarbon (per Federal Spec. TT-S-735).
3. Hydraulic fluid (per Mil-H-83282).

Chemical Resistance: The applied thermoplastic coating must exhibit no objectionable alteration to the surface such as discoloration, change in gloss, blistering, softening, loss of adhesion, or formation of holidays or special phenomena after immersion for 7 Days per ASTM D 1308 in the following chemical solutions:

a. 3M aqueous $CaCl_2$.
b. 3M aqueous NaOH.
c. Saturated aqueous $Ca(OH)_2$.
d. Aqueous solution of H_2SO_4 (specific gravity = 1.29 ± 0.02).

Dielectric Strength: The applied thermoplastic coating must have a dielectric strength of 900 ± 100 v/mil at 15 mil per ASTM D 149.

Weathering Properties: The applied thermoplastic coating must exhibit the following resistance to weathering:

1) Accelerated weathering. The applied thermoplastic powder coating must show no cracking, significant color change (fade), chalking, blistering, wrinkling or loss of adhesion, nor must there be any evidence of substrate corrosion after 2000 hours exposure to accelerated weathering per ASTM G 53 using UVB-313 fluorescent lamps. The coating must exhibit no more than 30 percent loss in 60 degree specular gloss after exposure.
2) Humidity resistance. Test panels must be exposed to a 120 °F ± 2 °F, 100 percent relative humidity environment per ASTM D 2247 for 30 Days. The coating must not show blistering, wrinkling, or loss of adhesion and there must be no evidence of substrate corrosion after humidity exposure.
3) Holidays. The applied thermoplastic powder coating must be free of holidays at an application thickness of 20 to 25 mil. Holiday detection must be performed with a low voltage (75 to 100 volts) direct current detector.

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4) Shelf life. Powder coating Materials must meet the requirements of the Owner and be submitted within 2 years from the date of manufacture when stored below 85 °F, 50 percent relative in the unopened original container.

MSDS must be provided to the Engineer.

9-30.1(4)D POLYETHYLENE ENCASEMENT (FILM WRAP)

Plastic film wrap for polyethylene encasement must be 8 mil polyethylene conforming to AWWA C105.

See Section 9-30.1(4)B for multi-layered polyethylene encasement.

9-30.1(4)E HEAT SHRINK JOINT SLEEVE

The sleeve must be Aqua Shield, or approved equal. The sleeve must be a wraparound type with a joint closure and must contain a thermal indicator.

9-30.1(4)F WAX TAPE COATINGS

Petrolatum-impregnated wax tape coating must conform to AWWA C217. Acceptable products are:

1. #1 Wax-Tape as manufactured by The Trenton Corporation, Ann Arbor, MI, or
2. Densyl Tape as distributed by Denso North America Inc., Houston, TX, or
3. Approved equal.

See Section 7-11.3(8)A for field application construction requirements.

9-30.2 FITTINGS

9-30.2(1) DUCTILE IRON PIPE

Fittings for ductile iron pipe must be ductile iron conforming to AWWA C110, and AWWA C111 or AWWA C153 and must be cement mortar lined conforming to AWWA C104.

Except where restrained joint systems are required, fitting joints must be mechanical joint.

Where restrained joint pipe is required, threaded flanges by restrained joint adapters must not be longer than 3 pipe diameters. Threaded flanges and pipe must conform to AWWA C115. The exterior flange lip overlapping the pipe barrel must be sealed with a bituminous mastic.

Sleeves less than 12 inches in diameter must be 12 inches minimum length and must be mechanical joint.

Sleeves greater than 12 inches in diameter must be of the long body type and must be 15 inches minimum length and must be mechanical joint.

Where ductile iron pipe is to be joined to existing cast iron pipe of the same nominal size, and electrical isolation is not required at the connection, and the outside diameter of the existing cast iron pipe varies 0.05 inches or less from the specified outside diameter of the ductile iron pipe being joined, the pipe must be joined with a mechanical joint sleeve.

Where 10-inch through 24-inch diameter ductile iron pipe is to be joined to existing cast iron pipe of the same nominal size, and electrical isolation is not required at the connection, and the outside diameter of the existing cast iron pipe conforms to AWWA 1908 classifications A, B, C, or D, the pipe must be joined with a transition mechanical joint sleeve having a single piece body.

Where 8-inch or smaller diameter ductile iron pipe is to be joined to existing cast iron pipe of the same nominal size, and electrical isolation is not required at the connection, and the outside diameter of the existing cast iron pipe conforms to AWWA 1908 classifications A, B, C, D, E, or F, the pipe must be joined with a transition mechanical joint sleeve having a single piece body.

Hub by flange fitting length must conform to AWWA C110 or AWWA C153. The body of hub by flange fittings must be a single piece casting. Do not use threaded pipe and flange combinations.

9-30.2(2) STEEL PIPE

Fittings for steel pipe 3-1/2 inches in diameter and smaller must be malleable iron threaded type with a pressure rating of 150 psi. Dimensions must conform to ANSI B16.3. Threading must conform to ANSI B2.1 Material must conform to ASTM A 47, Grade 32510. All fittings must be banded and hot dip galvanized inside and out.

Unions must be malleable iron with a pressure rating of at least 150 psi. Material must conform to ASTM A 47, Grade 32510. Unions must be ground joint, bronze to iron type.

Steel fittings for pipe 4 inches in diameter and larger must be per AWWA C208. The class of the fittings must be at least the same as that of the pipe. Coatings for couplings and fittings must be factory applied. Field couplings must be compression type. When flanges are required, they must conform to AWWA C207. Buried couplings, bolts and followers must be coated with wax tape per Section 7-11.3(8)A.

9-30.2(3) RESTRAINED JOINTS

Restrained joints, where required on the Drawings, must be flexible after assembly and be able to be disassembled. Restrained joints must meet the following criteria:

1. The restrained joint must have a positive metal to metal contact locking system without the use of gripping teeth,

2. The joint restraint system for the pipe must be the same as the joint restraint system for the pipe fittings, except as provided in item 4. below.
3. The joint restraint system for the pipe must be boltless if the Drawings show joint bonding and,
4. Where restrained jointed fittings required on the Drawings cannot be furnished, or where restrained jointed fittings are required in areas that are known to be subject to location adjustments, the Contractor may submit a lay plan showing mechanically jointed fittings with Wedge Restraint Glands for approval. Mechanically jointed pipe with Wedge Restraint Glands must not be substituted for restrained jointed pipe.

9-30.2(4) WEDGE RESTRAINT GLANDS

Wedge Restraint Glands must conform to AWWA C111, ASTM A 536-80 Grade 65-45-12. All bolts and wedges must be ductile iron. Wedges must be heat-treated to a minimum 370 BHN. Wedge Restraint Glands must be rated for 350 psi for pipe 12 inches in diameter and smaller. All Wedge Restraint Glands must be wax tape encased. Wedge Restraint Glands must be electrically joint bonded if installed on coated Water Main.

9-30.2(5) TRANSITION REDUCING, AND INSULATING FLEXIBLE COUPLINGS

Transition couplings, reducing couplings, transition reducing couplings, sleeves, and flexible insulating couplings for Water Main must be compression type by pipe manufacturer: Romac or Ford or approved equal. Bolts and nuts must be corrosion resistant per AWWA C111. Stainless steel bolts require anti seize compound. The long body pattern with a minimum center ring or center sleeve length of 12 inches for pipe less than 12 inches in diameter and equal to or greater than the pipe diameter for pipe greater than 12 inches in diameter. Solid sleeves (greater than 12-inch diameter) must be a 15-inch minimum length. Factory finish must be fusion bonded epoxy or Plascoat PPA 571 thermoplastic coating.

9-30.2(5)A INSULATING COUPLINGS

Insulating couplings and flange kits are required at any point of connection of two dissimilar metallic Material pipes (i.e. ductile iron to cast iron) as shown on the Drawings. The insulating coupling body must be coated with either thermoplastic powder coating Plascoat PPA 571 fusion bounded epoxy conforming to AWWA C213, or high build polyamide epoxy conforming to AWWA C210, and must be a liquid coating, portable water grade, capable of 4 to 8 mil dry film thickness per coat, or thermoplastic powder coat per Section 9-30.1(4)C; insulating boot must cover the pipe end to prevent metal contact between pipe sections being joined. The insulating boots and rubber gaskets must be virgin synthetic butyl rubber compatible for potable water service. The nuts and bolts must be stainless steel ASTM F 593, Type 316. The insulating coupling must be manufactured by Romac Industries, Inc., or approved equal.

9-30.2(5)B INSULATING FLANGE KITS

Insulating flange kits must consist of a full face neoprene faced phenolic, type “E” O-ring gasket; insulating sleeves and washers manufactured from glass reinforced epoxy design; and 1/8-inch thick plated, hot rolled steel washers. Acceptable Suppliers are GPT Industries, Wheat Ridge, CO; Central Plastics Co., Shawnee, OK.; or approved equal.

9-30.2(6) RESTRAINED FLEXIBLE COUPLINGS AND SLEEVES

Restrained flexible couplings or sleeves must be as shown on the Drawings. Lengths must comply with the minimums specified in Section 9-30.2(5).

9-30.2(7) SPECIAL FITTINGS

Special fittings must be as shown on the Drawings.

9-30.2(8) TWO INCH BLOWOFF ASSEMBLY

2-inch blowoff assembly must be as shown on Standard Plan 340a and 340b at the locations shown on the Drawings.

2-inch service tube must be Type K copper. Two-inch gate valve must be of iron body construction, having bronze seat rings and stem, an o ring stem seal system, must be fitted with a 2-inch square operating nut, F.I.P.T. inlet and outlet threading conforming to ANSI B2.1, and must be minimum 150 pounds working water pressure rated. Plastic foam Material must conform to Section 9-30.2(9). Frame and cover must conform to Section 9-30.3(9)H. Meter Box must conform with Section 9-30.5(7).

9-30.2(9) PLASTIC FOAM (ETHAFOAM)

Plastic foam must be as specified in Section 9-05.10.

9-30.2(10) CEMENT CONCRETE

Cement Concrete for pipe support saddles and cradles and for thrust blocking must be Class 3000 as specified in Section 6-02.

9-30.2(11) STEEL CASING PIPE

Steel casing pipe must have a diameter and wall thickness as specified on the Drawings. Pipe must be smooth and bare.

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9-30.2(12) SEALS AND SPACERS FOR STEEL CASING PIPE

9-30.2(12)A SEALS

Casing end seals must be used to completely seal the annular space between the casing and the Water Main at each end of the casing. Casing end seals must provide a moisture proof seal that is resistant to heat, cold, vibration, impact, abrasion, disbonding, expansion and contraction, and must be impermeable. Acceptable seals are standard pull on model S, or custom pull on model C as manufactured by Pipeline Seal and Insulator, Inc., or approved equal.

9-30.2(12)B SPACERS

Casing spacers must be bands at least 12 inches in width and must be either stainless steel or heavy-duty fusion bonded epoxy coated steel. Runners must be 2" wide glass reinforced plastic securely bonded to the spacer and must be aligned on the spacer along the axis of insertion of Water Main into casing pipe. Runner length must approximate the width of the spacer. Securing the spacer to the Water Main must be per the manufacturer's instruction.

Acceptable spacers are Pipeline Seal and Insulator, Inc. (PSI) model S12G-2 for stainless steel and model C12G 2 for coated steel, or approved equal.

9-30.2(13) HDPE PIPE FITTINGS

Fittings for HDPE pipe must be made of HDPE material meeting the minimum material designation code and cell classification code for pipe as specified in Section 9-30.1(3)A.

HDPE fittings must be capable of providing a working pressure rating no less than that of the HDPE pipe to which the fitting is connected. The pressure rating table for PE 3406/3408 with a design factor of 0.5 must be utilized for wall thickness design. Wall thickness design must not be based on the proposed PE4710 design factor of 0.63. The outside diameter of the pipes must be based on DIPS and nominal diameters of fittings are as indicated in the Drawings.

Acceptable HDPE fittings include molded fittings per ASTM D3261 and fabricated fittings complying with AWWA C906 and ASTM F2206. Fabricated fittings must be manufactured using a McElroy Data Logger or approved equal to record fusion pressure and temperature and must be stamped with unique joint number that corresponds to the Fusion Technician's Joint Report. Data Logger records must be maintained on fabricated fittings and must be made available upon request. Field fabricated fittings are not allowed. Butt fusion, electrofusion (if approved by Engineer), and flanged connections are acceptable joining methods for HDPE fittings to pipe as specified in Section 7-11.3(6)F.

The pipe/fitting manufacturer for wall anchor fittings used in wall anchor blocks must determine the ring dimensions. The pipe/fitting manufacture must certify the wall anchor fitting meets the same HDPE material and working pressure rating requirements for HDPE fittings as specified herein. Wall anchor fittings must be made with sufficient length to be clamped in the butt fusion-joining machine without the use of a stub-end holder.

The fitting manufacturer must be ISO 9001 certified and be able to demonstrate experience manufacturing HDPE fittings in similar size and pressure rating and length.

Flanged connections via flanged adapters, where approved by the Engineer, must be manufactured and tested per AWWA C906, and accompanied with gaskets, back-up rings, bolts, nuts, washers, and spacers (if required). The HDPE flange adapter must be made of HDPE material meeting the minimum material designation code, cell classification code, and pressure rating of the connected HDPE pipe or fitting. Flange adapters must be made with sufficient length to be clamped in the butt fusion-joining machine without the use of stub-end holder. The pipe manufacturer must determine the flange adapter thickness required to provide a pressure rating equivalent to the connected HDPE pipe.

Back-up rings, gaskets, bolts, nuts, washers, and spacers (if required) must provide a long-term service pressure rating equal to the pipe for which the flange adapter assembly will be used; and the back-up rings, bolts, nuts, washers, and spacers (if required) must be properly protected from corrosion using three-part wax tape as specified in Section 9-30.1(4)F and compatible with the materials of the connecting pipes and appurtenances.

Gasket materials must be full-face and recommended for use with HDPE flanges by the gasket manufacturer. Gaskets must be compatible with the internal fluid and external environment and must have an inner diameter matching the pipe for which the flange assembly will be used. Gaskets must be rated for use at 200 psi and also capable of maintaining seals at the anticipated compressive stresses induced by the HDPE flange assembly. Yield strength of back-up rings, bolts, nuts, washers, and spacers (if required) must be capable of achieving the minimum required compressive stress of gaskets to maintain a seal.

Electrofusion fittings and electrofusion couplings for joints, where approved by the Engineer, must be manufactured and tested in accordance with ASTM F1055 and AWWA C906 and must be capable of providing a long-term service pressure rating equal to the fitting for which the electrofusion joint or coupling will be used. Electrofusion fittings and couplings must be made of HDPE material meeting the minimum material designation code, cell classification code, and pressure rating of the connected HDPE fitting. The electrofusion processor must be capable of reading and storing the input parameters and the fusion results for later download to a record file.

The electrofusion fitting manufacturer and electrofusion coupling manufacturer must have experience with installations where electrofusion fitting product was successfully used to join HDPE pipe and fittings for the same nominal diameter pipe and pressure rating as proposed.

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Fabricated transition pieces, where required, must meet the requirements for HDPE pipe as specified in Section 9-30.1(3)A. Where indicated on the Drawings, ductile iron (DI) fittings connected to HDPE pipe must meet the requirements as specified in Section 9-30.2(1).

9-30.3 VALVES

9-30.3(1) GENERAL MANUFACTURE AND MARKING

The valves must be a standard pattern of a manufacturer whose products are approved by the Engineer and must have the name or mark of the manufacturer, year valve casting was made, size, and working pressure plainly cast in raised and legible letters on the valve body. All valves must be NSF approved and valve bodies must be ductile iron. All valves must be stamped with both NSF APPROVED and DI.

Where a valve is required to operate in a higher pressure environment than the Class of valve specified in Section 9-30.3, the class of valve must be as specified in the Contract.

9-30.3(2) GATE VALVES

9-30.3(2)A GATE VALVES DOUBLE DISC

In addition to 9-30.3(1), gate valves 3-inch through 12-inch must conform to AWWA C500, be equipped with nonrising stems and O-ring stuffing box, and with double disc gates or rotating double disc gates having a bronze wedging device.

All gate valves must have a ductile iron body.

Valves must open counterclockwise when viewed from above and must be equipped with a standard AWWA 2-inch square operating nut. Valves must be double disc bronze seated valves if they have iron bodies.

3 Manufacturer's Certificates of Compliance copies demonstrating performance tests comply with AWWA C500 must be submitted to the Engineer.

Valve ends must be mechanical joint. Where restrained joints are called out, valve ends must be flanged with appropriate flange by restrained joint adapters per Section 9-30.2(1).

Double disk gate valves must be manufactured by Clow, M & H, American Flow Control (ACIPCo), Pratt/Mueller, M&H/Kennedy, or approved equal in sizes 12 inches or less. Rotating double disk gate valves must be manufactured by McWane/Kennedy, J & S Valve, or approved equal in sizes 12 inches or less.

Gate valves 2-1/2 inches and smaller must be of ductile iron body construction having bronze seat rings and stem, o ring seal system, F.I.P.T. (female iron pipe thread) inlet and outlet conforming to ANSI B2.1, a standard AWWA 2-inch operating nut, and must be minimum 150 pounds water working pressure.

The 2-inch and smaller valves must be manufactured by Kennedy, Nibco Scott, Stokum, or approved equal.

9-30.3(2)B GATE VALVES RESILIENT SEAT

Gate valves 3-inch through 12-inch must conform to AWWA C509 and Section 9-30.3(1).

9-30.3(3) BUTTERFLY VALVES

Water Main butterfly valves must be as specified in Section 9-30.3(1), must conform to AWWA C504, and must be Class 150B. The valve must be short body type and must have flanged ends. Flanged ends must be sized and drilled in conformance with ANSI B16.1 Class 125. Valve must be suitable for direct burial installation; however, butterfly valves 12-inch and larger must be installed within an access vault sized to permit removal and replacement of the valve.

All butterfly valve bodies and discs must be ductile iron.

Butterfly valves except AWWA C504 Class 150 and butterfly valves installed on water transmission pipeline must be as specified in the Contract.

Where butterfly valves are installed on restrained joint Water Mains, the valve ends must be flanged with flanged by restrained joint adapters per Section 9-30.2(1).

Valves must be mounted on the Water Main or pipeline such that the operating nut is accessible and operable from above.

Operator must be manual, fully enclosed, and suitable for buried service. It must open left (counterclockwise when viewed from above) and must be equipped with a standard AWWA 2-inch square operating nut.

Operators for 16-inch and larger valves must be equipped with external indicators, visible from above, which show the position of the valve disc.

Unless otherwise specified in the Contract, the minimum number of turns from fully open to fully closed on Class 150 butterfly valves must be as follows:

Diameter	Turns, Min.
4"-8"	16 turns
10"-12"	28 turns

Diameter	Turns, Min.
14”-18”	30 turns
20”	60 turns
24”	100 turns
30”	150 turns
36” and larger	200 turns

A manufacturer’s certificate of compliance stating the valves to be furnished fully comply with AWWA C504 and the modifications contained here must be submitted to the Engineer before incorporation of the valve into the Work.

Unless the Contract specifies otherwise, bolting and torqueing for the valve connection to the Water Main must be as recommended by the manufacturer including any connection coating requirement when buried in soil. Wearing surfaces must be bronze or other approved noncorrosive Material and there must be no moving bearing or contact surface of iron in contact with iron. Rubber seat must be kept in the body and must mate against a stainless steel surface mounted on the disc. Contact surfaces must be machined and finished in the best workmanlike manner, and all wearing surfaces must be easily renewable.

The butterfly valves must be manufactured by Henry Pratt Company, Mueller, DeZurick, Mosser Valve Division of Olsen Technologies, or approved equal.

The valve manufacturer must provide a non-corrosive durable metal tag, measuring 4” x 6”, or other size as approved by the Engineer, with the number of turns to fully open/close the valve permanently stamped on the tag. A non-corrosive high strength durable cord, approximately 18 inches in length, must permanently attach the tag to either the bottom end of the valve box or the lower section of the valve chamber frame, as applicable.

