

CITY OF SEATTLE
2008 edition
STANDARD SPECIFICATIONS
FOR
ROAD, BRIDGE, AND MUNICIPAL CONSTRUCTION

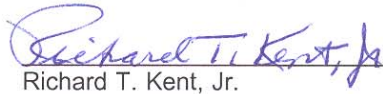
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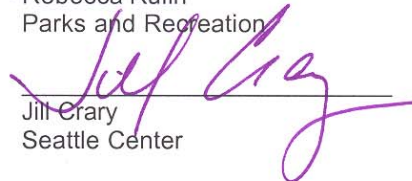
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2008 edition City of Seattle Standard Specifications for Road, Bridge, and Municipal Construction

PREFACE

The 2008 edition City of Seattle Standard Specifications for Road, Bridge, and Municipal Construction (henceforth referred to as the "2008 Standard Specifications") have been prepared by Seattle Public Utilities in cooperation with Seattle Department of Transportation, Seattle Parks and Recreation, Department of Executive Administration, Fleets and Facilities, Seattle City Light, and Seattle Center. This document was compiled by combining the 2006 WSDOT/APWA Standard Specifications with Seattle's 2005 edition Standard Specifications and supplemental General Special Provisions, and then revising or supplementing the resulting whole to reflect updated technologies, and current City policies and procedures. These Specifications have been coordinated with the 2008 edition City of Seattle Standard Plans for Municipal Construction.

The 2008 Standard Specifications apply whenever any public or private construction is performed within the Rights-of-Way of the City of Seattle including work performed by private parties at their own expense under authority granted by ordinance of the City Council or by permit of the Seattle Department of Transportation's Street Use section. All matters relating to financing of such work shall be between the permittee and the Contractor, and the City shall not enter into such matters.

SHADING: For the convenience of some of our users, we have shaded the text like this to indicate 2006 WSDOT / APWA 1-99 Standard Specification language.

VERTICAL BAR: For the convenience of some of our users, we have indicated current text that has been revised from the 2005 edition Standard Specifications with an adjacent vertical bar along the outside page margin. (as herein shown).

Despite considerable efforts to produce 1) a completely error-free document, 2) a document consistent with the 2008 Standard Plans, and 3) a web version of this document, some mistakes and inconsistencies among the versions seem to defy detection until after publication. Should you discover errors in this document or inconsistencies between or among the versions, please bring them to our attention by contacting the City's Construction Standards Engineer at the following web address:

http://www.seattle.gov/util/Engineering/Standard_Plans_&_Specs

Should conflict be discovered between this hard copy version of the 2008 Standard Specifications and any other version of the 2008 Standard Specifications, the hard copy shall take precedence over all other versions of the 2008 Standard Specifications. Should conflict be discovered between this hard copy of the 2008 Standard Specifications and any version of the 2008 Standard Plans, the hard copy of the 2008 Standard Specifications shall take precedence.

My sincere thanks and appreciation to all those individuals in the many City Departments and outside agencies who participated in the effort of providing input, discussing, and reviewing this document, and to the many City Departments for agreeing on standardizing similar constructions. In particular, thanks to Jonathan Marsh who shouldered most of the work in questioning, authoring, communicating, coordinating, obtaining cooperation, editing, and resolving conflict in the Standard Specifications, and with the Standard Plans. Additional thanks to Dean Noble and Dean Huber of the Seattle Public Utilities' Technical Resources section and to the Seattle Public Utilities' Information Technology section for assistance in preparing the hard copy and the web versions of the 2008 Standard Specifications.

I would also like to thank the City's new Construction Standards Engineer, Randy Earlywine for quickly coming up to speed and ensuring a timely publication of this document in the wake of Jonathan Marsh's retirement.

The hardcopy version of this document is available at the Seattle Public Utilities Engineering Records Center located in the Seattle Municipal Tower, 700 Fifth Avenue, Suite 4700, Seattle, Washington 98104, 206-684-5132. The web version of the 2008 Standard Specifications and 2008 Standard Plans can be viewed and downloaded in pdf format at the web address listed above.

This Preface is for informational purposes only and is not to be used to interpret or affect the terms of the Contract between The City of Seattle as the Contracting Agency and the Contractor.

Brian Patton, P.E.
Director
Engineering Services and Engineering Support Divisions
Seattle Public Utilities

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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 can be found in Sections 1-01.2 and 1-01.3. Often used abbreviations are found in Standard Plan no. 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
AGA	American Gas Association
AGC	Associated General Contractors of America
AHERA	Asbestos Hazard Emergency Response
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 Builders 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-Destructive Testing
ASSE	American Society of Sanitary Engineering
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers' Association
AWS	American Welding Society
AWWA	American Water Works Association
BR	Bridge Replacement and Redevelopment Program
CARB	California Air Research Board
CBD	Central Business District
CBE	Combination Business Enterprise
CDBG	Community Development Block Grant
CFR	Code of Federal Regulations
CLI	Chain Link Institute
CRAB	County Road Administration Board
CRSI	Concrete Reinforcing Steel Institute
CSI	Construction Specifications Institute
DBE	Disadvantaged Business Enterprise
DBRA	Davis-Bacon and Related Acts
DEA	Department of Executive Administration

DIPRA	Ductile Iron Pipe Research Association
DPD	Seattle Department of Planning and Development
EEl	Edison Electric Institute
EEO	Equal Employment Opportunity
EPA	Environmental Protection Agency
ESCBMP	Erosion and Sedimentation Control Best Management Practices
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
KCM	King County METRO
LPI	Lighting Protection Institute
MBE	Minority Business Enterprise
METROKC	King County Department of Transportation
MSDS	Material Safety Data Sheet
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 Protection Act
NETA	International Electric Testing Association
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NHS	National Highway System
NPCA	National Precast Concrete Association
NRMCA	National Ready Mix Concrete Association
NRCA	National Roofing Contractors Association
NSF	National Sanitation Foundation
NTCIP	National Transportation Communication for ITS Protocol
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
PCA	Portland Cement Association
PCSD	Purchasing and Contracting Services Division
P/PCI	Precast/Prestressed Concrete Institute
PORT	Port of Seattle
PPI	Plastic Pipe Institute
PSCAA	Puget Sound Clean Air Agency
RCW	Revised Code of Washington
REA	Rural Electrification Association
RRP	Railway-Highway Grade Crossing Program
SCADA	Supervisory Control And Data Acquisition
SAC	Washington State Apprenticeship and Training Council
SAE	Society of Automotive Engineers
SCS	Soil Conservation Service
SCL	Seattle City Light
SDOT	Seattle Department of Transportation

SEPA	State Environmental Policy Act
SKCDPH	Seattle-King County Department of Public Health
SMC	Seattle Municipal Code
SPMA	Seattle Popular Monorail Authority
SPU	Seattle Public Utilities
SSPC	Steel Structures Painting Council
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
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 and Minority Business Enterprise
WRI	Wire Reinforcement Institute
WSDOE	Washington State Department of Ecology
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 No. 002. Standard symbols are included on Standard Plan No. 003. When abbreviations are used in the Bid Form to denote Bid items of work and units of measurement, each abbreviated term shall have the meaning specified for it as noted in the subparagraph immediately above unless a Bid item measurement or payment description specifies another meaning.

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 shall be those contained in the official edition of the IEEE Dictionary of Electrical and Electronic Terms.

Definitions for street designations and classifications can be found in the current edition of Seattle's Rights of Way improvements Manual. The ROWIM applies solely to street rights-of-way and does not apply to rights of way dedicated solely for utility purposes.

ADDENDUM

A written or graphic document issued to all Bidders prior to the Bid opening and identified as an Addendum, which modifies or clarifies the Bid Documents and becomes part of the Contract.

ADDITIVE

A supplemental unit of Work or group of Bid items, identified separately in the Bid, which may be Awarded at the discretion of the Owner in addition to the Base Bid.

ADVERTISEMENT FOR BIDS

A public notice published in the official newspaper, designated by The City of Seattle, and/or on the internet, soliciting Bids for the Work.

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

Reasonable, good faith efforts to contact and employ women and minorities and to contact and Contract with Women and Minority Business Enterprises (WMBEs) as documented in the Outreach Plan form.

AGREEMENT FORM (CONTRACT FORM)

The Owner-provided form that requires the authorized signatures of the Contractor and the Owner to formally execute the Contract.

ALTERNATE

A unit of Work or group of Bid items, identified separately in the Bid, which permits a choice of different methods or Material of construction for performing the same Work.

ARCHITECT

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

ASSISTANT

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

AWARD

The formal decision of the Owner to accept the lowest responsive Bid of a responsible Bidder for the Work as evidenced by the issuance of the Award of Contract.

BASE BID

The summation of Bid item amounts (extensions) or the lump sum Bid in the Bid Form, excluding Additives, Alternates, Deductives and taxes.

BID

The written offer of a Bidder, executed pursuant to the Bid Documents, to perform the Work for a specific price. The terms "Bid" and "Bid Form" and like terms are synonymous.

BIDDER

An individual, partnership, firm, corporation, limited liability company or joint venture submitting a Bid.

BID DOCUMENTS

The component 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 FORM

The Bid and the Affidavit/Declaration included in the Bid Documents.

BID GUARANTY

Bid bond, cashier's check or certified check accompanying the Bid as a guarantee that the Bidder will enter into an agreement with the Owner for performance of the Work if the Bidder is Awarded the Contract.

CAPABILITY OR CAPABLE

A business that appears able to perform a Commercially Useful Function on the item of Work in question.

CHANGE ORDER

A written order issued by the Engineer to the Contractor authorizing a change to the Contract after execution of the Contract. A Change Order establishes the basis of payment and time adjustments, if any, for the Work affected by the change.

CERTIFIED ON-SITE-EROSION CONTROL LEAD (ESC Lead)

An employee of the Contractor certified by WSDOT/AGC as having completed the "Construction Site Erosion And Sediment Control Certification Program". Such certification shall remain in effect throughout the Contract term.

COMBINATION BUSINESS ENTERPRISE (CBE)

A business that has self-identified or has been certified by the Washington State Office of Minority and Women's Business Enterprises as a bona fide Combination Business Enterprise. A CBE is a business that is 50% owned and controlled by one or more minority men, and 50% owned and controlled by one or more non-minority women.

COMMERCIALLY USEFUL FUNCTION

The performance of real and actual services in the discharge of any contractual endeavor including managing and supervising the Work involved, negotiating price, determining quality and quantity, ordering, paying for and installing (if applicable) the material.

CONSTRUCTION OUTREACH PLAN

The Owner-provided form used by the Contractor to document Affirmative Efforts.

CONTRACT

The agreement between the Owner and the Contractor, which includes the signed Agreement Form, Bid Form, Contract provisions, Drawings, Standard Specifications, Standard Plans, Addenda, certifications, supplemental agreements, Change Orders and all other documents specifically incorporated by reference comprise the Contract.

CONTRACT BOND

The approved form of security, furnished by the Contractor and the Contractor's Surety, guaranteeing completion of the Work and payment to persons supplying labor and Materials in the prosecution of the Work. The Owner will provide the Contract Bond form to the Contractor.

CONTRACT FORM

See "Agreement Form."

CONTRACT PRICE

1. **Awarded Contract Price:** The summation of Bid item amounts or extensions or a lump sum for all items of Work, including applicable taxes, upon which the Award is made.
2. **Revised Contract Price:** The Awarded Contract Price, adjusted at any time after Award but prior to the Completion Date.
3. **Final Contract Price:** The total amount of money payable to the Contractor under the terms and conditions of the Contract.