9-30.3(4) VALVE BOXES

Valve boxes must be installed on all buried valves. The box and lid must be cast iron, 2 piece slip type with cast iron extension as necessary, conforming to requirements and dimensions of the Standard Plans.

The cover must have the word “WATER” or the letter “W” cast in it.

Valve boxes, lids, and extensions of the following manufacturers are approved for use:

1. Olympic Foundry, Inc.
    a. 045 Valve Box; Standard Base and Extension
    b. Lid Section # 13-5010
    c. Top Section # 13-5020
    d. Base Section # 13-5021
2. EJCO Part Numbers
    a. 24-inch Valve Box Complete Assembly - 00366420A01
    b. 30-inch Valve Box Complete Assembly - 00366420A02
    c. 36-inch Valve Box Complete Assembly - 00366420A03.
    d. Lid Section – 00366420
    e. Top section – 00366412
    f. Base Sections:
        1) 24-inch – 85556024
        2) 30-inch – 85556030
        3) 36-inch – 85556036

Each top and lid section must be tested for accuracy of fit and must be marked in sets for delivery.

Valve box extension pieces must be provided for valves with ground cover in excess of the depth of the standard valve box (see Standard Plans 315a and 315b).

9-30.3(5) COMBINATION AIR RELEASE / AIR VACUUM VALVES

Combination air release/air vacuum valves must comply with ANSI / AWWA C512.

9-30.3(6) END CONNECTIONS

The dimensions of hub or bell end connections must conform to the dimensions of AWWA C100. The dimensions for the mechanical joint connections must conform to ANSI A21.11.

The end flanges of flanged valves must conform in dimensions and drilling to ANSI B16.1 for cast iron flanges and flanged fittings, Class 125, unless specifically provided otherwise in the Contract. The bolt holes must straddle the vertical center line.

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9-30.3(7) OPERATING NUT EXTENSIONS

An operating nut extension conforming to Standard Plan 315b must be furnished and installed by the Contractor on all valves where the finished grade is more than 30 inches above the valve operating nut.

9-30.3(8) PLASTIC FOAM RINGS

Valve boxes must have a 2-inch thick plastic foam cushion installed between the base flange of the valve box bottom section ring conforming to the dimensions shown on Standard Plan 315b installed between the base and the valve casting. The plastic foam must be as specified in Section 9-05.10.

9-30.3(9) VALVE CHAMBERS

9-30.3(9)A PRECAST VALVE CHAMBER

Size, shape, and Materials must be as shown on the Drawings.

The chambers must be furnished in precast concrete sections with sufficient strength to withstand HS 20 traffic loading together or as specified on the Drawings with ladder and access frames and covers to provide the minimum clearance dimensions shown on the Drawings.

The chambers must be water tight after assembly. Gasket Material must be installed in the groove of the keyway of each chamber section as it is installed. There must be no evidence of moisture seeping into the chambers through the walls, floor, or joints.

9-30.3(9)B CONCRETE BLOCKS FOR VALVE CHAMBERS

Portland cement concrete blocks must be solid and must conform to ASTM C 139. Overall thickness of block must be 6 inches with optional lengths and widths. Curved maintenance hole blocks must be used for round valve chambers.

9-30.3(9)C CONCRETE BRICK FOR VALVE CHAMBERS

Concrete brick must be solid and conform to ASTM C 55, Grade A.

9-30.3(9)D CLAY BRICK FOR VALVE CHAMBERS

Clay brick must conform to ASTM C 62, Grade SW.

9-30.3(9)E MORTAR

Portland cement mortar must be 1 part Portland cement to not less than 1-1/2 parts nor more than 3 parts of plaster sand, mixed with the least amount of water necessary to provide a workable mix. Dehydrated lime, in an amount not exceeding 50 percent of the Portland cement by weight, may be added to the mix at the option of the Contractor.

9-30.3(9)F CEMENT CONCRETE

Cement Concrete for chamber foundation must be Class 3000 as specified in Section 6-02.

9-30.3(9)G CAST-IN-PLACE CONCRETE VALVE CHAMBER

The design, size, shape, and Materials for cast in place concrete valve chambers must be as shown on the Drawings. The Contractor must submit Shop Drawings of the chamber indicating all features to the Engineer as specified in Section 1-05.3.

9-30.3(9)H FRAME AND COVER

Castings for cast iron frame and cover must conform to ASTM A 48, Class 30 and must conform to the Standard Plans unless specified otherwise in the Contract.

The word WATER must be cast in the cover in 3-inch letters as shown on the Standard Plans.

Each frame and cover section must be tested for accuracy of fit and must be marked in sets for delivery.

An acceptable Supplier is Olympic Foundry standard box and lid, EJ Type EJ3761 Series or other approved equal.

See Section 9-30.3(3) regarding the permanent connection of the tag, indicating the number of turns to fully open/close the butterfly valve, to the valve box or to the valve chamber.

9-30.3(9)I MORTAR FOR PLASTER COATING

Mortar for plaster coating masonry unit maintenance holes must be proportioned according to either of the two following tabulated alternates:

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Alternate	Parts by Volume Portland Cement	Parts by Volume Masonry Cement	Parts by Volume Hydrated Lime or Lime Putty
1	1	1 (Type II)	0
2	1	0	1/4

Plaster sand for either alternate 1 or alternate 2 above must be measured in a damp, loose condition, and must be not less than 2-1/4 and not more than 3 times the sum of volumes of cement and lime.

A bituminous coating must be applied to all surfaces after plastering.

9-30.3(9)J LADDERS

Ladder must be made of steel and must be galvanized after fabrication. They must be made of 1-inch deformed steel bar conforming to ASTM A 615, intermediate or standard grade, hot bent at least 1600 °F. Galvanization must conform to ASTM A 123.

9-30.3(10) PAINTING AT FACTORY

After the factory test and inspection, all ferrous parts of the valves except finished or bearing surfaces must be painted inside and out with two coats of asphalt varnish, Federal Specification TT V 51A or approved equal.

9-30.3(11) WATER PRESSURE REGULATING VALVES

1. Water Pressure Regulating Valves, 3-inch through 12-inch Sizes: Valve must be flanged at both ends, Class 150 ASA drilling, with ductile iron body. Valve must be a diaphragm operated, single seat, globe valve with stainless steel trim. It must be spring loaded and hydraulically operated. Seat ring must be replaceable. The diaphragm must be fully guided top and bottom. All necessary repairs must be possible without removing the valve from the line. Packing glands are not permitted. Disc must be synthetic rubber and have a rectangular cross-section. The stem must be guided by a bearing in the valve cover and an integral bearing in the valve seat. There must be no piston operating the main valve.

   Valves must be designed to maintain a constant downstream pressure regardless of varying inlet pressure. They are to be used in handling clean, cold water.

   No control pilots or optional equipment is to be furnished. Valves must be CLA Valve No. 90 or approved equal.
2. Water Pressure Regulating Valves, 2-inch size: Valves must be Mueller No. H 9310 2-inch Water Pressure Reducing Valves or approved equal.

9-30.3(12) COATINGS FOR VALVES

Special coatings, thermoplastic powder coating, and polyethylene encasement must be per Section 9-30.1(4).

9-30.4 HYDRANTS

9-30.4(1) GENERAL

Fire hydrants must conform to AWWA C502 and must be of standard manufacture and of a pattern approved by SPU Water Operations. The name or mark of the manufacturer, size of the valve opening and year made must be plainly cast in raised letters on the hydrant barrel to be visible after the hydrant is installed.

The Kennedy K81D “Guardian” has been approved for use by the City of Seattle.

9-30.4(2) END CONNECTIONS

The end connection must be 6 inches, standard flange, Class 125 drilling conforming to ANSI B16.1.

9-30.4(3) HYDRANT DIMENSIONS

The dimensions and details of hydrant and nozzles must be as follows:

1. Hydrant connection pipe size inside diameter: 6 inches.
2. Standpipe, minimum inside diameter: 7 inches.
3. Valve opening, minimum diameter: 5-1/4 inches.
4. Size of auxiliary gate valve: 6 inches.
5. Hose nozzles, number and size: two 2-1/2 inches.
6. Thread (National Board of Fire Underwriters): 7-1/2 per inch.
7. Total length of threaded male nipple: 1 inch.
8. Streamer nozzle, number, and size: one 4 inch.
9. Hydrants must be furnished with one pumper nozzle with size and threads conforming to dimensions as identified on the current City of Seattle Standard Plans for Fire Hydrants.

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10. Drain Valve: Drain valve must be automatic with outlet tapped with 1/4 to 3/4-inch female iron pipe threads. The threads on the drain valve outlet holes must be protected with temporary pipe plugs until the hydrant is ready for installation.
11. Breakaway flange (ring) to center of pumper nozzle: 14 inches or more.
12. Face: Pumper port toward the street.

All nozzles must be fitted with cast iron threaded caps with operating nut of the same design and proportions as the hydrant stem nut. Caps must be threaded to fit the corresponding nozzles and must be fitted with suitable neoprene gaskets for positive water tightness under test pressures.

9-30.4(4) OPERATING NUTS

The operating nuts on hydrant stem and nozzle caps must be as follows:

Pattern of nut	Height	Size of pentagon
Tapered pentagonal	1-1/6 inch	1.35 inches at bottom of nut 1.23 inches at top of nut (measured from point to flat)

The direction of opening must be clearly marked on the operating nut or hydrant and must be counter clockwise

9-30.4(5) HYDRANT RESTRAINT

9-30.4(5)A RESTRAINT SYSTEM FOR SHACKLE RODS

Shackling rods must be 3/4-inch diameter with threaded ends and must comply with ASTM A 36. “All thread” rod is not acceptable. If a tie bolt restraint system is used, it must be “COR TEN Steel Star National Products Super Star Tie Bolt #SST7” or approved equal. If a mechanical joint gland with lugs restraint system is used, it must conform dimensionally as shown on the hydrant detail and must be ductile iron conforming to ASTM A 536 Class 80 55 06. Coating for shackling rods must be as specified in Section 9-30.12.

9-30.4(5)B RESTRAINT SYSTEM FOR WEDGE RESTRAINT GLANDS

If a wedge restraint system is used in lieu of shackle rods, mechanical joint (MJ) pipe must be used rather than slip joint (SJ) pipe. The wedge restraint system must be as specified in Section 9-30.2(4).

9-30.4(6) BREAKAWAY FLANGE CONSTRUCTION

Hydrants must be provided with a breakaway flange assembly and be equipped with breaking devices at the sidewalk flange which allow the hydrant barrel to separate at this point with a minimum breakage of hydrant parts in case of damage. There must also be provided at this point, a safety stem coupling on the operating stem that shears at the time of impact. Unless otherwise specified in the Contract, all hydrants must be equipped with O-ring stem seals.

9-30.4(7) HYDRANT PAINTING

9-30.4(7)A HYDRANT SHOP PAINTING

All iron parts of the hydrant must be thoroughly cleaned and painted at the factory. All inside surfaces and the outside surfaces below the groundline must be coated with asphalt varnish, Federal Specification TT-V-51a or J.A.N.P-450, unless otherwise specified in the Contract. They must be covered with two coats, the first having dried thoroughly before the second is applied.

9-30.4(7)B HYDRANT FIELD TOUCH UP PAINTING

All iron parts of the hydrant must be thoroughly cleaned and painted at the factory. All inside surfaces and the outside surfaces below the breakaway flanges must be coated with asphalt varnish, Federal Specification TT-V-51a or J.A.N.P-450, unless otherwise specified in the Contract. They must be covered with two coats, the first having dried thoroughly before the second is applied.

The hydrant curb stand section, including all exposed surfaces of the breakaway flange, must receive two coats of oil based gloss enamel paint (Kelly Moore Luxlite or approve equal) in Caterpillar yellow. Based on the elevation of the hydrant within the surrounding pressure zone, if the maximum static pressure at the hydrant is less than 60 psi, the engine port cap on the hydrant must be painted with two coats of oil based gloss enamel paint (Kelly Moore Luxlite or approve equal) with the final coat being Red.

9-30.4(8) HYDRANT FACTORY HYDROSTATIC TEST

All hydrants must be tested by the manufacturer, as required in AWWA C502. The Contractor must furnish to the Owner an Affidavit of compliance from the manufacturer for all tests.

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9-30.4(9) HYDRANT CONNECTION PIPE

Pipe connections from the hydrant to the Water Main must be 6-inch Ductile Iron Pipe, Class 52, as specified in Section 9-30.1(1).

9-30.4(10) HYDRANT VERTICAL EXTENSIONS

Hydrant barrel extensions must have a 7-inch minimum inside diameter and must be gray cast iron or Ductile Iron and must conform to the AWWA Standards for such castings. The drillings of the connecting flanges on the extensions must match the drillings of the flanges on the hydrant.

Hydrant vertical extensions must also include the necessary hydrant operating stem extension, complete with safety stem couplings.

Extensions with threaded flanges must be ductile iron and must conform to AWWA C115. The exterior flange lip overlapping the barrel pipe must be sealed with a bituminous mastic.

Vertical extensions shorter than 18 inches must be installed at the bottom of the factory supplied barrel pipe.

9-30.4(11) HYDRANT BLEEDER

The hydrant bleeder assembly, as shown on the hydrant detail, must be constructed of 3/4-inch copper tubing Type K, conforming to Section 9-30.5(4).

9-30.4(12) POLYETHYLENE ENCASEMENT AND SPECIAL TAPE COATING FOR HYDRANTS AND CONNECTIONS

Refer to Section 9-30.1(4).

9-30.5 SERVICE CONNECTIONS AND SERVICE PIPE OR TUBING

9-30.5(1) GENERAL

Service piping standards must be used, and modified when shown on the Drawings, for 2-inch blowoff assembly and hydrant bleeder assembly.

9-30.5(2) SADDLES

Unless otherwise indicated, saddles must be ductile iron, or bronze, double straps with thread standard outlet tapping. Saddles must be of a size designed by the manufacturer to fit the pipe called for on the Drawings.

Service connections on HDPE pipes must be done in accordance with Section 7-15.3(1) and selected in accordance with the following criteria:

1. Service connection of 2-inch-diameter and smaller on HDPE pipes must be the following:
   a. Mechanical-type, ductile iron saddle with full-circle double straps and thread standard outlet tapping. The mechanical-type, ductile iron saddle product must be manufactured for HDPE pipe and approved by the connection manufacturer for use on HDPE pipe at the pipe's required pressure class and diameter. The mechanical-type, ductile iron saddle must be rated for a minimum test pressure of 200 psi. Saddles must be of a size designated by the manufacturer to fit the pipe size indicated in the Drawings. Wax tape coating per Section 9-30.1(4)F must be applied to all metallic components.
2. Service connections larger than 2-inch-diameter on HDPE pipes must be made with HPDE tee fittings. HDPE tee fittings must meet the requirements as specified in Section 9-30.2(13).

9-30.5(3) CORPORATION STOPS

Corporation stops for use with saddle must be of bronze alloy with inlet M.I.P. (male iron pipe) standard thread and outlet thread compatible with connection piping, with no special adapters. Corporation stops for direct tapping must be bronze alloy with AWWA tapered inlet. Outlets must be on 3/4-inch and 1-inch direct tap corporation stops must be copper tubing size compression, with an external clamping or anti pullout feature. Outlets on 1-1/2-inch and 2-inch direct tap corporation stops must be male iron pipe or tubing to be connected.

9-30.5(4) SERVICE PIPE

9-30.5(4)A COPPER TUBING

Copper tubing must be per ASTM B 88, Type K, annealed. The tubing must be coupled using compression fittings having a positive external gripping feature to prevent tubing pull out, per AWWA C800, minimum 150 psi working pressure.

9-30.5(5) COMPRESSION COUPLINGS

Compression couplings for use in connecting plain end water service pipes must be applicable for the type of pipe being coupled. Compression couplings must have armored gaskets when similar metal pipes are being joined.

9-30.5(6) METER STOPS AND SETTERS

Meter stops and setters must be per the SPU Water Operation Standards.

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9-30.5(7) METER BOX AND LID

Meter Box and Lid must be per the current SPU Water Operation Standards. The Meter Box casting must conform to ASTM A 48, Class 30 for gray cast iron. The Lid casting must conform to ASTM A 536, Grade 80-55-06 for ductile iron. Castings must be brushed or dipped with a bituminous coating. Meter Box and Lid must be Olympic Foundry (1984) Inc. SM 29, or approved equal.

9-30.5(8) VALVES

Valves must conform to Section 9-30.3.

9-30.6 BEDDING, FOUNDATION MATERIAL AND GRAVEL

See Section 7-11.3(1)C for bedding requirements.

9-30.7 JOINT BOND CABLE

General joint bond cable must be single conductor No. 2 AWG stranded copper wire with 600 volt, 7/64 inches thick high molecular weight polyethylene (HMWPE) insulation. Supply all joint bonds complete with a formed copper sleeve on each end of the wire, as specified in Section 9-30.8.

9-30.8 THERMITE WELD MATERIALS

9-30.8(1) GENERAL

Thermite weld Materials must consist of wire adapter sleeves, welders, and weld cartridges according to the weld manufacturer's recommendations for each wire size and pipe or fitting size and Material. All welding Materials and equipment must be the product of a single manufacturer. Interchanging Materials of different manufacturers will not be acceptable.

Molds must be made of graphite. Ceramic "one shot" molds will not be acceptable.

Steel thermite weld cartridges must be used for steel pipe and fittings. Cast iron thermite weld cartridges must be used for all cast and ductile iron pipe and fittings. Maximum cartridge sizes for steel thermite welds must be: 15 grams for wire sizes #14 AWG through #4 AWG stranded, and 32 grams for #2 AWG stranded.

Maximum sizes for cast iron thermite welds must be: 25 grams for #14 AWG through #6 AWG stranded, and 45 grams for #4 AWG solid through #2 AWG stranded.

Thermite weld Material may be obtained from the following Suppliers: Erico Products Inc. (Cadweld), Cleveland, Ohio; or Continental Industries, Inc. (Thermoweld), Tulsa, Oklahoma; or approved equal.

9-30.8(2) ADAPTER SLEEVES

Provide Adapter Sleeves for all No. 12 AWG through No. 2 AWG test station and joint bond wire. Prefabricated factory sleeve joint bonds or bond wires with formed sleeves made in the field are acceptable. Field formed joint bond sleeves must be attached with the appropriate size and type of hammer die provided by the thermite weld manufacturer.

9-30.8(3) THERMITE WELD CAPS AND PRIMER

Thermite Weld caps must be prefabricated weld caps with coating and suitable primer, such as Handy Cap II with Royston Primer 707, as manufactured by Royston Laboratories, Inc., or equal.

9-30.8(4) COATING REPAIR AT THERMITE WELD

Repair of coating of pipe and fittings for spot damage at thermite weld connections not included in standard pipeline coating repair procedure, must be 100 percent solid epoxy that cures in submerged or buried conditions. Repair of thermoplastic powder coating must be as specified in Section 9-30.1(4)C6.

9-30.9 ELECTROLYSIS TEST STATION

9-30.9(1) GENERAL NON TRAFFIC AREA

An electrolysis test station must consist of a standard meter box and lid as specified in Section 9-30.5(7) providing a housing for a test box as specified in Section 9-30.9(2).

9-30.9(2) TEST BOX

Test box requirements must be as follows:

The 4-inch (10 cm) deep test box must provide a single piece enclosure 8" x 6" (20 cm x 15 cm) with a removable, hinged lid. The test box must be Hoffman No. 864CHQRFG or approved equal.

The lid must be manufactured from molded fiberglass reinforced Material and fitted with a one piece oil resistant O-ring gasket. The lid must be attached to the test box with a Monel hinge pin and secured by quick release latches.

The test box must comply with NEMA 4X standards, to supply protection against corrosion, windblown dust, rain, splashing water, and hose direct water.

A water tight connector consisting of a heat shrinkable cable entry system, must be used for passage of test wires into the enclosure. The entry system must be a 3 part assembly consisting of a rigid plastic nut, a rubber O-ring, and molded heat

shrinkable cable entry seal including tape sealant. The cable entry system must be type CES 2 or CES 3, with SFTS 1 or SFES 3 tape sealant as manufactured by Sigmaform Corporation; or approved equal.

9-30.9(3) TEST STATION WIRES

Test station wires must be single conductor, No. 10 AWG and No. 6 AWG stranded copper with 600 volt XHHW insulation. Color of insulation per Drawings.

9-30.9(4) WIRE CONNECTORS INSIDE TEST BOX

Wire connectors inside the test box must be one piece, tin plated crimp on lug connector as manufactured by Burndy Co., Thomas and Betts, or equal.

9-30.9(5) ZINC REFERENCE ELECTRODES

The electrode must be a 5 pound 99.9 percent pure zinc ingot packaged in a thoroughly mixed backfill material consisting of 75 percent gypsum, 20 percent bentonite clay and 5 percent sodium sulfate or a 50 percent gypsum and 50 percent bentonite mix. The package must be water permeable and of sufficient size to ensure complete envelopment of the reference electrode and must include 50 feet of 10-gauge yellow RHW lead wire.

9-30.9(6) ELECTRICAL CONDUIT AND FITTINGS

PVC electrical conduit and fittings must be schedule 40 and UL listed for direct burial. Conduit and fittings must comply with NEMA TC and TC3, Federal Specification W C 1094, UL and NEC.

9-30.9(7) SACRIFICIAL ANODES

The sacrificial anode must be a 17 pound high potential magnesium anode for cathodic protection with improved core, style #17D3-R, wire per standard plan 364 and 365, length of wire as necessary. If prepackaged, the anode must be packaged with backfill consisting of 75 percent gypsum, 20 percent bentonite, and 5 percent sodium sulfate contained in a cloth bag. Backfill used for bare anodes must consist of the same mixture as prepackaged anodes. Anode must conform to ASTM B843 Industry Standard for M1C high potential magnesium anodes.

9-30.10 TURBINE METERS (METER, COLD WATER, MAGNETIC DRIVE TURBINE TYPE, SIZES 2" - 12")

9-30.10(1) GENERAL

These requirements apply to Magnetic Drive Turbine Type Cold Water Meters 2 inches through 12 inches in size, manufactured for use on customer water services. Turbine Meters must consist of a cast bronze case containing the measuring mechanism with a strainer housing attached.

Meters must comply with AWWA C701, current edition, Class II type, except as modified here.

9-30.10(2) REGISTER AND REGISTER BOX

Registration must be in cubic feet.

9-30.10(3) MEASURING MECHANISM

The measuring mechanism must be the inline type, and so designed that it can be readily removed from the main case as a complete unit. The measuring mechanism must be capable of operating within the accuracy limits specified under Normal Flow Limits in Section without recalibration when transferred from one turbine meter case to another.

9-30.10(4) INTERMEDIATE GEAR TRAIN

If an intermediate gear train is utilized, it must operate in a dry, hermetically sealed compartment, separated from the water passage by a bronze wall.

9-30.10(5) CAPACITY AND ACCURACY

The turbine meter must register all rates of flow through it with an accuracy of 100 percent ± 2 percent at rates of flow within the limits specified under Normal Flow Limits in Section 9-30.10(6).

9-30.10(6) NORMAL FLOW LIMITS

Size	Normal Flow Limit
2”	5 - 160 GPM
3”	10 - 350 GPM
4”	15 - 800 GPM
6”	30 - 1800 GPM
8”	50 - 3500 GPM

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Size	Normal Flow Limit
10”	55 - 5500 GPM
12”	70 - 7000 GPM

NOTE: Above flow limit must be for continuous flows, all turbine meters must have a 25 percent overspeed capacity for intermittent flows.

9-30.10(7) HEAD LOSS

Maximum loss of head must not exceed 7 psi at the flow rates listed under “Normal Flow Limits” in Section 9-30.10(6).

9-30.10(8) CONNECTIONS

All main case connections must be flanged. The flanges for 2-inch meters must be of the two bolt oval type. Meters must be furnished without companion flanges.

9-30.10(9) INTERCHANGEABLE PARTS

All parts of turbine meters of the same size, make, and model must be interchangeable.

9-30.10(10) STRAINER

Turbine meters must be supplied with a strainer attached. Strainers must be short pattern, 125 lb. ANSI, iron body, with heavy gauge 1/4 inch perforated, stainless steel screen having an effective straining area at least double that of the meter main case inlet.

9-30.10(11) REMOTE READING

Turbine meters must be compatible with existing SPU Automated Meter Reading and Demand Recording Hardware and/or switches. Manufacturer, type, and style of switch must be submitted for approval by the Engineer before ordering.

9-30.10(12) MANUFACTURE AND APPROVAL

Meters must be submitted to the Engineer for approval prior to installation.

9-30.10(13) INSPECTION

All turbine meters purchased under this Specification will be subject to inspection and testing by SPU Water Meter Shop upon receipt, and if any meter is found not to conform with these Specifications, the lot or any portion thereof may be rejected.

9-30.10(14) GUARANTEE

All turbine meters must be guaranteed for a period of 1 year after installation. This guarantee must be against defects in Materials, workmanship, and construction.

9-30.10(15) TEST REPORT

All turbine meters purchased under this Specification must be accompanied by a notarized test report of the factory accuracy test.

9-30.11 LOCATING WIRE

Locating wire, except for HDPE pipe, must be 14 gauge solid copper with neoprene coating. Connections and splices must be made with Grainger Industrial Supply WeatherProof and Underground Wire Connectors, Item # 21GR20, or approved equal.

Locating wire for HDPE pipe must be AWG #14 solid copper wire or copper clad steel wire with high molecular weight polyethylene insulation (blue). Direct bury wire nuts and lugs must be waterproof and corrosion-proof that accepts wire ranges #14 - #10 AWG solid and stranded copper and specifically designed for low voltage tracer splices and cathodic applications up to 50V. Temperature rating must be -45 degrees F to 400 degrees F. Direct bury wire nuts must be Dryconn Direct Bury Wire Nut (10444) manufactured by King Innovation or approved equal. Direct bury lugs must be Dryconn Direct Bury Lug as manufactured by King Innovation or approved equal.

9-30.12 COATING FOR ALL BOLTS, LUGS, AND SHACKLE RODS

On corrosion protected Water Mains, all shackle rods, concrete blocking anchor rods, lugs, and shackle clamps must have a factory applied protective coating with fusion bonded epoxy per ASTM A755. After threading and assembly, the threaded ends, nuts, and washers must be coated with a wax tape coating system per Section 9-30.1(4)F.

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9-30.13 BACKFLOW PREVENTION ASSEMBLIES (BPAS)

9-30.13(1) GENERAL

All backflow prevention assemblies (formerly called backflow prevention devices or BPDs) must be on the Washington State Department of Health current list of approved backflow prevention assemblies, and both temporary and permanent installations of such assemblies must be verified acceptable by the Engineer.

All backflow prevention assemblies, whether temporary or permanent, are subject to inspection by SPU Inspection Services before connection with any Water Main. See Section 1-07.28 item 8D regarding BPA inspection notification requirements. After initial inspection and acceptance, annual testing is required.

Backflow prevention assemblies installed on premises, or not installed for premise isolation purposes, must be inspected by Seattle King County Health Department Plumbing Inspection.

9-30.13(2) ATMOSPHERIC VACUUM BREAKERS (AVBS)

Atmospheric vacuum breakers must be of a type included in the Washington State Department of Health current listing of "Acceptable Atmospheric (Non Pressure) Type Vacuum Breaker" or other types with IAPMO approval. AVBs must be installed downstream of the last shutoff valve and a minimum of 6 inches above the highest outlet or overflow level of the irrigation system. AVBs must be installed above ground.

An atmospheric vacuum breaker must be attached to each hose bib. An AVB must not be operated for more than 12 hours in any 24 hour period. AVBs must not be used on systems with chemical additions.

9-30.13(3) PRESSURE VACUUM BREAKER ASSEMBLIES (PVBAS)

Pressure vacuum breakers must be of a type included in the Washington State Department of Health current listing of "Acceptable Pressure Type Vacuum Breaker" or other types with IAPMO or University of Southern California approval. PVBAs must be installed a minimum of 12 inches above the highest outlet or overflow level of the irrigation system and located so that adequate room is available for maintenance and testing. PVBAs must be inspected and tested annually during the life of the Contract by backflow device testers certified by the Washington State Department of Health. PVBAs must not be installed below ground. PVBAs must not be used for systems with chemical additions.

9-30.13(4) DOUBLE CHECK VALVE ASSEMBLIES (DCVAS)

Double check valve assemblies must be of a type included in the Washington State Department of Health current listing of "Approved Double Check Valve Assemblies."

Installations must be according to procedures outlined in the current edition of "Accepted Procedure and Practice in Cross Connection Control Manual" published by the Pacific Northwest Section, American Water Works Association. DCVAs must be inspected and tested annually during the life of the Contract by backflow device testers certified by the Washington State Department of Health.

DCVAs can be installed below ground only if enclosed in an approved irrigation vault, chamber, or other approved enclosure. DCVAs must not be used for systems with chemical additions.

9-30.13(5) REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTION ASSEMBLIES (RPBAS)

Reduced pressure principle backflow prevention assemblies will be required for any system using chemical additions or proposed to use chemical additions. Such systems include irrigation systems with fertilizer or other chemical addition. These units must be of a type included in the Washington State Department of Health current listing of "Approved Reduced Pressure Backflow Assemblies." Inspection of the installation, to ensure proper operation, will be conducted by SPU. RPBAs must be inspected and tested annually during the life of the Contract by backflow device testers certified by the Washington State Department of Health.

Installation must be according to procedures outlined in the current edition of "Accepted Procedure and Practice in Cross Connection Control Manual" published by the Pacific Northwest Section, American Water Works Association.

RPBAs must not be installed below ground.

9-30.14 TRENCH MARKER TAPE

Marker tape for HDPE pipes must be an inert plastic film specifically formulated for prolonged underground use. Minimum thickness must be 4 mm thick with a minimum width of 3 inches. Marker tape must be blue in color and must have 2-inch black lettering with the inscription "CAUTION: HDPE WATER LINE BURIED BELOW". The message must be printed out at maximum intervals of 2 feet.

SECTION 9-31 ILLUMINATION AND ELECTRICAL MATERIALS

9-31.1 LUMINAIRES

9-31.1(1) GENERAL

External labels for (LED) luminaires must conform to ANSI C136.15.

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9-31.1(2) ROADWAY LIGHTING LUMINAIRE

LED luminaires must comply with the following SCL Material Standards:

1. For residential LED luminaires refer to SCL Material Standard 5723.47.
2. For collector-arterial LED luminaires refer to SCL Material Standard 5723.61.
3. For principal-arterial LED luminaires refer to SCL Material Standard 5723.71.

Glare control must be accomplished by use of a field-installable, house-side shield. For house-side shields, refer to above SCL Material Standards.

9-31.1(3) RESERVED

9-31.1(4) PHOTOELECTRIC CONTROLS

Photoelectric controls must be used with all luminaires and must comply with SCL Material Standard 5731.17 for 20-year design life applications.

9-31.1(5) UNDERDECK MOUNTED UNDERCROSSING LUMINAIRE

For underdeck mounted undercrossing luminaires, refer to SCL Material Standard 5719.40.

Underdeck luminaires must be pendant mounted as called for on the Drawings.

9-31.1(6) WALL PACK LUMINAIRE

For wall-pack luminaires, refer to SCL Stock Catalog stock class 57.

The luminaire must consist of a rear die cast back housing which encloses the ballast, lamp socket and reflector, and a refractor frame assembly. The back casting assembly must mount against the wall (or pole) and the refractor housing assembly must fasten to it by means of concealed hinges and a single point, positive acting latch. There must be plated steel retaining chain attached between the main housing and refractor frame. Overall dimensions must be approximately 16 inches square by 10-3/8 inches deep.

Units must be prewired and equipped to be wall mounted directly on conduit for surface wiring without bending the conduit or to a recessed outlet box and must require no tools for lamp replacement.

The optical train must consist of the lamp, fluted specular aluminum reflector, and molded prismatic borosilicate thermal shock resistant glass refractor. The dimensions of the refractor must be approximately 16 inches square by 4 inches deep and must have internal splitting prisms and external dispersing prisms. The refractor frame color must be anodized aluminum.

The integral ballast must operate the high pressure sodium 55 volt lamp at the wattage shown on the Drawings, and provide reliable starting at temperatures as low as 20 °F. The ballast must be multi-tap to allow field adjustments of voltage.

All insulation must be UL listed Class H; core, coil, and capacitors must be positioned for maximum heat dissipation. Supply wires to the unit are to be of proper temperature rating for the type of entry used. The housing must be finished with a black polyester powder paint coating. The complete unit must be UL listed as “Suitable for Wet Locations.” The unit must be Moldcast catalog no. PCL 1 or approved equal, to be furnished with photocontrol, wireway conduit adapter, and polycarbonate shield.

The wall pack luminaire must be furnished with photocontrol, wireway conduit adapter, and polycarbonate shield.

9-31.2 WIRE

Street light wire size and type must be constructed per the Drawings.

Street light wire in conduits must comply with SCL Material Standard 6122.3. Wire size will be shown on the Drawings.

Wire used inside of poles and bracket arms, including wood pole mounted bracket arms, must comply with SCL Material Standard 6404.45.

Overhead triplex wire must comply with SCL Material Standard 6007.50. Color coding is not required for triplex wire.

Multiple conductors must be color coded per the NEC. Wire must be continuously color coded. Neutral wire must always be white. Grounding conductors must be green and insulated. The first hot conductor must be black, the second hot conductor must be red, and the third hot conductor must be blue.

Trench ground wire must conform to SCL Material Standard 6102.20.

Plastic molding for covering wire attached to the side of wood poles must be per SCL Material Standard 5820.50.

9-31.3 WIRE SPLICES

This standard applies to wire connections made in above grade or below grade installations except where the wires are attached directly to the terminal board. All connectors must be U.L. or equivalent, labeled and approved for the intended use.

1. Above Grade Installations (including connections in pole handholes):
    a. Copper to Copper Connector - The connector must be a high strength bronze alloy of the split bolt type specified in SCL Material Standard 6688.7.

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b. Copper to Aluminum Connector - The connector must be of the one or two bolt type labeled CO/ALR and include a spacer bar approved by the Engineer.

c. Aluminum to Aluminum Connector - The connector must be of the 1 or 2 bolt type and comply with SCL Material Standard 6693.5.

d. Split bolt connections must be insulated as specified in Section 8-30.3(5).

2. Below Grade Installations (including on Structures):

a. Below grade splices must be made in a 2 piece rigid body transparent moisture proof spliced enclosure. The body must be webbed to ensure centering of the splice and even distribution of the encapsulant. The body and encapsulant must be composed of Material that do not support fungi or mold. The encapsulant must be a re-enterable, gel like, transparent type. Non-reenterable encapsulant may be approved if each splice is approved by the Engineer prior to installing encapsulant.

b. Connectors must be as described in "a" above, or a copper mechanical crimp type may be used when submitted to, and allowed by, the Engineer at least 3 Working Days in advance of proposed use, or when shown on a Shop Drawing submitted to and reviewed by the Engineer. Mechanical crimp splices must be made with an approved crimping tool.

3. Inside Cabinets and Panels: Wire nuts may be used only inside cabinets and panels. Copper or silver plated terminals must be used at terminal blocks.

9-31.4 FUSES AND FUSE HOLDERS

Fuses must be of the voltage and amperage specified on the Drawings.

Fuses must comply with SCL Material Standard 6855.50

Fuse holders and insulating boots must comply with SCL Material Standards 6857.05. Fuse holders must be crimp-type terminations and be sized appropriately for wire and fuse size.

Fuse, fuse holders, and insulating boots must be UL-listed for the intended application.

9-31.5 GROUND RODS, CLAMPS, AND HARDWARE

Ground rods, couplings, and driving studs must comply with SCL Material Standard 6762.25.

Ground rod clamps must comply with SCL Material Standard 6762.15 for 5/8-inch clamps and 6762.20 for 3/4-inch clamps.

Ground plates must be a minimum of 2 square feet surface area copper plate.

9-31.6 ENCLOSURES

Enclosures located outside must be weather proof type, NEMA Type 3R. All doors and covers must be gasketed. All enclosure metal must be formed of stainless steel or aluminum as noted on the Standard Plans, and must be constructed to the dimensions shown on the Drawings. All doors must be provided with a heavy-duty hasp suitable for padlocking.

All joints must be seam welded. Enclosures must be fabricated to allow for anchor bolt mounting.

A permanent sign must be attached to the exterior of the enclosure cover or door. The sign must be engraved into a 2" x 6" stainless steel plate with a minimum thickness of 18 gauge. The lettering must be in 3 lines as follows:

DANGER

HIGH VOLTAGE

KEEP OUT

The letters must be 1/2 inch high with a stroke width of 3/32 inch, and must be filled with a red paint.

The completed sign must be coated with a clear polyurethane enamel with exterior catalyst and attached to the enclosure cover with a minimum of 6 stainless steel drive rivets.

9-31.7 RECEPTACLES

Festoon receptacles must comply with SCL Material Standard 7330.0. Festoon receptacle must be 20 amp, 125 volt, AC, GFCI, Hospital Grade receptacles NEMA configuration 5-20R, to be UL listed "Hospital Grade" under UL No. 498.

SECTION 9-32 TRAFFIC SIGNALS SYSTEM

9-32.1 SIGNAL HEADS, VEHICLE

9-32.1(1) GENERAL

9-32.1(1)A SIGNAL HEAD COMPONENTS

Signal heads must be per the Institute of Transportation Engineers publication, current edition of Adjustable Face Vehicle Traffic Control Signal Head Standard and the following additional requirements:

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The equipment must be designed for operation under temperature and humidity conditions encountered in the Pacific Northwestern United States.

Materials and workmanship must conform to the best commercial standards of the industry.

Signal hanger pins must include a stainless steel washer between each cotter key and the signal hanger.

A terminal block of an approved type must be mounted inside at the back of each signal head. It must have sufficient studs to terminate 6 lamp wires independently to 6 field wires. The screws must be of sufficient length to easily accommodate 14 AWG field wires without having to remove the screws. The terminals to which field wires are attached must be permanently tagged to facilitate field work. Lamp socket wires must consist of a white wire and a wire of the same color as the lens connected to the terminal block.

All signal heads must be installed as shown on the Drawings.

The housing, door, visor exterior, and mounting hardware/framework must be dark green in color. The visor interior and both sides of the back plate must be optical black or flat black in color. The paint must be commercial quality synthetic resin enamel.

Adjustable signal heads must consist of separate signal sections, expandable type, for vertical or horizontal mounting, rigidly and securely fastened together into one weather tight signal assembly. The signal sections must be 8 inches or 12 inches in diameter, as shown on the Drawings.

Each section must consist of a housing, door assembly, LED technology module optical unit, and backplate and must be so constructed as to provide complete interchangeability of parts.

Weather resistant mildew proof gasketing must be provided between the housing and door assembly and between the lens and LED module, which must exclude dust and moisture.

9-32.1(1)B HOUSING

The housing must be cast aluminum alloy, free of flaws, cracks, blowholes and other imperfections.

Each vehicular signal head must have a 1/4-inch drain hole in the bottom of the head.

Each section must house 1 individual optical unit complete with 1 piece hinged square door, mounting for the lens and other parts of the optical system and a simple noncorrodible door locking device.

Sections must be interchangeable and so constructed that sections can be added or removed. The top and bottom must be drilled for 1-1/2-inch supporting pipe fittings. Hexagonal heavy plumbers lock nuts 2-1/2 inches across flats for 1-1/2-inch pipe must be provided for top and bottom.

The 4 backplate mounting holes (2 in the top of the backplate and 2 in the bottom of the backplate) must be a maximum distance of 1-1/4 inches on 8-inch signals and 2-1/2 inches on 12-inch signals from the top or bottom edge of the signal housing.

9-32.1(1)C DOOR ASSEMBLY

The door assembly must consist of the door, lens, and visor.

The door of each section must be made of aluminum alloy and must be hinged to the housing so as to permit access or removal. The door must be secured to the housing by a single finger type locking device. The door locking device must be easily removable to allow door removal.

Each section must have a visor made from aluminum alloy sheet of a tunnel design attached to the door by means of 4 pinhead screws. The mounting holes must be slotted. Visor length must be 8 inches for 8-inch signals and 12 inches for 12-inch signals.