CONTRACT TIME

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

CONTRACTOR

The individual or entity contracting with the Owner to do the Work.

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.

DATES

1. **Bid Opening Date:** The date on which Bids for the Work are opened and read publicly.
2. **Award Date:** The date on which the Owner formally accepts the lowest responsive Bid of a responsible Bidder and Awards the Contract for the Work.
3. **Notice to Proceed Date:** The date stated in the Notice to Proceed on which the Contract Time begins.
4. **Substantial Completion Date:** The date the Engineer determines the Owner has full and unrestricted use and benefit of the facilities, both from an operational and safety standpoint, and only minor incidental Work, replacement of temporary substitute facilities, or correction or repair remains for the physical completion of the Contract.
5. **Physical Completion Date:** The date the Owner determines that all Work is physically complete on the Project. All documentation required by the Contract and required by law does not necessarily need to be furnished by the Contractor by this date.
6. **Completion Date:** The date, certified in writing by the Owner, when the Work specified in the Contract is completed and all the obligations of the Contractor under the Contract are fulfilled by the Contractor. All documentation required by the Contract and required by law must be furnished by the Contractor before establishment of this date.

DAY

Unless otherwise specified, Day(s) shall mean Calendar Day(s).

1. **Business Day:** Any Day other than Saturday, Sunday, or Holiday.
2. **Calendar Day:** The time period of twenty-four 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 upon which the Engineer issues a suspension order.
 - 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 partial or whole Working Day the Engineer declares to be unworkable because of unusually severe weather, or another condition beyond the control of the Contractor that prevents satisfactory and timely performance of the Work, when such performance, if not hindered, would have otherwise progressed toward completion of the Work.

DECLARATION

The part of the Bid Form that is signed by the Bidder, which acknowledges Addenda issued during the bidding period and Contract conditions relating to affirmative action/equal employment opportunity; non-collusion; insurance and subcontracting.

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.

DISADVANTAGED BUSINESS ENTERPRISE (DBE)

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

DRAWINGS

The portions of the Contract showing in graphic or pictorial form the design, location, and dimensions of the elements of the Work.

ELECTRICAL SAFETY OBSERVER

The Engineer's authorized Assistant assigned to monitor electrical safety, unless indicated otherwise in the Contract.

ENGINEER

The Owner's representative(s), or authorized Assistant, who administers the Work of this Project.

EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICES (ESCBMPs)

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

HOLIDAY

Pursuant to SMC 4.20.190 and RCW 1.16.050, Holidays for The City of Seattle are the:

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

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

INSPECTOR

See "Engineer."

JOB SITE

See "Project Site."

LABORATORY

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

LIQUIDATED DAMAGES

The amount(s) 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 shall not be 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 construction of the project that enters into and forms a part of the finished Work.

MATERIALPERSON

A person or entity 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 which are commonly used in Seattle's road, bridge, and municipal construction.

MINORITY AND WOMEN'S BUSINESS ENTERPRISE (MWBE)

A business that has self-identified or has been certified by the Washington State Office Of Minority and Women's Business Enterprises as a bona fide minority business enterprise, and a bona fide women's business enterprise. A MWBE is a business that is at least 51% owned by one or more minority women, and whose management and daily operations are controlled by one or more minority women.

MINORITY BUSINESS ENTERPRISE (MBE)

A business that has self-identified or has been certified by the Washington State Office Of Minority and Women's Business Enterprise as a bona fide Minority and Women's Business Enterprise. A MBE is a business that is at least 51% owned by one or more minority males, and whose management and daily operations are controlled by one or more minority males.

NOTICE OF AWARD

A formal written notice from the Owner to the successful Bidder signifying acceptance of the Bid.

NOTICE TO PROCEED

The written notice from the Engineer to the Contractor authorizing and directing the Contractor to proceed with the Work and establishing the date on which the Contract Time begins.

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.

OWNER

The City of Seattle.

PROJECT MANUAL

The compilation of written provisions and requirements for the Work related to a specific project. The Project Manual includes, but is not limited to, the requirements for Bids, sample forms, original and executed Agreement Form, wage rates, conditions of the Contract, Special Provisions and Addenda.

PROJECT SITE

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

REAL PROPERTY

Land and improvements permanently affixed to the land.

RIGHT OF WAY

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

SEWER

Any pipe or conduit used for carrying sewage and other waste liquids, excluding hazardous materials.

SHOP DRAWINGS

Drawings, diagrams, illustrations, schedules, performance charts, brochures, and other similar data prepared or submitted to the Owner by the Contractor or a Subcontractor, manufacturer, Materialperson, or distributor to illustrate how specific portions of the Work shall be fabricated or installed.

SPECIAL PROVISIONS

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

SPECIFICATIONS

Written technical descriptions of materials, equipment, construction systems, standards, and workmanship that, in conjunction 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.

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 used for conveying rainwater, subsurface water, condensate cooling water or other similar discharges, but not commercial and industrial wastewater or sewage. Storm drains carry the excessive storm water from the point source and convey it to the nearest natural body of water.

STRUCTURES

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

SUBCONTRACTOR

An entity or individual who performs a portion of the Work pursuant to a Contract or subcontract of any tier with the Contractor, with the prior written approval of the Engineer as evidenced by the submission of the Subcontractor approval application.

SUBSTANTIAL COMPLETION

See "Dates".

SUPPLEMENTAL CONTRACT

An agreement for performance of a portion of the Work in accordance with the provisions of RCW 60.28.011(7).

SUPPLIER

See "Materialperson".

SUPPLIES

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

SURETY

A surety company that is bound with the Contractor to ensure:

1. Faithful performance of the Contract, and
2. Payment of all laborers, mechanics, Subcontractors and Materialperson and all persons or entities that supply any such person with provisions and Supplies for the carrying on of the Work.

TRAFFIC CONTROL MANUAL FOR IN-STREET WORK

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).