The lens must be glass, circular in shape of the color, type, and size specified. The lens must be designed to provide an outward distribution of light with a minimum above the horizontal. Each lens must be true to color and must conform to the current ITE Standard. The lenses must have a minimum visible diameter of 7-3/4 inches (eight inches nominal) or 11-1/2 inches (12 inches nominal).

9-32.1(1)D OPTICAL UNIT

All vehicle signal head sections must be provided with an expanded view LED technology rather than incandescent unless otherwise specified in the Contract. A sample of the LED module to be used, the manufacturer's Specifications, and a manufacturer's certificate of compliance to the VTCSH Specifications must be provided to the Engineer for approval. If approved, the LED sample submitted will then be used as the basis for accepting all further units to be installed. Written approval by the Engineer will be required prior to the first installation.

LED modules must fit into traffic signal housings built to the VTCSH standards without modification to the housing and must not require special tools for installation. It must be weather tight and fit securely in the housing and must connect directly to the electrical wiring terminals.

The lens Materials to enhance ON/OFF contrasts must not affect luminous intensity or chromaticity and must be uniform across the face of the lens and must be UV stabilized. The lens must be a replaceable part without the need to replace the complete module.

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The module must be a single, self-contained device, not requiring on-site assembly for installation and with its power supply packaged within the module enclosure and must be completely protected against dust and moisture intrusion as per NEMA Standard 250-1991 requirements, for Type 4 enclosures to protect all internal LED, electronic, and electrical components.

The LED signal module must be rated for use in the ambient operating temperature range of 40 °F to 165 °F.

The LED signal modules when operated at nominal voltage and 25 °C (77 °F) must provide a power factor of 0.90 or greater and a total harmonic distortion not to exceed 20 percent on modules with power consumption of 15 watts or greater, and 40 percent for modules with power consumption of less than 15 watts.

All electronic components must be adequately supported to withstand mechanical shock and vibration from high winds and other sources. Materials used for the module enclosure must be made of UL94VO flame retardant with the exception of the lens. The lens must have no scratches (abrasions), cracks, chips, discoloration, or other defects. Any such defects will be cause for rejection.

Each individual LED signal module must be identified for warranty purposes, nominal operating voltage, power consumption, volt-ampere, and a vertical indexing indicator for correct orientation.

The minimum luminous intensity throughout its useful life and at the end of the warranty period, must not be less than the values shown in Table 1 Section 4.1 of the latest edition of the ITE Specifications for LED traffic signal modules. When operating within the temperature range specified in Section 3.3.1 during the warranty period, the maximum luminous intensity must not exceed 800 candelas for the red.

The electrical, wiring, and terminal blocks must comply with Section 13.02 of the VTCSH standard. Fluctuations in line voltage over the range of 80VAC to 135VAC must not affect luminous intensity by more than ± 10 percent. The circuitry must prevent perceptible flicker and include voltage surge protection to withstand high repetition noise transients and low repetition high energy transients as stated in Section 2.1.6, NEMA Standard TS-2, 1992. A catastrophic failure of one LED light source must result in the loss of not more than 5 percent of the signal module light output. The module must be operationally compatible with NEMA (TS-1 or later) load switches. All LEDs must be of the AlInGap technology or approved equal in brightness and bulb life.

Manufacturers must replace or repair an LED module that fails to function as intended due to workmanship or Materials defects, or if it exhibits luminous intensity of less than the minimum values specified within the first 60 months from the date of installation.

Written Warranty: In addition to the Specifications of Section 1-05.10, the manufacturer must provide a written warranty against defects in materials and workmanship for the LED vehicle signal modules for a period of 60 months, and against loss of intensity below 50 percent of original values for a period of 36 months. This warranty must become effective after installation of the modules and acceptance by the Engineer.

9-32.1(1)E BACKPLATE

The signal, with backplate, must be designed to meet or exceed the load requirements per Section 2 of the 2013 edition of AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals. Back plates must be furnished and attached to each signal head assembly. Back plates must be louvered type to reduce wind loading, constructed of anodized, 3-S half hard aluminum sheet, 0.058 inches minimum thickness. The back plates must be attached with stainless steel hardware. Back plates must not interfere with either the operation of the door or the mounting of the signal. Mounting hole pattern must match pattern on signal head housing. The front and back of the back plates must be finished with 2 coats of flat black enamel.

Back plates must be permanently attached so as to provide a 5-inch border for either 8-inch or 12-inch signal heads. On combination heads (i.e. 12-inch and 8-inch sections) the back plate must have a 5-inch border relative to the 8-inch head. Therefore, the border on the 12-inch head must be approximately 3 inches.

Back plates must be provided with a minimum of 2 mounting holes per signal section, one on each side. The 2 top and 2 bottom backplate mounting holes must be a maximum distance of 1-1/4 inch from the corners of an 8-inch signal housing, and 2-1/2 inches from the corners of a 12-inch signal housing.

Backplates must have a 1-inch yellow, diamond grade retroreflective tape applied to the outside border.

9-32.1(2) BI MODAL VEHICLE SIGNALS SECTION

The signal section must display both yellow and green arrow indications from the same face and must use a fail-safe 2 lamp system to direct light of either color into a fiberoptic display. The section must be adaptable to conventional 12-inch vehicle signal heads.

9-32.1(3) DIRECTIONAL LOUVERS

Where shown on the Drawings, louvers must be furnished and installed in signal visors. Directional louvers must be constructed as to have a snug fit in the signal visor. The outside cylinder must be constructed of No. 22 U.S. gauge sheet steel, and the vanes must be constructed of No. 27 U.S. gauge sheet steel. Dimensions and arrangement of vanes must be as shown on the Drawings.

Louvers must be galvanized after fabrication by the hot dipped process in conformance with ASTM A 153 and painted flat black.

9-32.2 SIGNAL HEADS, PEDESTRIAN

9-32.2(1) GENERAL

Pedestrian signal heads must conform to the current version of Pedestrian Traffic Control Signal Indications published in the Equipment and Materials Standards of the Institute of Transportation Engineers (PTCSI), and in the applicable Sections of the current version of the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD), as modified and adopted by the Washington Department of Transportation (WSDOT); see Section 4E. Current versions are the versions in effect on the Day the Work was advertised for Bids by the Owner.

Pedestrian signal head must consist of a LED message module, case, eggcrate visor, and directional louvers.

The maximum overall dimension of the signal must be 19-1/2 inches wide, 19 inches high and 9 inches deep, not including eggcrate visor and hinges. In order to facilitate installation and maintenance, the signal must be designed so that all components are readily accessible from the front by merely opening the signal door.

Written Warranty: In addition to the Specifications of Section 1-05.10, the manufacturer must provide a written warranty against defects in materials and workmanship for the entire pedestrian signal including LED message module, and all Acrylonitrile Butadiene Styrene (ABS) or polycarbonate plastic parts for a period of 60 months from the date of delivery.

9-32.2(2) MESSAGE MODULE

LED Pedestrian Traffic Signal with Countdown Feature: The Pedestrian Signal Display must consist of a LED message module, case, eggcrate visor, and directional louvers; and must be in conformance with the PTCSI and MUTCD. The case, sun shield, and mounting hardware must be painted dark green in color. The eggcrate visor interior and directional louvers must be painted flat black in color.

Pedestrian signals must display international symbols (Portland Orange Hand and the Lunar White Walking Person) and numerical countdown (Portland Orange digit portion) LED's encased in a molded plug in plastic message module. The LED module must have a visual appearance of the display must be similar to that of an incandescent lamp (i.e. smooth and non-pixilated). The Hand and Walking Person symbols must be a minimum of 12 inches in height and 7 inches in width.

LED pedestrian and countdown signal module must be made of UL94 flame-retardant Materials. The lens is excluded from this requirement. The lens of the LED pedestrian and countdown signal module must be polycarbonate UV stabilized and the exterior of the lens must be uniform and frosted to reduce sun phantom effect.

All pedestrian and countdown signal display modules must be the LED type. Pedestrian and countdown LED traffic signal modules must be designed so they can be used as a retrofit replacement for optical units in Standard Plan 520 pedestrian signal housing and must not require special tools for installation. The installation of an LED pedestrian and countdown signal module must not require modification to the City of Seattle standard housings built to PTCSI standards.

The Walking Person, Hand icons, and countdown digits (16" x 18" module size) must be incandescent looking and fit within a traffic signal housing built to the Pedestrian Traffic Control Signal Indication (PTCSI) standards. The numbers 00 to 99 on the numerical display must be side by side, not offset, and must have a 7" x 9" high area for the countdown numerals.

LED pedestrian and countdown signal modules must be weather tight, fit securely in the housing and must connect directly to existing electrical wiring. Installation of a replacement LED module into the existing pedestrian housing must only require the removal of the existing optical unit components; including lens, lamp, gaskets, and reflector. Each LED pedestrian and countdown signal module must be a single, self-contained device, not requiring on-site assembly for installation into any City of Seattle standard pedestrian signal housing, and must include an insulated gasket. However, the power supply for the LED pedestrian signal module may be packaged as a separate module. The LED pedestrian and countdown signal modules must be operationally compatible with the traffic signal controllers and conflict monitors existing at the Project Site.

The LED pedestrian and countdown signal module must be rated for use in the ambient operating temperature range of -40 °F to 165 °F. Each LED pedestrian signal module must be protected against dust and moisture intrusion in compliance with MIL-STD-810F Procedure 1, Rain & Blowing Wind. The assembly, manufacturing, and mounting of the LED pedestrian signal module must be designed to assure all internal LED and electronic components are adequately supported to withstand mechanical shock and vibration from high winds and other live loading sources in compliance with MIL-STD-883 Test Method 2007.

LED pedestrian and countdown signal modules must operate at a maximum power consumption of 11 Watts for Hand, 8 watts for Walking Person and 6 watts for Countdown (Display 88). Each LED pedestrian and countdown signal module must operate from a 60 ± 3 Hz AC line over a range of 80VAC to 135VAC. Nominal operating voltage for all measurement must be 120 ± 3 volts rms. The LED circuitry must prevent flicker at less than 100 Hz over the specified voltage range. Fluctuations in the specified line voltage must not affect luminous intensity by more than ± 10 percent. The signal module on-board circuitry must include voltage surge protection to withstand high-repetition noise transients and low-repetition high-energy transients as stated in Section 2.1.6, NEMA Standard TS-2, 1992. The individual LED light sources must be wired so that catastrophic failure of one LED must not result in the loss of more than the light from that one LED. The LED pedestrian and countdown signal modules must provide a power factor of 0.90 or greater when operated at nominal voltage and at 77 °F. Total harmonic distortion induced into an AC power line by the LED pedestrian and countdown signal module must not exceed 20 percent when operated at nominal voltage and at 77 °F.

LED countdown modules must have two separate power supplies for power to the Walking Person and Hand icons. The circuitry must be unrelated to power the LED Walking Person and Hand icons in order to substantially eliminate the risk of displaying the wrong icon.

The manufacturer's Specifications for the LED module to be used, the warranties specified in this Section, a manufacturer's certificate of compliance indicating Specifications are met, and the Requirements Checklist by Manufacturer chart below, must be submitted to the Engineer for approval. Included in the submittal must be the manufacturer's recommendations for how the Contractor permanently marks the date of installation on the outside plate.

Requirements Checklist to be filled out by Manufacturer to demonstrate compliance:

Requirement	Comply
The LED module (16" x 18") must have a visual appearance similar to an incandescent lamp (i.e. Smooth and Non-Pixilated).	
The numbers 00-99 on the numerical display must be side by side, not offset, and must have a 7" x 9" high area for the countdown numerals.	
The display of seconds remaining must begin only at the beginning of the clearance interval. After zero, the display must remain dark until next countdown.	
Manufacturer must warrant the product with replacement or repair of a pedestrian signal including LED message module that fails due to workmanship or materials within 5 years from date of delivery.	
For a period of 5 years, the maintained minimum luminance values for the module must not be: 2,200 cd/SqM for Walking Person, and 1,400 cd/SqM for Hand and countdown displays.	
Default condition: for abnormal conditions when nominal voltage to the unit across the two phase wires (rather than being applied to the phase & neutral wires) the unit must default to the Hand display.	
The Maximum power consumption: 11 watts for Hand, 8 watts for Walking Person, and 6 watts for countdown (when display is "88").	
The units must not have any external attachments, dip switches, or options that will allow the mode to be changed from counting the clearance cycle to the full walk/don't walk cycle.	
Provide Model Number	

The manufacturer's name, trademark, operating characteristics (i.e. rated voltage, power consumption, and volt-ampere), and serial number must be permanently marked on the outside surface of the back of the LED pedestrian and countdown signal module including a permanently attached label or extra blank space that can be permanently marked with the date of installation of the module by the Contractor.

The LED pedestrian and countdown signal modules must be manufactured per a vendor quality assurance (QA) program including both design and production quality assurance. All QA process and test result documentation must be kept on file for a minimum of 5 years.

9-32.2(3) CASE

The case must consist of a housing and door each made from 1 piece, aluminum alloy die casting. It must be dustproof, weatherproof, and corrosion resistant and must provide for easy access to and replacement of all components. The housing must have an integral cast top, bottom, sides, and back. 4 integrally cast hinge lug pairs must be provided for operation of a swing down door.

The housing must be suitable for left or right hand (with pre drilled holes and rubber plugs) clamshell mounting hardware, post top mounting, or bracket mounting.

The top and bottom of the housing must have an opening to accommodate 1-1/2-inch pipe brackets. The bottom opening of the signal housing must have a standard 72 tooth locking boss integrally cast into the case. The teeth must be clean and sharp and provide full engagement. The radial angular grooves of the boss must provide positive positioning of the entire signal to eliminate rotation or misalignment of the signal.

The door must be attached to the case by means of 2 stainless steel spring pins. 2 stainless steel hinged bolts with captive stainless steel wingnuts and washers must be attached to the case with the use of stainless steel spring pins. Hence, latching or unlatching of the door must require no tools.

A 1/4-inch drain hole must be provided in the bottom of the case. All unused openings must be capped with corrosion resistant metal caps and weatherproofed with approved washers.

Clamshell mounting must be a two piece cast aluminum alloy assembly. One piece must be the pole half, the other piece the signal housing half. The clamshell assembly must have two integrally cast hinge lug pairs so, that when the clamshell is mounted in final position for pedestrian traffic, the clamshell must rotate horizontally to the open position for easy access to the control wiring inside the clamshell.

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9-32.2(4) EGGCRATE VISOR

Each signal must be provided with an eggcrate type visor designed to eliminate sun phantom.

The eggcrate type visor must be installed parallel to the face of the Hand Person message lens and must be held in place by stainless steel screws. The eggcrate assembly must consist of vertical members and horizontal members. The completed assembly must be approximately 1-1/2 inches deep.

The basic Material used in construction of the eggcrate must be nominally 0.030 inches thick polycarbonate plastic. Additional members may be employed outside the two legend areas but are not required unless needed to develop the full potential structural strength attainable through the particular assembly technique employed.

The assembly must be enclosed in a mounting frame constructed of 0.040 inches minimum thickness aluminum or polycarbonate plastic. This frame must be approximately 1-1/2 inches deep and may contain alternate mounting holes for use on alternate types of pedestrian signals.

9-32.3 PEDESTRIAN OR BICYCLE PUSHBUTTON ASSEMBLY

The complete pushbutton assembly must include these components:

1. The frame assembly must consist of an integral pushbutton mount and the sign platform. It must be cast aluminum and powder coat finished with the manufacturer's specified black color. The frame assembly must consist of a backplate to accept a 5" x 7" sign, or a sign sized as shown on the Drawings, secured with metal screws, and a round housing with predrilled holes to mount the pushbutton assembly.
2. The pushbutton housing must be die-cast aluminum, round body of approximately 3 inches diameter, and powder coat finished with the manufacturer's specified black color.
3. The pushbutton must be stainless steel, with a raised tactile directional arrow on the pushbutton. The manufacturer must provide arrow options of: Left, Right, Up, and bi-directional Left and Right.
4. The pushbutton assembly must include a Latching Mode with an LED indicator light that will stay ON and a percussive beeper for audible feedback. The LED and beeper must be actuated each time the pushbutton is pressed and must terminate at the beginning of the pedestrian walk phase or cyclist bike phase.
5. The central control unit must be shelf mounted and include all necessary, compatible components and cables to the traffic signal controller system. Contact the Traffic Signal Shop at (206) 386-1517 for compatibility approval. The central control unit must have a minimum of 12 feet of power connecting cable.
6. The sign must be an MUTCD R10-3 and size must be 5" x 7" or as shown on the Drawings.
7. When a sign larger than 5" x 7" is shown on the Drawings, the pushbutton assembly must be adjusted to accommodate the larger sign.
8. The mounting bracket and any extension bracket must be installed per the manufacturer's recommendations.

The complete pushbutton assembly must have the following characteristics:

a. Vandal resistant construction;
b. NEMA 250-6P or IP-68 enclosure protection rating;
c. NEMA TS-2 compliance for temperature and humidity, transient voltage protection, and mechanical shock and vibration rating;
d. IEC 61000-4-4 and IEC 61000-4-5 compliance for transient suppression;
e. A minimum call pulse length must be 240 milliseconds;
f. Constant call fail-safe; and
g. 2-year minimum warranty.

9-32.3(1) ACCESSIBLE PEDESTRIAN SIGNAL SYSTEM

An Accessible Pedestrian Signal (APS) system must be provided and installed at the intersection as specified as an APS system as shown on the Drawings. The APS System must consist of all components specified in Section 9-32.3 and include the following additional components and features:

1. Confirmation of button push via a latching sunlight visible red LED indication, audible tone, and vibrating indication;
2. The audible sound must be emitted from a weather proof and vandal resistant speaker within the pushbutton assembly. All sounds must automatically adjust for ambient noise;
3. The pushbutton assembly must include a product-manufactured sound baffle;
4. The pushbutton assembly must come programmed to emit a rapid tick. It must also have the capability to record custom voice messages and custom sounds during the walk or clearance interval or if the button is held for 3 seconds or more;
5. Standard and customized locating tone and message features;
6. In addition to the standard locate sounds, ability for custom locate sounds and location messages;
7. Capability for extended pushbutton press customized functions; and

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8. And all sounds are synchronized.

The complete APS system must have the characteristics as described in Section 9-32.3 with the addition of the following:

a. Volume Over Ambient Noise: adjustable up to a minimum of 10dB;

b. Locate Tone Volume: -24dB to + 6dB Ambient (must meet or exceed);

c. Maximum Volume: 100 dB@ 1m.

9-32.4 DETECTOR LOOPS

Detectors must be used for actuating traffic actuated controllers and sample stations. A complete detector loop installation must consist of loop wire and lead in cable from the loop to the amplifier. Loop wires and lead-in cables must be 600 volt rated.

Loop wire in concrete pavement must be either IMSA 51-3 or IMSA 51-7. Loop wire in asphalt pavement must be IMSA 51-7 with either PVC or polyethylene tube.

The lead in from the detector junction box to the controller cabinet or remote amplifier cabinet must be either 3 pair #16 AWG 7 x 24, or 6 pair #16 AWG 7 x 24 stranded tinned copper, polyvinyl chloride/nylon individual insulated, overall PVC jacketed, twisted pair cable with aluminum foil polyester shield. The 3 pair and the 6 pair lead in cables must have a #18 AWG stranded tinned copper drain wire. The conductors must be twisted together approximately 3 turns per foot. Connections of the loop wire to the lead in wire must be made only in a handhole with a waterproof splice as shown on the Drawings.

9-32.4(1) INDUCTIVE LOOP DETECTOR SEALANT

Polyurethane sealant must match roadway color, require no mixing, and totally encapsulate the detector conductors. Polyurethane sealant must also meet the following specifications:

Test	Specification Limits
Skin Time at 77 °F	2 hours maximum
Cure Time at 77 °F	48 hours maximum
Tensile Strength (ASTM D-142)	600 psi minimum
Elongation (ASTM D-412)	300% maximum
Linear Shrinkage (ASTM D-2566)	0%
Hardness Shore A (ASTM D-2240)	70 minimum

Hot-applied asphaltic sealant must be meet the following specifications when heated to in accordance with ASTM D5167:

Test	Specification Limit
Thermosel Viscosity at 400 °F (ASTM D-4402)	4000 cp maximum
Penetration, 125 °F, 50 g, 5 s (ASTM D5)	50 maximum
Penetration, 77 °F, 100 g, 5 s (ASTM D5)	10 - 25
Softening Point (ASTM D36)	210 °F minimum
Ductility, 77 °F (ASTM D113)	15 cm minimum

9-32.4(2) PERFORMED DETECTOR LOOP

Preformed detector loops are used for actuating traffic-actuated controllers and traffic counting applications. The complete loop-and-lead-in assembly must be suitable for applications in which the loop-and-lead-in assembly will be placed on compacted aggregate sub-base and overlaid with concrete.

The loop cable must be a four-conductor, double-jacketed cable with a nominal outer diameter of 0.360 inch. The individual conductors must be #18 AWG wire (formed from seven strands of #26 AWG copper wire) with a 0.020 inch thick layer of cross-linked polyethylene (XLPE) insulation. The inner jacket must be 0.040 inch thick cross-linked polyethylene (XLPE). The void between the conductors and the inner jacket must be spiral wrapped with a clear, moisture resistant binder tape and filled with an amorphous water-block compound. The outer jacket must be 0.035 inch thick cross-linked polyethylene (XLPE).

The lead-in cable must be a two-conductor, double-jacketed cable with a nominal outer diameter of 0.360 inch. The individual conductors must be #16 AWG wire (formed from nineteen strands of #28 AWG copper wire) with a 0.020 inch thick layer of cross-linked polyethylene (XLPE) insulation. The inner jacket must be 0.040 inch thick cross-linked polyethylene (XLPE). The void between the conductors and the inner jacket must be spiral wrapped with a clear, moisture resistant binder

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tape and filled with an amorphous water-block compound. The outer jacket must be 0.042 inch thick cross-linked polyethylene (XLPE).

The cross-linked polyethylene (XLPE) insulation used for wire insulation and cable jacketing must be capable of withstanding temperatures up to 426 °F. Splices between the individual loop cable conductors, and the splices between the loop cable conductors and the lead-in cable conductors must be soldered, sealed, and waterproofed. The enclosure that encapsulates the spliced connections must be fabricated from a high impact glass impregnated plastic with a minimum thickness of 0.240 inch. The two halves of the splice enclosure must be sealed with a water resistant gasket material. The interior cavity of the splice enclosure must be completely filled with an amorphous water block compound. The splice enclosure must be submerged in a saltwater solution for 3 days. At the end of this 3 day period, the electrical integrity of these splices must be verified by using a 500 Volt DC MegaOhm meter to ensure that the resistance between either lead-in conductor and the saltwater solution is 200 MegaOhms or greater.

9-32.5 TRAFFIC SIGNAL CAMERAS

9-32.5(1) FISH-EYE DETECTION CAMERA

The components of the Fish-Eye Detection Camera must meet the following requirements:

1. The camera enclosure must be waterproof and dust-tight to the latest (National Electrical Manufacturers Association) NEMA-4 specifications.
2. The camera must meet FCC class B requirements for electromagnetic interference emissions.
3. Vibration and shock resistance must meet the requirements of Sections 2.1.9 and 2.1.10, respectively, of NEMA TS 2
4. System components must comply with the environmental requirements detailed in the NEMA TS 2 standard.
5. The system must be designed to operate reliably in an operating temperature ranging from -34°C (-30° F) to +74°C (+165°F) degrees Celsius at 0 percent to 95 percent relative humidity, noncondensing.
6. The camera, mounting hardware, and any related material, when properly installed, must be able to withstand 150 mph wind speeds.
7. Detection system field hardware must meet the requirements listed in the Federal Communications Commission (FCC) 2005 Code of Federal Regulation (CFR) Title 47, Part 15 and must not interfere with any known equipment.
8. The camera must feature an additional warranty to require no aiming or focusing for a period of five (5) years, following successful installation and configuration. This excludes any changes required due to extraordinary impact or duress on the camera.

The VIVDS must consist of the following components:

a. Camera assembly(ies), machine vision processor (MVP), detection algorithms, application software, and all associated equipment required to setup and operate in a field environment including a field setup computer (if required), connectors and camera mounting hardware.

b. The VIVDS must use camera assembly(ies) to collect video image data for the MVP for purposes of detecting vehicle presence and generating traffic data.

9-32.6 EMERGENCY VEHICLE PREEMPTION

All emergency vehicle preemption detectors must be Opticom™, without substitution. All detector wiring must be Opticom™, Model 138, shielded detector cable, without substitution, and must comply with International Municipal Signal Association (IMSA) Specification 51-5.

9-32.6(1) OPTICOM DISCRIMINATORS

The Contractor must furnish and install Opticom™ Model 764 phase selector with Model 768 auxiliary interface panel, without substitution, in the control cabinets when called for on the Drawings.

9-32.7 INTERCONNECT CABLE

9-32.7(1) UNDERGROUND

Interconnect cable (UIC) must be #19 or #22 solid aerial/duct communication cable and must conform to REA Specification PE 39 or I.M.S.A. Specification No. 20-2. The number of pairs and size must be as shown on the Drawings.

9-32.7(2) AERIAL (FIGURE 8)

Interconnect cable (AIC) must be #19 or #22 solid figure 8 communication cable and must conform to REA Specification PE-38, or I.M.S.A. Specification no. 20-4. The number of pairs and size must be as shown on the Drawings.

9-32.7(3) INDOOR

Interconnect cable must be #19 or #22 multiple pair communications cable and conform to REA Specification PE 22, or I.M.S.A. Specification no. 20-2. The number of pairs and size must be as shown on the Drawings.

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9-32.8 SERVICE CABINET

The service cabinet must serve a 120/240 VAC (or 120/208 VAC for SCL Network area), 1 phase, 3 wire system. The service cabinet must be rated for 22K ampere interrupting capacity (AIC). The service cabinet must accommodate a ring-type socket with test/bypass blocks per ERC 308. The service cabinet service address and system labels must be permanently mounted phenolic labels with location of mounting, background and letter size per SCL Standards. The Contractor must coordinate with the SCL Electrical Service Representative to confirm correct labelling prior to installation.

The service cabinet must be constructed of .125-inch thick natural mill finish aluminum. The service cabinet must be rated NEMA 3R. The service cabinet must have separate sealable and lockable utility termination section, separate sealable and lockable metering section, and separate sealable and lockable customer section. Metering section must be a 180 degree hinged hooded section. The cabinet must be pad mounted per the standard plan. A separate mounting base must be cast into the concrete foundation pad and secured with four 5/8-11 x 18” anchor bolts.

The load center must have a main circuit breaker and a minimum of 9 blank breaker spaces. Additional breakers must be added per the Drawings. Signal, ITS, and auxiliary breakers must be attached to line 1 and lighting breakers must be attached to line 2. Compatible breakers must be specified by the service cabinet manufacturer. A documentation holder must be attached to the customer door with a circuit directory. Circuit labels must be provided using phenolic labels with white background and black lettering. Labels must be permanently adhered in load center. Tape and chemical adhesives must not be considered permanent. For traffic signal loads the label must be ascending beginning with SG1. For lighting loads the label must be ascending beginning with SL1. For ITS loads the label must be ascending beginning with ITS1. For auxiliary loads the label must be ascending beginning with AUX1.

9-32.9 SIGNAL WIRING

9-32.9(1) TRAFFIC SIGNAL CABLE

Signal Cable must have stranded #14 or #16 AWG copper conductors and must conform to IMSA Specification 20-1.

9-32.9(2) PEDESTRIAN PUSHBUTTON CABLE

Pedestrian pushbutton cable must be single pair #16 AWG 19 x 29 stranded copper, polyethylene insulated, PVC jacketed, twisted pair cable with copper or aluminum polyester shield and a No. 18 AWG stranded tinned copper drain wire. The conductors must be twisted together approximately 3 turns per foot.

9-32.9(3) ELECTRICAL SERVICE CONNECTIONS

For underground service conductors, THWN must be used. Conductors must be sized as shown on the Drawings. Color coding must be per industry standard for voltage.

For overhead service conductors, SCL Standard Material Specification 6007.50 must be used.

9-32.9(4) OVERCURRENT PROTECTION

Circuit breakers in service cabinets must comply with the specifications of the service cabinet manufacturer.

9-32.9(5) TERMINAL CABINETS

Junction boxes or terminal cabinets must conform to NEMA 3R requirements.

1. Junction boxes or terminal cabinets must be constructed of welded 14 gage (minimum) hot-dipped galvanized sheet steel, 14-gage, minimum type 316 stainless steel or 0.125 inch, minimum 5052 alloy aluminum H32 ASTM designator minimum.
2. Nominal Junction boxes or terminal cabinets dimensions must be:

Depth	Height	Width
8”	16”	12”

3. The doors must have two stainless steel piano hinges. The door must also be provided with a spring loaded construction core lock capable of accepting a Best 6-pin CX series core. The locking mechanism must provide a tapered bolt. The Contractor must supply construction cores with two master keys. The keys must be delivered to the Engineer.
4. All seams must be continuously welded.
5. Junction boxes or terminal cabinets must provide a gasketed door flange.
6. One spare 18-position terminal block must be installed.
7. Each Junction box or terminal cabinet must have 1/8-inch drain holes in back corners.

9-32.9(6) GROUND RODS, CLAMPS AND BONDING

See Section 9-31.5.

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9-32.9(7) SQUEEZE CABLE FITTINGS

Cable fittings for entry of cable through metal walls of poles, signs, and signals must be compression type cable fittings with water tight neoprene bushings. Size must be carefully chosen to match the cable diameter to assure a water tight fitting without damaging the cable.

9-32.10 SPAN WIRE

Span wire must be 5/16 inch, 7 strand aluminum covered steel span wire conforming to ASTM B 415 with rated breaking strength of 10,270 lbs. per SCL Material Standard No. 5664.1.

Catenary span wire must be 7/16 inch, 7 strand aluminum covered steel span wire conforming to ASTM B 415 with rated breaking strength of 20,800 lbs. per SCL Material Standard No. 5664.1.

9-32.11 POLE LINE HARDWARE

Strain insulators must be wet process, porcelain, conforming to EEI NEMA TDJ 54 as follows:

Size	Class
5/16 inch wire	Class 54-2
7/16 inch wire	Class 54-3

Tether wire must be 1/8-inch galvanized steel stranded wire conforming to ASTM A 475, extra high strength grade (rated at 1500 pounds minimum), Class A galvanized.

Bull rings (purse seine rings) must be low carbon steel with an ultimate strength of 25,000 pounds. The ring must be closed with a weld equal to or greater than 90 percent of the unwelded steel. The ring must be galvanized with at least 2 ounces of zinc per square foot, which is equivalent to 3 mils of thickness. The steel must be 3/4 inches in diameter and must form a ring with a 3-inch ID. Higher strength steel must be used when more than 4 signal heads are being supported.

All pole hardware, bolts, plate rods, hangers, clamps, wire guards, and pole bands must be hot dipped galvanized per ASTM A 153, or must be stainless steel.

All miscellaneous pole line hardware required to complete the project as planned must be standard Material manufactured for pole line construction.

Pole band assembly must consist of 4 band sections and must be 4-way adjustable mounting connection on 4 sides. Each band must have four 3/4-inch diameter all threaded studs and four 3/4-inch regular nuts per stud (total 16 nuts per assembly). Pole band assembly must have 20,000 pounds ultimate tensile strength. All parts of the pole band must be hot-dipped galvanized per ASTM A153. .

9-32.12 GALVANIZING REPAIR PAINT

Field repair of galvanized surfaces must be a coating of heated zinc alloy solder to a minimum thickness of 2 mils per ASTM A 780.

9-32.13 RAPID FLASHING BEACON

All materials furnished, assembled, fabricated, or installed as part of a rapid flashing beacon must be new, corrosion resistant and in strict accordance with the details shown on the Drawings and Specifications. All components must be procured and installed as recommended by the manufacturer. The rapid flashing beacon components must seamlessly integrate with the other rapid flashing beacon system equipment and materials shown in the Drawings. All other rapid flashing beacon system equipment must conform to the requirements of Section 9-31, Section 9-32, Section 9-33, and Section 9-34.

9-32.13(1) RAPID FLASHING BEACON OPERATIONAL REQUIREMENTS

The rapid flashing beacon must include the light bar, control cabinet, flash controller, universal switching power supply, pushbuttons, wireless communication components, all associated wiring and mounting equipment, and when specified in the Contract, solar panels.

The rapid flashing beacon must meet the following operating requirements:

1. Upon activation by the pedestrian pushbutton, the rapid flashing beacon system flash controller must activate all integral signal displays.
2. When activated, all indications associated with a given crosswalk must simultaneously commence operation within 0.12 seconds, and must cease operation at a predetermined time (programmable timeout) after any pedestrian actuation.
3. Must operate on 120 VAC power.
4. Individual components must be independently replaceable, equipped with approved terminal strips or wire end molded connectors. All individual components must be free from defects or damage and be fully functional per manufacturer specifications.

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5. The flashing pattern must be user-selectable in the field and the rapid flashing beacon system must be capable of providing, at a minimum, all of the following two-channel flashing patterns:
    a. NEMA Standard 50-50:
        1) Channel one is ON and channel two is OFF for 0.5 seconds.
        2) Channel one is OFF and channel two is ON for 0.5 seconds.
        3) (Cycle repeats; the total flashing pattern cycle length is 1.00 second.)
    b. WSDOT Interim Pattern:
        1) Channel one is ON and channel two is OFF for 0.25 seconds.
        2) Channel one is OFF and channel two is ON for 0.25 seconds.
        3) Channel one is ON and channel two is OFF for 0.25 seconds.
        4) Channel one is OFF and channel two is ON for 0.25 seconds.
        5) Channel one is ON and channel two is OFF for 1.00 seconds.
        6) Channel one is OFF and channel two is ON for 1.00 seconds.
        7) (Cycle repeats; the total flashing pattern cycle length is 3.00 seconds.)
    c. Rapid Flash Beacon “WW+S” Pattern:
        1) Channel one is ON and channel two is OFF for 0.05 seconds.
        2) Both channels are OFF for 0.05 seconds.
        3) Channel one is OFF and channel two is ON for 0.05 seconds.
        4) Both channels are OFF for 0.05 seconds.
        5) Channel one is ON and channel two is OFF for 0.05 seconds.
        6) Both channels are OFF for 0.05 seconds.
        7) Channel one is OFF and channel two is ON for 0.05 seconds.
        8) Both channels are OFF for 0.05 seconds.
        9) Both channels are ON for 0.05 seconds.
        10) Both channels are OFF for 0.05 seconds.
        11) Both channels are ON for 0.05 seconds.
        12) Both channels are OFF for 0.25 seconds.
        13) (Cycle repeats; the total flashing pattern cycle length is 0.80 seconds.)

9-32.13(2) LIGHT BAR

The light bar housing must be constructed of durable, corrosion-resistant powder-coated aluminum with stainless steel fasteners. Enclosed components must be modular in design whereby any component can be easily replaced using common hand tools in the field, without having to uninstall the housing. All mounting hardware required for mounting the light bar housing either singly or back to back must be provided and be universal.

The light intensity of the vehicle indications on the light bar must meet the minimum specifications of Society of Automotive Engineers (SAE) standard J595 dated November 2008. Manufacturer Certification of Compliance must be provided upon request. Each of the two vehicle LED indications must be approximately 7" wide x 3" high, each with eight amber LEDs.

The pedestrian LED indication, approximately 0.5" wide x 1.75" high, must be side-mounted in the light bar housing. The assembly must be mounted so it is directed toward, and visible to, pedestrians in the crosswalk. RRFB light bars placed in advance of a crosswalk do not require the pedestrian LED indicator.

Dimensions of the light bar must be approximately 23.56" wide x 3.76" high x 1.37" deep.

9-32.13(3) FLASH CONTROLLER

The flash controller must be housed within a within a NEMA 3R control cabinet along with the universal switching power supply and must:

1. Include integrated constant-current LED drivers with a minimum of two-channel output for driving one or two rapid flashing beacon systems.
2. Be capable of flashing signal display LEDs 70 to 80 flashes per minute
3. Have multiple programmable run function options, including:
    a. Run from Dusk to Dawn
    b. Run 24 hours per day, 7 days per week
    c. Run for a programmable time period when activated via switch, button contact closure or when triggered from an external sensor such as a wireless transmitter, radar, presence detector or loop detector with a compatible sensor output.

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d. Run on a timeclock schedule that is programmed to the controller and determines the days of the and times of the day that the sign flashes

4. Have multiple levels of signal display brightness through the LED drive current control
5. Have capability to automatically adjust the signal display LED drive current control to optimize brightness for the ambient lighting conditions.
6. Have signal display LED drive outputs reach the full output current as programmed within the duration of the 100ms on-time
7. Include an integrated Real Time Clock (RTC) with on-board battery back-up
8. Have the capability of RS232 communication for programming with Windows-based software
9. Include a minimum of two General Purpose Inputs and Outputs (GPIO)
10. Be internally housed in its own IP67 type enclosure
11. Be independently replaceable of other control panel components
12. Be able to monitor internal temperature
13. Operate between the temperatures of -40° to +176°F (-40° to +80°C)

9-32.13(4) CONTROL CABINET

The control cabinet must be NEMA 3R Type, 15” tall, 12.5” wide, 9.9” deep, and constructed of minimum 0.080” thick aluminum. The control cabinet must promote airflow for internal components, and the cabinet must be vented with screening included on all vents and drains to prevent insects and other foreign matter from entering.

The control cabinet must include at least two tamper-resistant stainless-steel hinges and replaceable #2 traffic lock with keys. The control panel to which all control circuit components either mount or connect must be removable to enable maintenance or repairs.

Control cabinet must mount using four 5/16” – 18 stainless steel mounting studs that mate to a range of bracket options. To ensure a secure mount to the supporting pole or post, two banded style brackets that fit poles with a 2-3/8” or larger diameter must be included as standard equipment. All materials used in the construction or mounting of the control cabinet must be included and either aluminum or stainless steel.

The control cabinet must include a UV resistant label applied to the exterior of the cabinet which describes the system specification information including model number, serial number, date of manufacture, and any applicable regulatory compliance information.

9-32.13(5) UNIVERSAL SWITCHING POWER SUPPLY

The universal switching power supply must have the following specifications:

1. Accept a universal AC input, full range, 50/60 hz
2. Output 12 VDC regulated to +/- 1%
3. Have Short Circuit, Overload and Over Voltage protection
4. Be convection cooled, DIN rail mount
5. Have an LED power ‘ON’ indicator
6. Be UL60950-1, TUV EN60950-1, Class I, Div. 2 Group A, B, C, D and Hazardous Locations T4 Approved
7. Operate in a relative humidity of 20 to 90% non-condensing
8. Operate from -4° to +158°F (-20° to +70°C)

9-32.13(6) SOLAR PANEL

Where shown on the Drawings, the rapid flashing beacon must include a solar panel. The solar panel must provide a minimum of 20 watts. Solar panel must contain a minimum 12 V 44 Ah Battery with a lifespan of 3 to 5 years, and be field replaceable.

Solar panel must be contained in a NEMA 3R type aluminum housing. Mounting hardware must be stainless steel, and must be capable of mounting to round poles from 2-3/8” to 4-1/12” OD and square posts from 1-3/4” to 2-1/2”, or other poles as shown on the Drawings.

9-32.13(7) WIRELESS COMMUNICATION COMPONENTS

The wireless communication components must:

1. Have a 900 MHz FHSS wireless transceiver
2. Seamlessly integrate with the flash controller to ensure sequential activation of other radio-equipped devices in the system
3. Include an integrated LCD and two user-interface buttons for setup and troubleshooting, including readouts of flash duration (timeout), battery conditions, and LED testing functionality
4. Include two LED indicators for status and troubleshooting

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5. Be capable of operating as a Parent (Gateway) or Child (Node or Repeater)
6. Be capable of providing site-survey data for verification of signal strength between network devices
7. Include network-wide modification of sign controller settings and output durations, using programmability from any networked transceiver without the use of additional equipment or software
8. Synchronize the system components to activate the indications within 0.12 seconds of one-another and remain synchronized throughout the duration of the flash (timeout) cycle.
9. Operate on the license-free ISM band
10. Comply with part 15 of FCC rules
11. Operate from 3.3VDC to 15VDC
12. Be replaceable independently of other components, in the event of a failure.