VOLUNTARY GOAL

Participation level, voluntarily established by the Contractor, for potential employment of women or minority employees and/or the use of WMBEs, that is not a requirement or condition of the Contract.

WATER MAIN

A water supply pipe for public or community use.

WOMEN AND MINORITY BUSINESS ENTERPRISES (WMBES)

See "MWBE."

WOMEN'S BUSINESS ENTERPRISE (WBE)

A business that has self-identified or has been certified by the Washington State Office of Minority and Women's Business Enterprises as a bona fide women's business enterprise and is at least 51% owned by women.

WORK

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

SECTION 1-02 BID PROCEDURES AND CONDITIONS**1-02.1 QUALIFICATIONS OF BIDDERS**

Bidders shall be qualified by experience, financing, Equipment, and organization to do the Work called for in the Contract. The Owner reserves the right to take whatever action it deems necessary to ascertain the ability of the Bidder to perform the Work satisfactorily. This action may include conducting an evaluation of the Bidder's qualifications and references prior to Award.

1-02.2 RESPONSIBLE BIDDER

Before Award of the Contract, the Bidder must meet the following responsibility criteria to be considered a responsible Bidder. The Bidder must:

1. at the time of bid submittal, have a certificate of registration in compliance with Chapter 18.27 RCW;
2. have a current State unified business identifier number;
3. have industrial insurance coverage for the Bidders employees working in Washington as required in Title 51 RCW; an employment security department number as required in Title 50 RCW; and a state excise tax registration number as required in Title 82 RCW; and
4. not be disqualified from bidding on any public works contract under RCW 39.06.010 or 39.12.065
5. meet any supplemental criteria requirements, if applicable.
 - a. In the case that supplemental criteria are established for the project, in a timely manner before the bid submittal deadline, the bidder may request that the supplemental criteria be modified. If the City determines a modification is necessary, an addendum to the bidding documents will be issued to identify the new criteria.
 - b. If the bidder fails to supply information requested concerning responsibility within the time and manner specified in the Bid Documents, the Owner may base its determination of responsibility upon any available information related to the supplemental criteria or may find the Bidder not responsible [note: this paragraph only applies when the City has established criteria in addition to 1-4 above].

If the Owner determines a Bidder to be not responsible, the Owner will provide, in writing, the reasons for the determination. The Bidder may appeal the determination within the time period specified in the Bidding Documents [see § 1-

03.7 re appeals] by presenting additional information to the Owner. The Owner shall 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 two (2) business Days after the Bidder determined to be not responsible has received the final determination.

Additionally, the Bidder must verify responsibility criteria for each first tier subcontractor, and a subcontractor of any tier that hires other subcontractors must verify responsibility criteria for each of its subcontractors. Verification shall include that each subcontractor, at the time of subcontract execution, meets the responsibility criteria listed in items (1) through (4) above, and possess an electrical Contractor license, if required by Chapter 19.28 RCW, or an elevator Contractor license, if required by Chapter 70.87 RCW. This verification requirement, as well as the responsibility criteria, must be included in every public works Contract and subcontract of every tier.

1-02.3 ESTIMATED QUANTITIES

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

1-02.4 EXAMINATION OF BID DOCUMENTS AND PROJECT SITE

1-02.4(1) GENERAL

The Bidder shall carefully examine the Bid Documents. Submittal of a Bid shall be conclusive evidence that the Bidder has made these examinations and understands all requirements for the performance of the Work. The Bidder further warrants, agrees and acknowledges by submitting a Bid, that the Bidder:

1. has taken all steps necessary to ascertain the full scope, nature and location of the Work;
2. has investigated and is satisfied as to the general and local conditions which can affect the Work and its cost, including but not limited to:
 - a. conditions bearing upon acquisition, transportation, disposal, handling, and storage of materials,
 - b. the 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. the conformation and condition of the ground,
 - e. the character of equipment and facilities needed preliminary to and during Work performance, and
 - f. site and environmental conditions which by statute, law, or regulation require specific training and certifications for employees;
3. is satisfied as to the character, quality, and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable 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; and
4. is satisfied as to the adequacy of the amount of time allowed for physical completion of the Contract.

Any failure of the Bidder to take the actions described and acknowledged above, shall not relieve the Bidder from responsibility:

1. for estimating properly the difficulty and cost of successfully performing the Work, and
2. from proceeding to successfully perform the Work without additional expense to the Owner.

The Bidder agrees that the Owner shall not be liable to the Bidder for any claim whatsoever, if the claim directly or indirectly results from the Bidder's failure to investigate and become sufficiently knowledgeable of the conditions under which the Contract is to be performed.

The Bidder shall be familiar and comply with all federal, state, and local laws, ordinances, and regulations that might affect those engaged in the Work. The Owner will not consider any plea of misunderstanding or ignorance of such requirements.

Bid prices shall reflect the Bidder's anticipated cost of completing the Work, including methods, Materials, labor, and equipment. The Bidder will not be compensated for any costs that exceed those in the Bid prices except as the Contract may provide.

The Bidder is advised to include in its Bid the applicable costs of complying with Section 1-07.18 relating to insurance

A claim will not be allowed because of any ambiguity in the Contract if:

1. The Bidder discovers an ambiguity but fails to notify the Engineer, or
2. The Bidder failed to discover any ambiguity that would be discovered by a reasonably prudent Contractor in preparing its Bid.

Any prospective Bidder desiring an explanation or interpretation of the Bid Documents must request the explanation or interpretation in writing within three (3) Business Days prior to Bid opening. Oral explanations, interpretations, or instructions given by anyone before Award will not be binding on the Owner. Any information given to a prospective Bidder concerning any of the Bid Documents will be furnished to all prospective Bidders as an Addendum if:

1. that information is deemed by the Engineer to be necessary in submitting a Bid, or
2. the Engineer concludes that the lack of information would be prejudicial to other prospective Bidders.