9-32.13(8) PUSHBUTTON

The pushbutton must operate as a normally open (n/o) circuit, operate at a temperature range of -30° to +165°F (-34° to +74°C), be programmed and compatible with the same manufacturer of the RRFB system, and be ADA complaint.

9-32.13(9) WARRANTY

The manufacturer must offer a 3-year limited battery warranty, 5-year limited system warranty, and 10-year limited solar panel warranty.

SECTION 9-33 POLES, PEDESTALS, AND FOUNDATIONS

9-33.1 GENERAL

9-33.1(1) POLES, MAST ARMS, AND BRACKET ARMS

All metal poles, mast arms, and bracket arms must be designed and fabricated per AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, 2013 edition (referred to as “AASHTO”), and EEI TDJ 135 and 139. All load requirements must be accommodated as shown on the Standard Plans and the Drawings.

Poles must be galvanized steel, timber, or aluminum as shown on the Drawings.

Poles not complying with the Drawings and Specifications will be rejected.

9-33.1(2) ANCHOR BOLTS

Anchor bolts for light poles (steel or aluminum) must conform to ASTM A 307 or ASTM A 576, unless otherwise specified in the Contract. Anchor bolts for steel strain and mast arm poles must be designed and fabricated per AASHTO and conform to ASTM F 1554, Grade 105, Class 2A including supplementary requirements S2, S3, and S4. Each anchor bolt must have a hexagonal leveling nut with a washer for leveling and a hexagonal nut with a flat washer and a lock washer for the top of the anchor base plate. All anchor bolts (full length), nuts and washers must be galvanized per ASTM A 153, AASHTO M232, or ASTM F 2329. Anchor bolts must not be bent or cut after fabrication. Bending of anchor bolts must be cause of rejection and removal of entire foundation.

Anchor bolt extenders (sleeve nuts), where required, must be of a strength greater than the existing anchor bolts. The bolt extenders must have a hexagonal tightening nut, and must be galvanized per ASTM A 153, AASHTO M232, or ASTM F 2329.

9-33.1(3) GALVANIZING

Before galvanizing, all sharp edges on welds and cut-ins inside the pole shaft, mast arm, and luminaire arms must be removed or filed smooth to prevent damage to the wires in the pole.

Structural Material must be zinc coated by hot dip process per ASTM A 123 and the final coating must measure 0.003 inches or more in thickness as determined by a magnetic thickness gauge. Hardware and appurtenances must be coated per ASTM A 153. Threads must be recut after galvanizing without exposing base metal. Galvanizing certification of compliance with the applicable ASTM Standards signed by an ASTM accredited independent testing laboratory must be submitted to the Engineer before shipment.

The finished pole must be straight and free from injurious defects. Poles distorted by the galvanizing process must be straightened without damage to the galvanizing coating. The finish coating must be smooth and free of dross. After galvanizing, the interior of the pole and arms must be free from sharp edges to prevent damage to wiring.

9-33.1(4) GROUND LUGS

Metal poles must have a 3/8-inch tapped hole in the bottom edge of the handhole inside the pole. A 3/8-inch stainless steel bolt with stainless steel lock washer suitable for grounding must be provided.

9-33.1(5) NUT COVERS

On light poles, the Contractor must furnish and install separate nut covers to cover anchor bolts and nuts only (not the base flange). Nut covers must fit snugly to the bolt. Nut covers must be made of the same Materials as the pole and must be

provided by the pole manufacturer. Nut covers are not required on steel strain or Chief Seattle base type poles unless specified on the Drawings.

9-33.1(6) CONCENTRICITY

Unless otherwise noted on the Drawings, poles, mast arms, and luminaire extensions must be within ± 1/16 inch of perfect round with a constant taper of approximately 0.14 inches per foot and of uniform thickness.

9-33.1(7) GROUT

Grout must be as specified in Section 9-04.3(2) for non-shrink cement sand grout.

9-33.2 STEEL POLES, MAST ARMS, BRACKET ARMS, AND LUMINAIRE EXTENSIONS

9-33.2(1) GENERAL

Poles must be inspected for Material compliance and acceptance by the Engineer prior to installation.

The term “steel strain pole” as used here refers to any steel pole subjected to a span wire load (including KCM trolley loads) or mast arm load. Luminaires or other street lighting appurtenances may be mounted on a steel strain pole. The term “steel lighting pole” refers to any steel pole which carries a luminaire but does not carry a span wire or mast arm load.

The length of the mast arm, height of pole, and size and type of bracket extension must be as shown on the Drawings. An aluminum or stainless steel pole identification plate must be securely attached immediately above the handhole, and must indicate gauge, manufacturer, bolt circle, design principle moment in kip feet, length, and date of manufacture.

Outside diameter of pole shafts must be as shown on the Standard Plans.

9-33.2(2) STRENGTH AND DEFLECTION REQUIREMENTS

The pole shaft must have strength sufficient to support all indicated loads.

The following design loads must be used: Dead load must consist of the weight of the signals, luminaires, and bracket arms, signs and supporting structure, and associated appurtenances; wind and ice loads must be as indicated by AASHTO. Mast arms must be of size and gauge as to resist the bending moment.

The design of steel strain poles that support overhead trolley loads must include trolley loads as shown on the Drawings.

Structural steel having a yield point of 33,000 psi or more must be used for all structural parts. Silicon content of the steel must be no more than 0.04 percent or 0.15 to 0.25 percent to prevent discoloration during galvanizing.

The total deflection at the top of metal poles must not exceed 2.5 percent of pole height.

The deflection of the mast arm after loading must not cause the end of the mast arm to extend below a horizontal line from the center of the arm flange. The maximum of the mast arm rise from a horizontal line must not be more than 0.35 inch per foot after moment load is applied.

The tenon for the luminaire must be between 1 and 4 degrees above horizontal with the luminaire installed and all other loads applied to the pole.

Pole designs for a specific loading scenario must increase pole wall thickness up to 1/2 inch and pole base plate up to 2 inches before increasing the pole footprint.

The use of an active, non-aerodynamic vibration damper system to effectively mitigate the vertical movement under fatigue loads is required. Effectiveness must be proven through an analytical model and approved by the Engineer prior to utilizing in a design. The device must be effective for a range of loading by incorporating a dampening system for large displacements and a second dampening system for small displacements. The multi-design system must be self-adapting and must not require structure-specific tuning. The device must provide an 85 percent or greater excitation reduction. An approved device may be utilized during the design process for the Galloping and Truck Gust design cases.

9-33.2(3) BOLT CIRCLE

Mast arm flange and pole base bolt circles must be as shown on the Standard Plans.

9-33.2(4) WELDS

Circumferential butt welds must have permanent back up rings and full penetration for 100 percent of the circumference. All exposed butt welds must be ground flush. All welds must be as specified in Section 6-03.3(25).

9-33.2(5) HANDHOLES, FESTOONS, AND CABLE OUTLETS ON POLES

Steel poles must have one oval 4” x 6-1/2” handhole, as shown in the Standard Plans, reinforced so as to result in no loss of shaft strength. The handhole must have matching cover attached with stainless steel bolts. The cover must be rain tight and removable. The handhole must be fabricated into the pole in a position 90 degrees clockwise from the side on which the bracket or mast arm is attached.

Festoon outlets, when required, must be as shown on the Standard Plans.

Cable outlets (on poles) as shown on Standard Plan 563b must be schedule 40 steel pipe extending perpendicularly from the pole. Both ends of the pipe must be rounded for wire protection. The cable outlet must be installed, drilled and edges rounded before galvanizing.

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9-33.2(6) ANCHOR BASE PLATES

A one piece steel anchor base plate must be secured to the lower end of the shaft by continuous electric arc welds as shown in the Standard Plans. The welded connection must develop the full strength of the adjacent shaft section.

9-33.2(7) POLE AND MAST ARM CAPS

All metal poles (except davit poles) and mast arms must be equipped with a rain tight pole cap constructed of the same Material as the pole, and attached with stainless steel bolts.

9-33.2(8) BRACKET ARMS

Bracket arms must be per SCL Material Standard 5705.1 or 5705.2 or manufactured as shown on the Standard Plans and per AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, 2013 edition, to support a luminaire of 50 pounds, a 1.2 square foot effective projected area for an 80 mph wind and a coefficient of height of 1.10.

Bracket arm hardware must include the bolts, nuts, and washers galvanized for wood and steel poles and stainless steel for aluminum pole types. Bracket arms must be the same style as depicted on the Drawings. Small differences in dimensions may be acceptable to the Engineer when structural calculations accompany these dimension differences shown on the Shop Drawings, as specified in Section 1-05.3(12).

Bracket arms must accommodate the luminaire slipfitter attachment. The terminal end of the arm must be a straight, tubular section with external dimensions of 2 inches NPS by 6-1/2 inches long.

Bracket arms mounted on metal poles must be constructed of the same Material as the poles. If the bracket arm and metal pole are of dissimilar metals, they must be separated by an approved plastic dielectric pad of 5 mils minimum thickness.

The longitudinal axis at the end of the bracket arm must be at least 1 degree and not more than 4 degrees above the horizontal with the luminaire installed under load as shown on Standard Plan 572.

All tubing used for aluminum bracket arm members must be seamless, Alloy 6063 heat treated to T 6 after fabrication. Aluminum bracket arms must be per ANSI C136.13.

9-33.3 ALUMINUM POLES

9-33.3(1) ROADWAY

Aluminum street light poles for cobra-head style fixtures must comply with SCL Material Standard 5750.03, except as modified here and in the Contract. Aluminum street light poles for pedestrian and decorative style fixtures must comply with SCL Material Standard 5752.05, 5754.07, and/or 5756.09, as appropriate.

Anchor bolts for aluminum poles must be the same as required for steel poles.

9-33.3(2) PEDESTRIAN ROUND

Round aluminum street light poles for post-top style fixtures must comply with SCL Material Standard 5752.05.

9-33.3(3) PEDESTRIAN SQUARE

Square aluminum street light poles for shoe-box style fixtures must comply with SCL Material Standard 5754.07.

9-33.3(4) DECORATIVE

Decorative aluminum street light poles for decorative post-top style fixtures must comply with SCL Material Standard 5756.09.

9-33.4 WOOD POLES

9-33.4(1) GENERAL

Strain poles must be either Douglas Fir, class 1, or Western Red Cedar, class 1.

Street light wood poles must be Western Red Cedar or Douglas Fir, Class 3 or greater.

Poles must be framed (notched) before treatment with a 1/2-inch deep by 2-inch high setting gain on the pole face, 12 feet from the pole butt.

Poles must be branded by burning the pole face, as specified by ANSI 05.1, 12’-6” above the pole butt. Metal marking tags will not be accepted.

Western Red Cedar poles must be butt treated per AWPA U1 and T1. After framing and roofing, the cuts must be well brushed with the hot preservative.

9-33.4(2) DOUGLAS FIR

Douglas fir wood poles must comply with SCL Material Standard 5082.00.

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9-33.4(3) WESTERN RED CEDAR

Western red cedar wood poles must comply with SCL Material Standard 5072.00.

9-33.5 STEEL PEDESTALS AND ALUMINUM PEDESTALS

9-33.5(1) STEEL PEDESTALS

Shafts must be constructed of welded structural steel, open hearth lap welded steel, or standard steel pipe per ASTM A 53. Shafts must be 4-inch schedule 40 galvanized steel pipe with threaded end for mounting to the base. The overall height of the shaft excluding the base must be as shown on the Drawings.

Pedestal base must be of cast iron per ASTM A 48, Class 40 and made in accordance to the configuration on the Standard Plans. Bases for pedestals must be threaded, square cast iron equipped with an access door for wiring. A 13-1/2-inch diameter bolt circle size must be used. The base must have a grounding lug inside which is accessible from the handhole. The base must be silver in color.

9-33.5(2) ALUMINUM PEDESTALS

Shafts must be 4-inch schedule 80 aluminum pipe with one threaded end for mounting to the base. A pole and base collar assembly must be installed to add strength and help prevent loosening of the aluminum pedestal connection. The overall height of the shaft excluding the base must be as shown on the Drawings.

Pedestal base must be of cast aluminum conforming to the configuration on the Standard Plans. Bases for pedestals must be threaded, square, aluminum and equipped with an aluminum access door for wiring. A 13-1/2-inch diameter bolt circle size must be used. The base must have a grounding lug inside which is accessible from the handhole. The base must be aluminum in color.

9-33.6 PEDESTRIAN PUSHBUTTON POSTS

Pedestrian pushbutton posts must be constructed of 2-inch I.D. schedule 40 galvanized steel pipe with length as shown on the Drawings. The post collar, pipe flange, bolts, nuts, and washers must conform to the details of the Drawings.

9-33.7 BACK GUY ASSEMBLIES AND GUY WIRE

Unless otherwise specified in the Contract, guy wire must be 5/16 inch, aluminum covered steel strand wire.

Guy assembly components including the dead end grips, the porcelain strain insulator, and the automatic feed thru dead end must be sized so as to meet or exceed the rated breaking strength of guy wire.

Anchors for back guys must consist of one of the following types:

1. A 4 way or 8 way steel expanding anchor, having a minimum of 300 square inches, made of pressed steel, coated with asphalt or similar preservative and fitted with 3/4 inch minimum guy eye anchor rod 8 feet long.
2. Plate anchor fitted with 3/4-inch minimum guy eye anchor rod 8 feet long.
3. An approved steel screw, such as a power installed steel helix anchor with extension rods, extension rod coupling, and strand eye nut. The steel screw must be sized based upon its load and soil conditions by the Engineer.

The following components must conform to the SCL Material Standards:

Component	SCL Material Standard
Guy Wire	5664.1
Guy Hook with Integral Spurs	5651.15
Dead End Grip	5651.4
Porcelain Strain Insulator	6901.1
Plastic Wire Guard	5651.8
Automatic Feed Through Dead End	5650.3
Plate Anchor	5622.17
Single Strand Eye Nut	5652.1
Sidewalk Pipe Guy Fittings	5650.1

The pipe brace must be galvanized extra strong steel pipe.

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SECTION 9-34 ELECTRICAL AND SIGNAL CONDUITS

9-34.1 GENERAL

Conduit must be PVC coated galvanized rigid steel, galvanized rigid steel, or schedule 80 PVC conforming to Articles 344 (rigid metal conduit) or 352 (rigid nonmetal conduit) of the NEC type and size as shown on the Drawings. All conduit, elbows, fittings, and accessories must be UL listed.

Factory bends and elbows must be utilized in all cases where they provide the required deflection.

Field bends, when required, must be performed so as to result in no flattening of conduit or damage to the galvanizing or PVC coating.

9-34.2 RIGID STEEL CONDUIT

9-34.2(1) GENERAL

Exterior and interior surfaces of all steel conduit, including threads, except field cut threads, must be uniformly and adequately zinc coated by a hot dip galvanizing process. The average weight of zinc coating must not be less than 0.80 ounces of zinc per square foot of single surface area as determined by tests on 12-inch samples taken from a standard length of conduit of each size. The weight of zinc coating on any individual test specimen must be not less than 0.7 ounces of zinc per square foot of single surface area. The weight of zinc coating will be determined per AASHTO T 65. Determinations and nominal weights must conform to the requirements of the Underwriters Laboratory Publication No. 6 (current edition). In addition, the exterior as well as the interior conduit samples must withstand 4 dips in the PREECE test per ASTM A 239.

Every length of rigid metal conduit must bear the label of Underwriters Laboratories, Inc., or the label of the Canadian Standards Association, if affected items of Canadian manufacture are approved for use on the project as specified in the Contract. Installation must conform to appropriate articles of the NEC.

Rigid steel conduit may be substituted where PVC is shown on the Drawings at the Contractor's option when approved by the Engineer at no additional expense to the Owner, except on pole risers.

Fittings for field and factory bends must be identical and interchangeable.

9-34.2(2) THREADS

The exposed thread ends of rigid steel conduit must be hot dipped galvanized. Field cut threads must be painted with galvanized repair paint approved by the Engineer.

9-34.2(3) COUPLINGS AND FITTINGS

Couplings and fittings for rigid steel type conduits must be hot dip galvanized, with the same quantities of zinc noted above. Couplings must withstand 4 dips in the PREECE test as specified above.

9-34.2(4) PVC COATING

All galvanized rigid steel conduit must be PVC (polyvinyl chloride) coated with dark gray, and U.V. resistant type plastic where shown on the Drawings.

The zinc surface prior to plastic coating must be conditioned with chromic acid to provide an anchor for the plastic coating.

Both interior and exterior must be coated with an epoxy acrylic primer not to exceed 0.0005 inches thick prior to the application of the PVC coating.

A PVC coating must be bonded to the outside of the pipe (excluding the threads) with a thickness between 0.035 inches and 0.045 inches. The PVC coating must be applied by the plastisol dip method and must contain ultraviolet inhibitors.

A urethane coating of a nominal 2 mil thickness must be applied to the interior of all conduits.

A coupling with the same PVC coating must be furnished loose with each length of conduit and must have a plastic sleeve extending 1 pipe diameter or 2 inches (whichever is less) beyond the end of the coupling. The inside diameter of the plastic sleeve must be the same as the outside diameter of uncoated pipe of the same nominal size. The wall thickness of the plastic sleeve must be the same as the plastic coating on the pipe. The bond between the metal and the PVC coating must be equal to or greater than the tensile strength of the PVC coating.

All conduit fittings which are hollow and serve as part of the raceway must be coated with the same coatings on the outside and inside as described above. The fittings must have PVC sleeves at all female openings similar to the sleeves on the couplings. The coated conduit must conform to NEMA Standard No. RNI 2005.

All coated conduit brackets, supports, clamps, NEMA 4 junction boxes, drains, breathers, expansion/deflection fittings, and seals must be PVC coated by the producer of the conduit. Field repair and touch up must be made with Materials approved by the Engineer.

9-34.2(5) EXPANSION/DEFLECTION FITTINGS IN NON HAZARD AREAS

Expansion/deflection fittings must be installed in all structural expansion joints. The expansion portion of the set must provide for 4 inches of movement, 2 inches in each direction, unless specified otherwise on the Drawings. The deflection

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portion of the set must provide for a movement of 3/4 inch in all directions, and an angular deflection of 30 degrees from normal in any direction. Fittings must be O.Z. Gedney Type AXDX or approved equal.

9-34.3 PVC CONDUIT

Plastic conduit and fittings must be rigid PVC Type EPC schedule 80.

PVC rigid nonmetallic conduit may be used for all installations except from the handhole to the pole and the first 10 feet above ground on a pole riser and the adjacent bend, unless specified otherwise in the Contract.

Rigid PVC must be per ASTM D 1785 and ASTM D 2466. The conduit must be suitable for use above ground, for direct burial, and for corrosive atmosphere areas.

Rigid PVC must comply with SCL Material Standard 7020.05.

9-34.4 CONDUIT RISER

Refer to Section 8-33.3(3).

9-34.5 PULL CORD

Pull cords must be 1/4-inch polypropylene complying with SCL Material Standard 7272.2.

9-34.6 HANDHOLES

Handholes must comply with SCL Material Standard 7203.10.

Installation of polymer concrete handholes must be approved by the Engineer and must comply with SCL Material Standard 7203.20.

The letters “SDOT” must be cast or otherwise permanently affixed to all SDOT handhole covers and must be easily readable. Lettering must be fixed in such a manner as to avoid being a tripping hazard or causing any damage to the integrity of the handhole cover.

SECTION 9-35 ELASTOMERIC BEARING PADS

Elastomeric bearing pads must be per AASHTO M 251. The elastomer must not contain any form of wax.

All bearing pads must be individually cast with fully molded edges. Corners and edges of molded pads may be rounded at the option of the Contractor. Radius at corners must not exceed 3/8 inch, and radius of edges must not exceed 1/8 inch.

Shims contained in laminated bearing pads must be mill rolled steel sheets not less than 20 gage in thickness with a minimum cover of elastomer on all edges of:

1. 1/8 inch for pads up to 3 inches thick
2. 1/4 inch for pads over 3 inches thick, and
3. 1/2 inch for pads greater than 7 inches thick.

Steel shims must conform to ASTM A 1011, Grade 36, unless otherwise noted.

The shims must be spaced to divide the pad thickness into equal laminations. The bond between the elastomer and metal shims must be such that, when a sample is tested for separation, failure must occur within the elastomer and not between the elastomer and the metal shim.

The shear modulus at 73 ºF or the durometer hardness of the bearing pads must be as noted in the Contract. If durometer hardness is noted, the following shear modulus must be applicable for shear modulus testing purposes: 50 durometer - 112 psi, 60 durometer-165psi, 70 durometer - 250psi. Elastomer must be Grade 3 minimum.

Elastomeric bearing pads must be manufactured with the following tolerances:

Overall Vertical Dimensions:	
Design thickness 1 1/4” or less	-0, + 1/8”
Design thickness over 1 1/4”	-0, + 1/4”
Overall Horizontal Dimensions:	
36” and less	-0, + 1/4”
Over 36”	-0, + 1/2”

SECTION 9-36 DETECTABLE WARNING

9-36.1 GENERAL

The detectable warning plate (cast in place with curb ramp or surface) and the detectable warning plate retrofit (surface applied to existing curb ramp or surface) must comply with the requirements for tactile warning surfaces established by the ADA (Americans with Disability Act) Accessibility Guidelines (ADAAG).

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Detectable warnings must consist of a surface of truncated domes and must comply with the following:

1. Dome Size: Truncated domes in a detectable warning surface must have a base diameter of 0.9 inches (23 mm) minimum and 1.4 inches (36 mm) maximum, a top diameter of 50 percent of the base diameter minimum to 65 percent of the base diameter maximum, and a height of 0.2 inches (5.1 mm).
2. Dome Spacing: Truncated domes in a detectable warning surface must have a center-to-center spacing of 1.6 inches (41 mm) minimum and 2.4 inches (61 mm) maximum, and a base-to-base spacing of 0.65 inches (17 mm) minimum, measured between the most adjacent domes on a square grid.

See Standard Plan 422k for truncated domes detail.

Unless the Contract specifies otherwise, the detectable warning must extend the full width of the curb ramp (exclusive of flared sides) and must extend either the full depth of the curb ramp or 24 inches (610 mm) deep minimum measured from the back of the curb on the ramp surface. The truncated dome pattern must be perpendicular to the long axis of the ramp.

The detectable warning plate must comply with the following:

a. Federal Safety Yellow (Federal Standard 595 Color FS 33538) in color;
b. ASTM Compressive strength of 10,000 psi unless otherwise approved;
c. Resistant to breakage, fading, permanent deformation, and loss due to abrasion;
d. Durable, high impact resistant, and possess thermal and moisture stability; and,
e. Approval by the Engineer.

9-36.2 DETECTABLE WARNING PLATE – CAST-IN-PLACE

Cast-in-place Materials must be wet set, replaceable tiles listed in WSDOT's Qualified Products List (QPL).

For products not on the QPL, the Contractor must provide the Engineer with a submittal on the alternate Material as specified in section 9-36.4 and 8-14.3(7).

9-36.3 DETECTABLE WARNING PLATE RETROFIT – SURFACE APPLIED

The warning pattern must be capable of being bonded to an existing cement concrete surface. The surface of the warning pattern, excluding the domes, must not be more than 3/8 inch above the surface of the concrete after installation.

Acceptable surface applied Materials are:

1. Surface Applied Systems by Armor-TileTM Tactile Systems. A Seattle Supplier is White Cap Construction Supply; (http://www.armor-tile.com);
2. Surface-Mount / Retrofit Detectable Warning Tiles by ADA Solutions, (http://www.adatile.com);
3. TopMark® as manufactured by Flint Trading, Inc: (http://www.flinttrading.com); or,
4. An approved equal; for products other than named above, the Contractor must provide the Engineer with a submittal on the alternate Material as specified in Section 9-36.4. See Section 8-14.3(7).

9-36.4 "APPROVED EQUAL" REQUIREMENTS

Should the Contractor propose an "or equal" Material to those Materials named in Sections 9-36.2 and 9-36.3, the Contractor must make the following submittal to the Engineer for approval at least 5 Working Days in advance as specified in Section 1-05.3:

1. All information required in Section 8-14.3(7);
2. 2 rectangular or square samples of the "or equal" material with minimum 6" x 6" dimensions; color acceptance will be based on Engineer comparison to Federal Safety Yellow comparison chip (SPU Lab).
3. For the detectable warning retrofit plate, include information on the bonding material and its performance.
4. Documentation of the testing laboratory accreditation by a testing standards organization recognized by ASTM, the National Cooperation for Laboratory Association (NACLA) or approved by the Engineer.
5. At least 5 hard copies of the installation instruction or manual.

9-36.5 TACTILE DIRECTIONAL INDICATOR – CAST-IN-PLACE

The tactile directional indicator must be cast-in-place material and match the dimensions shown in the Drawings and Standard Plan 422i. The tactile directional indicator must be Federal Safety Yellow, non-slip surface and be installed per manufacturer's recommendations. Contractor must provide the Engineer with a submittal of manufacturer's details for review.

9-36.6 TACTILE DIRECTIONAL INDICATOR – SURFACE APPLIED

The tactile directional indicator must be capable of being bonded to an existing cement concrete and asphalt surface. The surface of the tactile directional indicator, including the tactile bumps, must not be more than 3/8 inch above the finished grade after installation.

The tactile directional indicator must be all-season methyl methacrylate (MMA) and match the dimensions shown on the Drawings or as shown in the Standard Plans. The MMA must be retro-reflective, durable, color stable, non-slip surface meeting the material requirements of Section 9-29.3(4) and be installed per manufacturer's recommendations.

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Material properties: Methyl methacrylate mixed with quartz aggregate for increased skid resistance. The finished tactile directional indicator must meet the following:

Property	Requirement	Standard
Skid	>60	ASTM E274
Hardness	50 – 60	ASTM D2240
Solids	99%	ASTM D1644

Federal Yellow MIMA Resin:

Property	Requirement	Standard
Tensile	>2000 psi	ASTM D638
Elongation	>70%	ASTM D638
Flash Point	>IOC	ASTM D1310
Density	12.86 lbs/gal	

Aggregate:

Dry Bulk Density (g/cm^3)	Porosity	Saturated Hydraulic Conductivity (Ks, cm/s)	D_{10} (mm)	D_{50} (mm)	D_{60} (mm)	Uniformity Coefficient
1.60	0.397	0.55	0.62	0.88	0.90	1.5

The tactile directional indicator material formulation must be as follows:

1. 2 gallons of Federal Yellow MMA resin
2. 25 lbs hard-wearing aggregate
3. Catalyst as recommended by manufacturer for ambient and road temperature

Material must be installed as specified with manufacturer's certification. Contractor must have installation certification approved prior to installation.

SECTION 9-37 CONSTRUCTION GEOTEXTILES

9-37.1 GEOTEXTILE AND THREAD FOR SEWING

The material must be a geotextile consisting only of long chain polymeric fibers or yarns formed into a stable network such that the fibers or yarns maintain their position relative to each other during handling, placement, and design service life. At least 95 percent by weight of the material must be polyolefins or polyesters. The material must be free from defects or tears. The geotextile must also be free of any treatment or coating which might adversely change its hydraulic or physical properties after installation. The geotextile must conform to the properties as per Tables 1 through 6 for each use specified in the Contract. Specifically, the geotextile uses included in this Section and their associated tables of properties are as follows:

Geotextile Application	Applicable Property Tables
Underground Drainage, Low Survivability, Classes A, B, and C	Tables 1 and 2
Underground Drainage, Moderate Survivability, Classes A, B, and C	Tables 1 and 2
Separation	Table 3
Soil Stabilization	Table 3
Permanent Erosion Control, Moderate Survivability, Classes A, B, and C	Tables 4 and 5
Permanent Erosion Control, High Survivability, Classes A, B, and C	Tables 4 and 5
Ditch Lining	Table 4
Temporary Silt Fence	Table 6

Thread used for sewing must consist of high strength polypropylene, polyester, or polyamide. Nylon threads will not be allowed. The thread used to sew permanent erosion control geotextiles must be resistant to ultraviolet radiation. The thread must be of contrasting color to that of the geotextile itself.

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9-37.2 GEOTEXTILE PROPERTIES

Table 1. Geotextile for Underground Drainage Strength Properties for Survivability

		Geotextile Property Requirements[1]	
Geotextile Property	**Test Method[2]**	**Low Survivability Woven/Nonwoven**	**Geotextile Property Woven/Nonwoven**
Grab Tensile Strength, min. in machine and x machine direction	ASTM D 4632	180 lbs / 115 lbs min.,	250 lbs / 160 lbs min
Grab Failure Strain, in machine and x machine direction	ASTM D 4632	<50% / ≥50%	<50% / ≥50%
Seam Breaking Strength	ASTM D 4632[3]	160 lbs / 100 lbs min.	220 lbs / 140 lbs min.
Puncture Resistance	ASTM D 6241	370 lbs / 220 lbs min.	495 lbs / 310 lbs min.
Tear Strength, min. in machine and x machine direction	ASTM D 4533	67 lbs / 40 lbs min	80 lbs / 50 lbs min.
Ultraviolet (UV) Radiation stability	ASTM D 4355	50% strength retained min., after 500 hrs in weatherometer	50% strength retained min., after 500 hrs in weatherometer

See Notes after Table 6, this Specification.

Table 2. Geotextile for Underground Drainage Filtration Properties

		Geotextile Property Requirements[1]		
Geotextile Property	**Test Method[2]**	**Class A**	**Class B**	**Class C**
AOS	ASTM D 4751	No. 40 max	No. 60 max	No. 80 max
Water Permittivity	ASTM D 4491	.5 sec^{-1} min.	.4 sec^{-1} min.	.3 sec^{-1} min.

See Notes after Table 6, this Specification.

Table 3. Geotextile for Separation or Soil Stabilization

		Geotextile Property Requirements[1]	
Geotextile Property	**Test Method[2]**	**Separation Woven/Nonwoven**	**Soil Stabilization Woven/Nonwoven**
AOS	ASTM D 4751	No. 30 max	No. 40 max
Water Permittivity	ASTM D 4491	0.02 sec^{-1} min.	0.10 sec^{-1} min.
Grab Tensile Strength, min. in machine and x machine direction	ASTM D 4632	250 lbs / 160 lbs min.	315 lbs / 200 lbs min.
Grab Failure Strain, in machine and x machine direction	ASTM D 4632	<50% / 50%	<50% / 50%
Seam Breaking Strength	ASTM D 4632[2]	220 lbs / 140 lbs min.	270 lbs / 180 lbs min.
Puncture Resistance	ASTM D 6241	495 lbs / 310 lbs min.	620 lbs / 430 lbs min.
Tear Strength, min. in machine and x machine direction	ASTM D 4533	80 lbs / 50 lbs min.	112 lbs / 79 lbs min.
Ultraviolet (UV) Radiation stability	ASTM D 4355	50% strength retained min., after 500 hrs in weatherometer	50% strength retained min., after 500 hrs in weatherometer

See Notes after Table 6, this Specification.

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Table 4. Geotextile for Permanent Erosion Control and Ditch Lining

		Geotextile Property Requirements[1]		
		Permanent Erosion Control		Ditch Lining
Geotextile Property	**Test Method[2]**	**Moderate Survivability Woven / Nonwoven**	**High Survivability Woven/Nonwoven**	**Woven/Nonwoven**
AOS	ASTM D 4751	See Table 5	See Table 5	.60 mm max (No. 30 sieve)
Water Permittivity	ASTM D 4491	See Table 5	See Table 5	.02 sec^{-1} min.
Grab Tensile Strength, min. in machine and x machine direction	ASTM D 4632	250 lbs / 160 lbs min	315 lbs / 200lbs min.	250 lbs / 160 lbs min.
Grab Failure Strain, in machine and x machine direction	ASTM D 4632	15% 50% / > 50%	15% 50% / > 50%	<50% / ≥ 50%
Seam Breaking Strength	ASTM D 4632[3]	220 lbs / 140 lbs min.	270 lbs / 180 lbs min.	220 lbs / 140 lbs min.
Puncture Resistance	ASTM D 6241	495 lbs / 310 lbs min.	620 lbs / 430 lbs min.	495 lbs / 310 lbs min.
Tear Strength, min. in machine and x machine direction	ASTM D 4533	80 lbs / 50 lbs min.	112 lbs / 79 lbs min.	80 lbs / 50 lbs min.
Ultraviolet (UV) Radiation stability	ASTM D 4355	70% strength retained min., after 500 hrs in weatherometer	70% strength retained min., after 500 hrs in weatherometer	70% strength retained min., after 500 hrs in weatherometer

See Notes after Table 6, this Specification.

Table 5. Filtration Properties for Geotextile for Permanent Erosion Control

		Geotextile Property Requirements[1]		
Geotextile Property	**Test Method[2]**	**Class A**	**Class B**	**Class C**
AOS	ASTM D 4751	No. 40 max	No. 60 max	No. 70 max
Water Permittivity	ASTM D 4491	0.7 sec^{-1} min.	0.4 sec^{-1} min.	0.2 sec^{-1} min.

See Notes after Table 6, this Specification.

Table 6. Geotextile for Temporary Silt Fence

		Geotextile Property Requirements[1]	
Geotextile Property	**Test Method[2]**	**Unsupported Between Posts**	**Supported Between Posts with Wire or Polymeric Mesh**
AOS	ASTM D 4751	No. 30 max for silt woven, No. 50 max for all other geotextile types, No. 100 min	No. 30 max for silt woven, No. 50 max for all other geotextile types, No. 100 min
Water Permittivity	ASTM D 4491	.02 sec^{-1} min.	.02 sec^{-1} min.
Grab Tensile Strength, min. in machine and x machine direction	ASTM D 4632	180 lbs min. in machine direction, 100 lbs min. in x machine direction	100 lbs Min
Grab Failure Strain, in machine and x machine direction	ASTM D 4632	30% max. at 180 lbs or more	--

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		Geotextile Property Requirements[1]	
Geotextile Property	**Test Method[2]**	**Unsupported Between Posts**	**Supported Between Posts with Wire or Polymeric Mesh**
Ultraviolet (UV) Radiation Stability	ASTM D 4355	70% Strength retained min., after 500 hrs in xenon arc device	70% Strength retained min., after 500 hrs in xenon arc device

NOTES:

1. All geotextile properties in Tables 1 through 6 are minimum average roll values (i.e. the test result for any sampled roll in a lot must meet or exceed the values shown in the table).
2. The test procedures used are essentially in conformance with the most recently approved ASTM geotextile test procedures, except for geotextile sampling and specimen conditioning, which are per WSDOT Test Methods 914 and 915, respectively.
3. With seam located in the center of 8-inch long specimen oriented parallel to grip faces.

9-37.3 AGGREGATE CUSHION FOR PERMANENT EROSION CONTROL GEOTEXTILE

Aggregate cushion for permanent erosion control geotextile, Class A must be as specified in Section 9-03.7(2). Aggregate cushion for permanent erosion control geotextile, Class B or Class C, must be as specified in Sections 9-03.7(3) and 9-03.7(2).

9-37.4 GEOTEXTILE APPROVAL AND ACCEPTANCE

9-37.4(1) SOURCE APPROVAL

For each geotextile application, the Contractor must submit to the Engineer for approval, the manufacturer's name, address, the geotextile full product name, and the geotextile Structure including fiber/yarn type.

If the geotextile source has not been previously evaluated, a sample of each proposed geotextile must be submitted to the Engineer for evaluation. After the sample and required information for each geotextile type has been received by the Engineer, a maximum of 14 Calendar Days will be required for this testing. Source approval will be based on conformance to the applicable values from Tables 1 through 6 in Section 9-37.2.

Source approval is not the basis of acceptance of specific lots of Material unless the lot sampled can be clearly identified and the number of samples tested and approved per WSDOT Test Method 914.

9-37.4(2) GEOTEXTILE SAMPLES FOR SOURCE APPROVAL AND ENGINEER TESTING

Each sample must have minimum dimensions of 5 feet by the full roll width and must be a minimum 6 square yards. The machine direction must be marked clearly on each sample and is defined as the direction perpendicular to the axis of the geotextile roll. Source approval for temporary silt fences will be by manufacturer's certificate of compliance, as specified in Section 1-06.3.

Samples must be cut from the geotextile roll by a suitable method that produces a smooth geotextile edge without edge ripping or tearing. The samples must not be taken from the outer wrap of the roll nor the inner wrap of the core.

9-37.4(3) ACCEPTANCE SAMPLES

Samples will be taken by the Engineer at the Project Site to confirm the geotextile complies with Specifications.

Approval will be based on testing of samples from each lot. A "lot" must be defined for the purposes of this Specification as all geotextile rolls within the consignment (i.e. all rolls sent to the Project Site) which were produced by the same manufacturer during a continuous period of production at the same manufacturing facility and have the same product name. After receipt of the samples by the Engineer, a maximum of 14 Calendar Days will be required for testing. If the results of the testing show that a geotextile lot, as defined, does not meet the properties required for the specified use as per Tables 1 through 6 in Section 9-37.2, the roll or rolls which were sampled will be rejected. Two additional rolls for each roll found defective from the lot tested will then be sampled at random by the Engineer for retesting. If retesting shows any of the additional rolls tested do not meet the required properties, the entire lot will be rejected. If the test results from all the rolls retested meet the required properties, the entire lot minus the roll which failed will be accepted. All geotextile with defects, deterioration, or damage will be rejected and must be replaced at no expense to the Owner.

9-37.4(4) ACCEPTANCE BY CERTIFICATE OF COMPLIANCE

When the quantities of geotextile proposed for use in each geotextile application are less than or equal to the following amounts, acceptance must be by manufacturer's certificate of compliance:

Application	Geotextile Quantity
Underground Drainage	600 sq. yards

Application	Geotextile Quantity
Soil Stabilization and Separation	1,800 sq. yards
Permanent Erosion Control	1,200 sq. yards
Temporary Silt Fence	All quantities

The manufacturer's certificate of compliance must include the manufacturer's name, current address, full product name, geotextile Structure including fiber/yarn type, geotextile roll number, proposed use, and certified test results.

9-37.4(5) APPROVAL OF SEAMS

If the geotextile seams are to be sewn in the field, the Contractor must provide a section of sewn seam which can be sampled by the Engineer before the geotextile is installed.

The seam sewn for sampling must be sewn using the same equipment and procedures as are to be used to sew the production seams. If production seams are to be sewn in both the machine and cross machine directions, the Contractor must provide sewn seams for sampling which are oriented in both the machine and cross machine directions. The seams sewn for sampling must be at least 2 yards in length in each geotextile direction. If the seams are sewn in the factory, the Engineer will obtain samples of the factory seam at random from any of the rolls to be used. The seam assembly description must be submitted by the Contractor to the Engineer and are to be included with the seam sample obtained for testing. This description must include the seam type, stitch type, sewing thread type, and stitch density.

SECTION 9-38 TEMPORARY TRAFFIC CONTROL MATERIALS

9-38.0 GENERAL REQUIREMENTS

Temporary traffic control materials in this Section consist of various traffic communication, channelization and protection items described in Section 1-10 and listed below:

1. Stop/Slow Paddles
2. Construction Signs
3. Wood Sign Posts
4. Sequential Arrow Signs
5. Portable Changeable Message Signs
6. Barricades
7. Traffic Safety Drums
8. Traffic Cones
9. Tubular Markers
10. Warning Lights and Flashers
11. Truck-Mounted Attenuator
12. Portable Temporary Traffic Control Signal
13. Tall Channelizing Devices

The Contractor's TCM and TSC must be responsible for assuring temporary traffic control devices and materials comply with these Specifications. Certification for crashworthiness according to NCHRP 350 will be required as described in Section 1-10.2(5)B.

MUTCD, as used in this Section, refers to the latest WSDOT-adopted edition of the Manual on Uniform Traffic Control Devices for Streets and Highways. The RCW 47.36, Traffic Control Devices, requires traffic control devices along city streets to conform to the WSDOT adopted standards to the extent possible. In the event of conflicts between the MUTCD, and the Contract Documents, then the Contract Documents must govern.