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 made available for inspection by the Bidders. The boring logs shall be considered as 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 are 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, DPD has geotechnical reports for private property located in an Environmentally Critical Area-Geographically Hazardous zone if the private property has been under DPD permit review. This data is available for the Contractor's review by contacting:

DPD
Soils Reports
700 Fifth Avenue
22nd Floor
Seattle, Washington 98104
206-684-8860
206-233-7902 (FAX)

The availability of subsurface information from the Engineer shall not relieve the Bidder or the Contractor of any duty to make examinations and investigations as required by Section 1-02.3(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 shall be submitted only on the Bid Form issued by the Owner. The sample Bid Form found in the Project Manual shall not be used to submit Bids. Bids shall be completed by typing or shall be printed in ink by hand, preferably in black ink. A price shall be submitted for each Bid item listed.

Spaces to be filled in by the Bidder include:

1. Bid item prices;
2. Bid item amounts (extensions);
3. Summations and, where applicable, retail sales taxes;
4. Acknowledgment of Addenda;
5. The Bidder's name, address, telephone and fax number, UBI number, and signature;
6. A State of Washington Contractor's Registration Number; and
7. A City of Seattle Business License Number.

The signer of the Bid shall initial any correction to a Bid made by interlineation, alteration, or erasure. The Bidder shall make no stipulation on the Bid Form nor qualify the Bid in any manner. A Bid amount shall be included for every Additive, Alternate, or Deductive identified in the Bid Form, unless otherwise specified. A person authorized to legally bind the Bidder must sign the Declaration in the Bid Form.

1-02.6 ADDENDA

Questions regarding the meaning or intent of the Bid Documents shall be submitted to the Engineer in writing within three (3) Business Days prior to the Bid opening. If the Engineer determines modifications or clarifications are required, they will be provided by Addenda. Only issues addressed by a written Addendum are binding. Oral or other interpretations or clarifications are without effect.

Addenda and other project information will only be sent to "official" plan holders who downloaded or ordered documents through the City's official electronic Bidding website (including plan centers that obtained documents through the website). A link to the current electronic bidding website can be found at <http://www.cityofseattle.net/contract/pubwkbids.htm>. All Bidders are encouraged to check the electronic bidding website for Addenda at least twenty-four hours prior to Bid Opening.

The Bidder shall acknowledge receipt of each Addendum by filling in the appropriate spaces on the Bid Form Declaration.

1-02.7 BID GUARANTY

A Bid shall be accompanied by:

1. a certified or cashier's check payable to the order of The City of Seattle, or
2. a Bid bond.

The Bid Guaranty shall be for a sum equal to five percent of the maximum Bid amount that could be Awarded based on the Bidder's Bid, including sales tax and Additives, if applicable. A Bid will not be accepted or considered unless accompanied by a Bid Guaranty.

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 shall contain the following:

1. Ordinance, L.I.D., or specification number of the Project;
2. Name and nature of improvement
3. The City of Seattle named as obligee;
4. The amount of the Bid bond stated either as a dollar figure or as a percentage that represents five percent of the maximum Bid amount that could be Awarded;
5. Signature of the Bidder's officer empowered to sign official statements. The signature of the person authorized to submit the Bid should agree with the signature on the bond, and the title of the person must appear along with the signature; and
6. The signature of the Surety's officer empowered to sign the bond and the power of attorney.

1-02.8 NONCOLLUSION REQUIREMENT

The Bidder, by signing its Bid, declares that the Bidder has 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 to the Owner for consideration in the Award of a Contract on the Improvement.

1-02.9 BID SUBMITTAL

1-02.9(1) GENERAL

The Bid Form shall be submitted at the time and place specified in the Advertisement for Bids. The Bid Form, together with the Bid Guaranty and such other documentation as is required, shall be enclosed in a sealed envelope marked with the project title and the Bidder's name, and be addressed to:

mailing address: Purchasing and Contracting Services Division
City of Seattle Department of Executive Administration Seattle Municipal Tower,
P.O. Box 94687
Seattle, Washington 98124-4687

physical address: Purchasing and Contracting Services Division
City of Seattle Department of Executive Administration Seattle Municipal Tower,
Suite 4112
700 Fifth Avenue
Seattle, Washington 98104

If sending by courier (UPS, FedEx, etc.) the physical street address must be used. If mailing by regular US mail, the Post Office Box must be used. Bidders are responsible for ensuring that the proper Zip Code is used.

If the Bid is sent through the mail or other delivery system, the sealed envelope shall be enclosed in a separate envelope, with a notation "BID ENCLOSED" on the face of the envelope. The Bidder assumes full responsibility for the timely delivery of the Bid at the location designated in the Advertisement for Bids. A Bid submitted or delivered after the time fixed for receipt of Bids will not be accepted.

1-02.9(2) CHANGE OF BID SUBMITTAL DATE

The Owner reserves the right to 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 any public works Contract estimated to cost one million dollars (\$1,000,000.00) or more, each Bidder shall complete and submit the Bidder/Subcontractor List form, Section 0-01.4 in the Bid Form, naming those Subcontractors with whom the Bidder, if Awarded the Contract, will subcontract to perform the heating, ventilation and air conditioning; plumbing; and electrical Work, or naming itself for the Work. The Bidder may list no more than one Subcontractor for each category of Work identified, 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. Failure of the Bidder to complete and submit the Bidder/Subcontractor List as required shall render the Bidder's Bid non-responsive and, therefore, void.

Section 0-01.4 in the Bid Form, the Bidder/Subcontractor List, may be submitted with the Bid, or separately within one hour of the time and date for Bid submittal, but no later than 3:00 p.m. on Bid Opening date. The Bidder/Subcontractor List may be faxed to (206) 684-4511.

No changes shall be made to any Bidder/Subcontractor List that has been submitted following the Bid submittal time.

1-02.10 MODIFICATION OR WITHDRAWAL OF BID

After submitting a Bid to the Owner, the Bidder may withdraw its Bid if:

1. the Bidder submits a written request signed by a person authorized to bind the Bidder, and
2. the Owner receives the written request before the time for receipt of Bids.

After submitting a Bid to the Owner, the Bidder may modify its Bid if:

- 1) the Owner receives the written modification request before the time for receipt of Bids;
- 2) the modification request is on company letterhead;
- 3) the title of the project is on the modification request;
- 4) the modification request contains a detailed description of the requested change including Bid Item, Bid item price, Bid item quantity, Bid item extension, subtotals, and total amount Bid;
- 5) a person authorized to bind the Bidder has signed the modification request.
- 6) If the modification request is sent by FAX (206-684-4511), the original hard copy of the FAX shall be promptly mailed to PCSD, City of Seattle Department of Executive Administration, P.O. Box 94687, Seattle, Washington 98124-4687.

The original Bid, as modified prior to the time designated for receipt of Bids, will be accepted and used as the official Bid.

A Bid may not be modified, withdrawn, or canceled by the Bidder after the time for receipt of Bids unless the Award is delayed for a period exceeding the limit set forth for Award or a Bidder's claim of error is upheld by the Owner.

1-02.11 ADDITIVE, ALTERNATE, DEDUCTIVE

The Engineer reserves the right to arrange the Bid Form with Alternate, Additive, and/or Deductive items, if such be to the advantage of the Owner. The Bidder shall Bid on all Alternates, Additives and Deductives in the Bid Form unless otherwise specified in the Contract.

1-02.12 PUBLIC OPENING OF BIDS

Bids will be opened and read immediately after 2:00 p.m. on the date indicated in the Advertisement for Bids or in an Addendum, in the Seattle Municipal Tower, 700 Fifth Avenue, Suite 4112, Seattle, Washington 98104.

1-02.13 IRREGULAR BIDS

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

1. The authorized Bid Form is not used or is altered; or
2. The completed Bid Form contains any unauthorized addition, deletion, alternate Bid, or condition; or
3. The Bidder adds provisions reserving the right to accept or reject the Award or to enter into the Contract; or
4. A Bid item price cannot be determined; or
5. For Projects estimated to cost \$1,000,000 or more, the Bidder did not comply with the Bidder/Subcontractor list requirements (See Section 1-02.8(3), Bidder/Subcontractor List); or
6. The Bid does not constitute a definite and unqualified offer to meet the material terms of the Bid invitation.

A Bid may be considered irregular and may be rejected if:

1. The Bid Guaranty is insufficient or improper; or
2. Any of the Bid item prices are excessively unbalanced (either above or below the amount of a reasonable Bid) to the potential detriment of the Owner; or
3. Receipt of Addenda is not acknowledged; or
4. 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); or
5. The entries in the Bid Form are not typewritten or entered in ink; or
6. The Bid is not properly executed; or
7. The Bidder did not Bid on all Additives, Deductives, or Alternates, when required; or
8. The Bid does not include a Bid item price for every Bid item.

1-02.14 DISQUALIFICATIONS OF BIDDERS

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

1. More than one Bid is submitted for the same project from a Bidder under the same or different names; or
2. Evidence of collusion exists with any other Bidder or potential Bidder; or Participants in collusion will be restricted from submitting further Bids and may be debarred pursuant to SMC Chapter 20.70; or
3. A Bidder, in the opinion of the Owner, is not qualified to perform the Work specified; or
4. An unsatisfactory performance record exists as shown by past or current Work for the Owner, or for others, as judged from the standpoint of conduct of the Work, environmental or safety compliance records, workmanship, progress, Affirmative Efforts, or equal employment opportunity practices; or
5. A Bid is submitted on a Bid Form that is not issued by the Owner; or
6. The Bidder failed to settle bills for labor or Materials on past or current contracts; or
7. The Bidder has failed to complete a public Contract or has been convicted of a crime arising from a previous public Contract; or
8. The Bidder is unable, financially or otherwise, to perform the Work; or
9. A Bidder is determined to be not responsible pursuant to RCW 39.04 and section 1-02.2(1).
10. The Bidder failed to meet the Affirmative Efforts requirements of SMC Ch. 20.42 or RCW 35.22.650 pertaining to women and minority employment and/or women and minority subcontracting; or
11. The Bidder under consideration for Award does not submit the Equal Benefits Compliance Declaration (if applicable), indicating compliance with SMC Ch. 20.45 and the Equal Benefit Program Rules; or
12. For any other reason deemed proper by the Owner

SECTION 1-03 AWARD AND EXECUTION OF CONTRACT**1-03.1 CONSIDERATION OF BIDS****1-03.1(1) RESERVED****1-03.1(2) BID TABULATION**

After Bid opening, Bids will be checked for correctness of Bid item price extensions and the total Bid price. A discrepancy between a Bid item price and the extended amount of any Bid item shall be resolved by accepting the Bid item price as correct.

The summation of extensions, corrected where necessary and including sales taxes if applicable, will be used for Award purposes, to fix the Awarded Contract Price and the amount of the Contract Bond.

1-03.1(3) CLAIM OF ERROR

A Bidder who wishes to claim error after the Bids have been opened and tabulated shall submit a signed and notarized statement, accompanied by original work sheets used in the preparation of the Bid, requesting relief from the responsibilities of Award. The statement shall describe the specific error(s) and certify that the work sheets are the originals used in the preparation of the Bid. The statement and the work sheets shall be submitted to:

Purchasing and Contracting Services Division
City of Seattle Department of Executive Administration

physical address:

Seattle Municipal Tower, Suite 4112
700 Fifth Avenue

mailing address:

P.O. Box 94687
Seattle, Washington 98124-4687
Telephone (206) 684-0430
Fax (206) 684-4511

by 5:00 p.m. on the Business Day after Bid opening or the claim will not be considered. The Owner reserves the right to extend this deadline at its discretion.