9-38.1 STOP/SLOW PADDLES

Paddles must conform to the MUTCD, except that the minimum width must be 24 inches.

9-38.2 CONSTRUCTION SIGNS

Construction signs must conform to the MUTCD and must be per NCHRP Report 350 for Category 2 devices. Any sign/sign stand combination that satisfies these requirements will be acceptable. Post mounted Class A construction signs must be as specified in Section 9-38.2 and additionally must be as specified in Section 9-28.

All Class A and Class B signs must utilize materials and be fabricated as specified in Section 9-28. All regulatory signs having a red background (such as Stop and Yield) and all other regulatory information signs (for example Speed Limit or Traffic Fines Double in Work Zones) must have Type III or IV sheeting in urban areas. All signs having a green background (such as Exit arrow) must have Type II sheeting for the background and Type III or IV sheeting for the letters, border, and symbols.

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9-38.3 WOOD SIGN POSTS

Post sizes for construction signs must be as follows:

One Post Installation

Post Size	Min. Sign sf	Max. Sign sf
4 x 4	--	16
4 x 6	17	20
6 x 6	21	25
6 x 8	26	31

Two Post Installation

Post Size	Min. Sign Sq. Ft.	Max. Sign Sq. Ft.
4 x 4	-	16
4 x 6	17	36
6 x 6	37	46
6 x 8	47	75[1]

NOTE:

1. The Engineer must determine post size for permanent signs greater than 75 square feet.

Sign posts must conform to the grades and usage listed below. Grades must be determined by the current standards of the West Coast Lumber Inspection Bureau (WCLIB) or the Western Wood Products Association (WWPA).

Post Size	Grade
4 x 4	Construction grade (Light Framing, Section 122-b WCLIB) or (Section 40.11 WWPA)
4 x 6	No. 1 and better, grade (Structural Joists and Planks, Section 123-b WCLIB) or (Section 62.11 WWPA)
6 x 6, 6 x 8, 8 x 10	No. 1 and better, grade (Posts and Timbers, Section 131-b WCLIB) or (Section 80.11 WWPA)
6 x 10, 6 x 12	No. 1 and better, grade (Beams and Stringers, Section 130-b WCLIB) or (Section 70.11 WWPA)

9-38.4 SEQUENTIAL ARROW SIGNS

Sequential Arrow Signs must conform to the MUTCD supplemented with the following:

1. Sequential arrow signs furnished for stationary lane closures on this project must be Type C.
2. The color of the light emitted must be yellow.
3. The dimming feature must be automatic, reacting to changes in light without a requirement for manual adjustment.

9-38.5 PORTABLE CHANGEABLE MESSAGE SIGNS

Portable Changeable Message Signs (PCMS) must conform to the MUTCD.

The PCMS must employ one of the following technologies:

1. Fiber optic/shutter
2. Light emitting diode
3. Light emitting diode/shutter
4. Flip disk

Regardless of the technology, the PCMS must comply with the following general requirements:

a. Be light emitting and must not rely solely on reflected light. The emitted light must be generated using fiber optic or LED technology.

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b. Have a display consisting of individually controlled pixels no larger than 2-1/2" x 2-1/2". If the display is composed of individual character modules, the space between modules must be minimized so alphanumeric characters of any size specified below can be displayed at any location within the matrix.

c. When activated, the pixels must display a yellow or orange image. When not activated, the pixels must display a flat black image that matches the background of the sign face.

d. Be capable of displaying alphanumeric characters that are a minimum of 18 inches in height. The width of alphanumeric characters must be appropriate for the font. The PCMS must be capable of displaying 3 lines of 8 characters per line with a minimum of one pixel separation between each line.

e. The PCMS message, using 18-inch characters, must be legible by a person with 20/20 corrected vision from a distance of not less than 800 feet centered on an axis perpendicular to the sign face.

f. The sign display must be covered by a stable, impact resistant polycarbonate face. The sign face must be non-glare from all angles and must not degrade due to exposure to ultraviolet light.

g. Be capable of simultaneously activating all pixels for the purpose of pixel diagnostics. Any sign that employs flip disk or shutter technology must be programmable to activate the disks/shutters once a day to clean the electrical components. This feature must not occur when the sign is displaying an active message.

h. The light source must be energized only when the sign is displaying an active message.

i. Primary source of power must be solar power with a battery backup to provide continuous operation when failure of the primary power source occurs.

j. The sign controller software must be NTCIP compliant.

The PCMS panels and related equipment must be permanently mounted on a trailer with all controls and power generating equipment.

The PCMS must be operated by a controller that provides the following functions:

1) Select any preprogrammed message by entering a code.
2) Sequence the display of at least 5 messages.
3) Blank the sign.
4) Program a new message, which may include animated arrows and chevrons.
5) Mirror the message currently being displayed or programmed.

9-38.6 BARRICADES

Barricades must conform to the MUTCD, Standard Plans, and Drawings.

9-38.7 TRAFFIC SAFETY DRUMS

Traffic safety drums must conform to the MUTCD and must have the following additional physical characteristics:

Characteristic	Requirement
Material	Fabricated from low-density polyethylene per ASTM D 4976 and is UV stabilized.
Overall Width	18-inch minimum regardless of orientation.
Shape	Rectangular, hexagonal, circular, or flat-sided semi-circular.
Color	The base color of the drum must be fade resistant safety orange.

The traffic safety drums must be designed to accommodate at least one portable light unit. The method of attachment must ensure the light does not separate from the drum upon impact.

Drums and light units must comply with the crashworthiness requirements of NCHRP 350 as specified in Section 1-10.2(5)B.

When recommended by the manufacturer, drums must be treated to ensure proper adhesion of the reflective sheeting. Retroreflective bands must be fabricated from Type III or Type IV reflective sheeting as described in Section 9-38.15.

9-38.8 RESERVED

9-38.9 TRAFFIC CONES

Cones must conform to the MUTCD, except the minimum height must be 28 inches.

Retroreflective bands must be fabricated from Type III or Type IV reflective sheeting as specified in Section 9-38.15.

9-38.10 TUBULAR MARKERS

Tubular markers must conform to the MUTCD, except the minimum height must be 28 inches.

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The devices must be stabilized by affixing them to the pavement by using either weighted bases or adhesive. Adhesive used to glue the device to the pavement must be as specified in Section 9-26.2. Retroreflective bands must be fabricated from Type III or Type IV reflective sheeting as specified in Section 9-38.15.

9-38.11 WARNING LIGHTS AND FLASHERS

Warning lights and flashers must conform to the MUTCD.

9-38.12 TRUCK-MOUNTED ATTENUATOR

The Truck-Mounted Attenuator (TMA) must be selected by the Contractor as required, or as specified in the Contract. The TMA must be mounted on a vehicle with a minimum weight of 15,000 pounds and a maximum weight per the manufacturer's recommendations. Ballast used to obtain the minimum weight requirement, or any other object that is placed on the vehicle must be securely anchored such that it will stay on the vehicle during an impact. The Contractor must provide certification that the unit complies with NCHRP 350 Test level 3 requirements.

The TMA must have an adjustable height so it can be placed at the correct elevation during usage and to a safe height for transporting. If needed, the Contractor must install additional lights to provide fully visible brake lights at all times.

The TMA unit must have a chevron pattern on the rear of the unit. The standard chevron pattern must consist of 4-inch yellow stripes, alternating non-reflective black and retro-reflective yellow sheeting, slanted at 45 degrees in an inverted V with the V at the center of the unit.

9-38.13 TALL CHANNELIZING DEVICES

Tall channelizing devices must comply with MUTCD Part VI for channelizing devices and must conform to these general Specifications:

1. Fabricated of fade resistant, safety orange color, low-density polyethylene that is resistant to deformation upon impact and complies with ASTM D 4976 and is UV stabilized.
2. 42 inches in height minimum, using a tapered cone type shape of consistent dimensions regardless of orientation to traffic.
3. 4 inches in width minimum at the top and 8 inches in width minimum at the base, which incorporates a separate ballast that is designed to resist overturning or other movement from wind gusts or other external forces.
4. 4 retroreflective 6-inch wide horizontal bands, alternating orange and white beginning 6-inch from the top of the device. Retroreflective bands must be fabricated from Type III or Type IV reflective sheeting as described in Section 9-38.15.
5. Warning lights are not required unless specifically shown on the Traffic Control Plan but provisions for securely attaching a warning light are required. The method of attachment must ensure the light does not separate from the device upon impact and light units must be crashworthy per NCHRP 350 as specified in Section 1-10.2(5)B.
6. Devices must be regularly maintained to ensure they are clean and the reflective sheeting is in good condition.

Except for the Specifications and requirements specifically listed above, tall channelizing devices are defined to be Traffic Cones. All non-conflicting Contract provisions related to Cones apply to tall channelizing devices.

9-38.14 PORTABLE TEMPORARY TRAFFIC CONTROL SIGNAL

Portable traffic control signals must comply with MUTCD and these Specifications.

The portable temporary traffic control signal must be fully operational for two-phase traffic actuated, pretimed, or manual control. The portable temporary traffic control signal must conform to the following requirements:

1. Controllers must demonstrate conflict-monitoring capability as specified in Section 9-38.14(1), with a flashing red display in both directions. The portable traffic control signal must be capable of terminating the movement 1 or movement 2 all red clearance, in order to repeat the previous movements operation.
2. Signal head displays must be either hard wired or controlled by radio signal. Manual operation will not require hardwiring or radio control except for the use of two-way radio communication by manufacturer trained qualified operators.
3. The system must be equipped with a means of informing the operator of signal indications, such as a light on the back of each signal head that illuminates when the signal displays a red indication, during manual operation.
4. A vehicle detection system is required. The system must be capable of operating either as fixed time or traffic actuated controller. The detection system must provide presence detection (continuous call to the controller) while there is a vehicle in the detection zone.
5. Signal supports used with portable traffic control signals must provide a minimum of two signal displays, spaced a minimum of 8 feet apart. When trailer mounted portable traffic signals are used to provide alternating one-way control, a minimum of one of the signal displays must be suspended over the traveled way. The minimum vertical clearance to the traveled way for this signal display is 16-1/2 feet. Vehicular signal heads must be of the conventional type with standard ITE approved, 12-inch ball LED display. Tunnel visors must be provided for all indications. The system must include a countdown display capable of a 199 second countdown clock for motorist information when there is no direct line of sight between the stop bar locations.

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6. Back plates must be furnished and attached to the signal heads. Back plates must be constructed of 5-inch wide .050-inch thick corrosion resistant louvered aluminum, with a flat black finish. A highly retroreflective strip, 3 inches wide, must be placed around the perimeter of the face of all vehicle signal backplates to project a rectangular image at night towards oncoming traffic.
7. Trailers must have a leveling jack installed at all 4 corners. The crank for the leveling jacks and trailer hitch must be locked. The signal pole and mast arm assemblies must be of the collapsible type, which can be erected and extended at the Job Site. The mast arm assemblies must be firmly attached to the trailer to form a stable unit, which can withstand an 80 mph design wind speed with a 1.3 gust factor.
8. The portable temporary traffic control signal must be powered using a self-contained battery system capable of providing over 12 Days of continuous operations without solar array assistance. A solar panel array will be allowed.

9-38.14(1) FLASHING OPERATIONS

All temporary traffic signals must be equipped for flashing operation of signal displays. Controllers must be programmed for flashing red displays for all approaches. During flash display, all pedestrian circuits must be de-energized.

Actuated traffic signal control mechanisms must be capable of entry into flash operation and return to normal operation as follows:

1. Terminal Strip Input (Remote Flash). When called as a function of a terminal strip input, the controller must provide both sequenced entry into flash and sequenced return to normal operation consistent with the requirements of the latest edition of the Manual on Uniform Traffic Control Devices.
2. Police Panel Switch. When the flash-automatic switch located behind the police panel door is turned to the flash position, the signals must immediately revert to flash; however, the controller must “STOP TIME.” When the switch is placed on automatic, the signals must immediately time an 8 to 10 second all red period then resume normal cyclic operations at the beginning of major street green.
3. Controller Cabinet Switches. When the flash-automatic switch located inside the controller cabinet is placed in the flash position, the signals must immediately revert to flash; however, the controller must continue to function. When the flash-automatic switch is placed in the automatic position, the controller must immediately resume normal cyclic operation at the beginning of the artery green. Adjacent to the flash-automatic switch must be a controller on-off switch. If the flash-automatic switch is in the automatic position and the controller on-off switch is placed in the OFF position, the signals must immediately revert to flash.
4. Power Interruption. On “NEMA” controllers any power interruption longer than 475 ± 25 milliseconds, signals must re-energize consistent with No. 2 above to ensure an 8 second flash period prior to the start of major street green. A power interruption of less than 475 ± 25 milliseconds must not cause resequencing of the controller and the signal displays must re-energize without change. Type 170 controllers must re-energize consistent with No. 2 above after a power interruption of 1.75 ± 0.25 seconds. The 8 second flash period will not be required.
5. Conflict Monitor. Upon sensing conflicting signals or unsatisfactory operation voltages, the conflict monitor must immediately cause the signal to revert to flash; however, the controller must stop time at the point of conflict. After the conflict monitor has been reset, the controller must immediately take command of the signal displays at the beginning of major street green.

9-38.15 TYPE III OR TYPE IV REFLECTIVE SHEETING

Type III and Type IV reflective sheeting must consist of spherical or prismatic lens elements adhered to a synthetic resin and encapsulated by a flexible, transparent, weatherproof plastic having a smooth outer surface. All sheeting must be weather resistant and have a protected precoated adhesive backing.

The reflective sheeting must have the following minimum coefficient of retroreflection values at 0.2 degrees and 0.5 degrees observation angle expressed as average candelas per foot-candle, per square foot of material. Measurements must be conducted per ASTM E 810.

Type III Glass Bead Retroreflective Element Material

Obs. Angle	Entrance Angle	Silver White	Yellow	Orange	Green	Red	Blue	Brown
0.2 degrees	-4 degrees	250	170	100	45	45	20	12
0.2 degrees	+30 degrees	150	100	60	25	25	11	8.5
0.5 degrees	-4 degrees	95	62	30	15	15	7.5	5.0
0.5 degrees	+30 degrees	65	45	25	10	10	5.0	3.5

Type IV Micro Prismatic Retroreflective Element Material

Obs. Angle	Entrance Angle	White	Yellow	Green	Red	Blue	Brown
0.2 degrees	-4 degrees	250	170	35	35	20	7.0
0.2 degrees	+30 degrees	80	54	9	9	5.0	2.0
0.5 degrees	-4 degrees	135	100	17	17	10	4.0
0.5 degrees	+30 degrees	55	37	6.5	6.5	3.5	1.4

1. The standard rainfall test specified in Federal Specification LS 300C and the brightness of the reflective sheeting totally wet by rain must not be less than 90 percent of the above values.
2. Samples must be submerged in a tank of clean water (approximately 72 °F) for a period of 5 minutes. Reflex-reflective performance of the sheeting must be viewed in a darkened room by reflected light through the surface of the water or through a transparent plane surface of the tank parallel to the sample surface. Light source must be such as a hand flashlight held close to the eye. The wet sheeting must show no apparent loss of reflective performance as compared to dry material.

The diffuse day color of the reflective sheeting must be visually evaluated by comparison with the applicable Highway Color Tolerance Chart. Color comparison must be made under north daylight or a scientific daylight having a color temperature from 6500 K to 7500 K. Daytime color evaluation must be illuminated at 45 degrees and viewed at 90 degrees. There must be no significant color shift when viewed under nighttime (retroreflective) conditions.

9-38.16 TEMPORARY PEDESTRIAN CURB RAMPS

Temporary pedestrian curb ramps must be constructed as shown in the traffic control plans or be pre-manufactured devices meeting the requirements of the ADA Accessibility Standards, see Chapter 4: Ramps and Curb Ramps at www.access-board.gov.

9-38.17 PEDESTRIAN CHANNELIZING DEVICES

When exposed to vehicular traffic, pedestrian channelizing devices must meet the crashworthiness requirements of NCHRP 350 or MASH as described in Section 1-10.2(5)B. The bottom and top surfaces of the pedestrian channelizing device must have 6-inch retroreflective bands matching the body color of the device fabricated from Type IV (High Intensity) or a higher type reflective sheeting.

SECTION 9-39 SHAFT-RELATED MATERIALS

9-39.1 SHAFT CASING

9-39.1(1) PERMANENT CASING

Permanent casing must be of steel base metal conforming to ASTM A36, ASTM A 252 Grades 2 or 3, ASTM A572 Grade 50, or ASTM A588.

9-39.1(2) TEMPORARY CASING

Temporary casing must be a smooth wall structure of steel base metal, except where corrugated metal pipe is shown on the Drawings as an acceptable alternative material.

9-39.2 SHAFT SLURRY

9-39.2(1) MINERAL SLURRY

Mineral slurry must conform to the following requirements:

Property	Test	Requirement
Density (pcf)	Mud Weight (Density) API 13B-1, Section 1	63 to 75
Viscosity (seconds/quart)	Marsh Funnel and Cup API 13B-1, Section 2.2	26 to 50
pH	Glass Electrode, pH Meter, or pH Paper	8 to 11

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Property	Test	Requirement
Sand Content (percent)	Sand API 13B-1, Section 5	
Prior to final cleaning		4.0 max.
Immediately prior to placing concrete		4.0 max.

Use of mineral slurry in saltwater installations will not be allowed.

Slurry temperature must be at least 40 degrees F when tested.

9-39.2(2) SYNTHETIC SLURRY

Synthetic slurries must be used in conformance with the manufacturer's recommendations and must conform to the quality control plan specified in Section 6-12.3(2)B, item 4. The synthetic slurry must conform to the following requirements:

Property	Test	Requirement
Density (pcf)	Mud Weight (Density) API 13B-1, Section 1	64 max.
Viscosity (seconds/quart)	Marsh Funnel and Cup API 13B-1, Section 2.2	32 to 135
pH	Glass Electrode, pH Meter, or pH Paper	6 to 11.5
Sand Content (percent)	Sand API 13B-1, Section 5	
Prior to final cleaning		1.0 max.
Immediately prior to placing concrete		1.0 max.

The Contractor must submit a request for approval of slurry material with the following information:

1. Test data showing conformance to the properties in the table above, and
2. Documentation showing that the synthetic slurry (with load-tested additives) has been approved by the California Department of Transportation (Caltrans).

9-39.2(3) WATER SLURRY

Water without site soils may be used as slurry when casing is used for the entire length of the drilled hole. Water slurry without full length casing may only be used with the approval of the Engineer.

Water slurry must conform to the following requirements:

Property	Test	Requirement
Density (pcf)	Mud Weight (Density) API 13B-1, Section 1	65 max.
Sand Content (percent)	Sand API 13B-1, Section 5	1.0 max.

Use of water slurry in saltwater installations will not be allowed.

Slurry temperature must be at least 40 degrees F when tested.

9-39.3 STEEL REINFORCING BAR CENTRALIZERS

Steel reinforcing bar centralizers must be steel, conforming to the details shown on the Drawings. The Contractor may propose the use of alternative steel reinforcing bar devices as part of the shaft installation narrative as specified in Section 6-12.3(2)B, item 9, subject to the Engineer's review and approval of such devices.

9-39.4 CROSSHOLE SONIC LOG (CSL) ACCESS TUBES AND CAPS

Access tubes for CSL or TIP testing must be steel pipe of 0.145-inch minimum wall thickness and at least 1-1/2-inch inside diameter.

The access tubes must have a round, regular inside diameter free of defects and obstructions, including all pipe joints, in order to permit the free, unobstructed passage of 1.3-inch maximum diameter source and receiver probes used for the CSL.

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The access tubes must be watertight and free from corrosion, with clean internal and external faces to ensure a good bond between the concrete and the access tubes. The access tubes must be fitted with watertight threaded PVC caps on the bottom, and must be fitted with watertight PVC caps, secured in position by means as approved by the Engineer, on the top.

9-39.5 GROUT FOR CSL ACCESS TUBES

Grout for filling the access tubes at the completion of the CSL tests must be a homogeneous mixture of neat cement grout and potable water, conforming to Section 9-20.3(4), except that the maximum water/cement ratio must be 0.45.

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