The Engineer will review the certified work sheets to determine the validity of the claimed error and make a recommendation to the Owner. If the Owner concurs in the claim of error, the Bidder will be relieved of responsibility, the Bid will be withdrawn from the Bid pool and the Bid Guaranty of the Bidder will be returned. Thereafter, at the discretion of the Owner, all Bids may be rejected or Award made to the next lowest responsible Bidder.

1-03.1(4) PRE-AWARD INFORMATION

The Owner will evaluate all Bids to determine the lowest responsive Bid of a responsible Bidder. This evaluation may include investigations to establish the responsibility, qualifications, financial resources, construction experience and organization available to do the Work pursuant to the Contract.

- A. Pre-Award Information Sheet: The Apparent Low Bidder shall, within seven (7) Business Days after receipt of a written request from the Owner or Engineer, submit the Pre-Award Information Statement in the Appendix of the Project Manual to the Project Manager.
- B. Responsible Bidder Information: If requested by the Owner, the Apparent Low Bidder must provide any Responsible Bidder information, including any applicable supplemental criteria requirements, within seven (7) Business Days. See Section 1-02.2.
- C. Seattle Business License: The Apparent Low Bidder must have a current Seattle Business License and must be current on all Business and Occupancy Taxes pursuant to SMC Ch. 5.45.060
- D. Equal Benefits: Except as may be provided in the Equal Benefits Program Rules, the Bidder under consideration for Award shall submit the Equal Benefits Work Sheet and Declaration to PCSD within seven (7) Business Days of receipt of the request. The Apparent Low Bidder's compliance with SMC Ch. 20.45 and the Equal Benefit Program Rules shall be part of the Owner's evaluation of the Bidder's responsibility. See Section 1-07.11(1) for more information and reporting requirements.
- E. Construction Outreach Plan: The Apparent Low Bidder is responsible for compliance with SMC Ch. 20.42 and RCW 35.22.650 pertaining to women and minority employment and subcontracting. If applicable, the Bidder shall submit an Outreach Plan to PCSD within seven (7) Business Days of receipt of the request, if applicable. The Appendix of the Project Manual contains a sample Outreach Plan form. See Section 1-07.11(2) for more information and reporting requirements. The Construction Outreach Plan shall document:
 1. Affirmative Efforts to employ women and minority group members;
 2. Affirmative Efforts to subcontract with Women and Minority Businesses on City contracts; and
 3. The Contractor's non-discrimination in the provision of goods and services.
- F. In addition, an 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; and
4. Such additional information as may be specified to assist the Owner in ascertaining the Bidder's general ability to perform the Work.

1-03.1(5) RIGHTS OF THE OWNER

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

1. Reject any or all Bids and, at the Owner's discretion, re-advertise for Bids,
2. Waive informalities or immaterial irregularities in the Bidding,
3. Accept the lowest responsive Bid of a responsible Bidder,
4. Correct arithmetical errors in a Bid,
5. Revise or cancel the Work,
6. Require the Work be done in another way if, in the opinion of the Owner, the best interest of the public will be served, and
7. Award such Additive, Deductive or Alternate, as may be set forth in the Bid Form.

1-03.2 AWARD OF CONTRACT

If a Contract is to be awarded, the Owner will endeavor to Award the same within sixty (60) Days after the Bid Opening Date. If a Contract is not awarded within that 60-Day Award period, all Bids will expire and will not be considered further unless, prior to the end of the 60-Day Award period the Owner requests and the Bidder(s) grant an extension of the time period for Bid evaluation and the allowable period for Award.

The following conditions shall apply to each such extension:

1. The extension shall be by mutual consent between the Owner and the Bidder(s);
2. The extension shall be documented in writing on a form acceptable to the Owner; and
3. The written extension shall be received by the Owner prior to the expiration of the initial 60-Day Award period.

The Owner reserves the right to request an extension after expiration of the 60-Day Award period subject to the consent of the Bidder(s).

1-03.3 EXECUTION OF CONTRACT

1-03.3(1) GENERAL

The Owner is prohibited by RCW 39.06.010 from executing a Contract with a Contractor who is not registered or licensed as required by the laws of the State. In addition, SMC 5.45.060 requires that every person engaging in business with The City of Seattle possess a City of Seattle Business License.

Bidders shall provide their City of Seattle Business License number and their State of Washington Contractor's Registration number in the spaces provided on the Bid Form Affidavit.

1-03.3(2) TIME TO EXECUTE AGREEMENT FORM

The original and one copy of the Project Manual, including the unsigned Agreement Form, will be available for signature by the successful Bidder, on the first Business Day following Award, at the:

Purchasing and Contracting Services Division
City of Seattle Department of Executive Administration

Physical address:

Seattle Municipal Tower, Suite 4112
700 Fifth Avenue
Seattle, Washington

Mailing address:

P.O. Box 94687
Seattle, Washington 98124-4687
Telephone (206) 684-0430

The successful Bidder shall submit to PCSD within ten (10) Business Days of Award:

1. The original Project Manual including signed Agreement Form;
2. The Contract Bond (see Section 1-03.4); and
3. Evidence of insurance (see Section 1-07.18).

The above time limit may be extended by mutual agreement between the Owner and the successful Bidder.

The Owner will forward a copy of the fully executed Agreement Form to the successful Bidder for incorporation into the successful Bidder's copy of the Project Manual.

No Work shall begin within the project limits or within sites furnished by the Owner until the successful Bidder has been given the Notice to Proceed per Section 1-08.4. The Contractor shall bear all risks for any Work begun prior to the issuance of the Notice to Proceed.

1-03.4 CONTRACT BOND

The successful Bidder shall provide an executed Contract Bond for the Awarded Contract Price. The Contract Bond shall:

1. Be on an Owner-approved form;
2. Be signed 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; and
 - d. Is included in the U.S. Department of the Treasury's Listing of Approved Sureties (Circular 570).

3. The Owner may require the Surety (or Sureties) named on the Contract Bond to appear and qualify itself whenever the Owner deems the Surety (or Sureties) to be inadequate. In such case, the Owner may require upon written demand that the Contractor furnish additional Surety to cover any remaining Work. Until the added Surety is furnished, payment on the Contract will stop.

1-03.5 FAILURE TO EXECUTE THE CONTRACT

The Bidder's Bid Guaranty will be 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 bond(s) and insurance(s) within the required time period.

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 bond(s) and insurance(s) within ten (10) Business Days after Award has been made to the second Bidder, or within the time period mutually agreed upon by the Owner and second Bidder, the second Bidder's Bid Guaranty will also be forfeited. The Contract may be Awarded successively in a like manner to the remaining responsible Bidders until the Agreement Form is executed and bond(s) and insurance(s) furnished by a responsible Bidder or the remaining Bids are rejected.

1-03.6 RETURN OF BID GUARANTY

After the Agreement Form has been executed and the required bond(s) and insurance(s) approved by the Owner, the Bid Guaranty in the form of a check will be returned to the successful Bidder. A Bid Guaranty in the form of a Bid Bond from the successful Bidder shall be filed with the executed Contract. A Bid Guaranty in the form of a check will be returned to each unsuccessful Bidder after Contract Award or after all Bids have been rejected. Bid Bonds of unsuccessful Bidders will be retained for thirty (30) -Days after the executed Contract has been filed with the City Clerk, and then disposed of, unless return is requested by an unsuccessful Bidder.

1-03.7 APPEALS

Any protest of an intended Award, any appeal of a notice that a Bid is non-responsive, or of a notice that a Bidder is not responsible must be filed in writing by 5:00 P.M. on the second Business Day after such notification. All such protests or appeals shall be filed with the:

Director
 Purchasing and Contracting Services Division
 City of Seattle Department of Executive Administration
physical address:
 Seattle Municipal Tower, Suite 4112
 700 Fifth Avenue
mailing address:
 P.O. Box 94687
 Seattle, Washington 98124-4687
 Telephone (206) 684-0430
 Fax (206) 684-4511

The Department of Executive Administration will review and decide all such protests and appeals.

SECTION 1-04 SCOPE OF WORK**1-04.1 INTENT OF 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 shall not relieve the Contractor from completing the Work.

The Project Manual may describe Work the Standard Specifications do not cover. The Contractor's Work shall comply first with the Special Provisions requirements of the Project Manual and then with any Standard Specifications that may apply. The Contractor shall include all costs of completing the Work in the Bid item prices.

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

The Contractor shall furnish all labor, Materials, tools, Equipment, transportation, Supplies, and everything needed or required to make each and every part of the Work complete. The Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.

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

Where the Contract requires Work that is not listed as a Bid item in a "Payment" clause of the Standard Specifications, then the costs shall be incidental and included within the Bid item prices of the various Bid items in the Contract. If Bid item 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 a Standard Specification, then payment will be in accordance with Section 1-09.4. Exceptions for Bid item work in which payment will be considered incidental to other Bid items are specified in the Standard Specification payment Sections and may also be included in the Contract in which no separate or additional payment will be made. See Section 1-09.3.

1-04.2 COORDINATION OF CONTRACT

All parts of the Contract are essential and complementary. A requirement occurring in one is binding as though occurring in all.

Work or Materials that have been omitted from the description of a part of the Work, but is clearly implied, shall be furnished by the Contractor as though it had been specifically stated. The Contractor shall inform 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
- 3) A discrepancy in the layouts and instructions given by the Engineer,

The Contractor shall 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 shall take precedence in the following order:

1. Change Orders.
2. Signed Agreement Form.
3. Addenda.
4. Project Manual (including Bid Form).
5. Drawings.
6. This hard copy version Standard Specifications.
7. The hard copy version Standard Plans.

The web and pdf file compact disc versions, and any other non-hard copy versions of the Standard Specifications and the Standard Plans are for informational purposes only. Should any discrepancy exist between this hard copy version of the Standard Specifications and the web and/or pdf file compact disc and/or any other versions of the Standard Specifications, this hard copy version Standard Specifications shall take precedence over all other versions. Should any discrepancy exist between the hard copy version of the Standard Plans, and the web and/or pdf file compact disc and/or any other versions of the Standard Plans, the hard copy Standard Plans shall take precedence over all other versions of the Standard Plans. Should any discrepancy exist between the hard copy version of the Standard Specifications, and any versions of the Standard Plans, the hard copy Standard Specifications shall take precedence over all versions of the Standard Plans.

When Seattle City Light "guidelines", "standards", or "procedures" are included in the Contract, they have precedence over the Drawings, Standard Specifications and Standard Plans, unless specified otherwise. Written dimensions shall take precedence over scaled dimensions.

Supplemental Drawings provided to the Contractor after the Award of the Contract to further detail or clarify the Work shall have precedence over all other components of the Contract, unless specified otherwise.

This order of precedence shall 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. If any part of the Contract requires Work that does not include a description for how the Work is to be performed, the Work shall be performed in accordance with standard trade practice(s). 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 Engineer shall be final as provided in Section 1-05.1

1-04.3 RESERVED**1-04.4 CHANGES**

As the Work proceeds, the Engineer may, at any time and without notice to the Surety or sureties, change the Work within the general scope of the Contract. Among others, these 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.

The Contractor shall obtain written consent of the Surety (or Sureties) if changed Work increases the Awarded Contract Price by more than 25 percent or the Engineer specifically requests the Surety's consent.

Changes in the Work will be incorporated into the Contract by Change Order. 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 1-04.5.

An equitable adjustment for deleted work will be made in accordance with 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 in accordance with Section 1-04.6. For all other changes the Engineer will determine if the change should be paid for at Bid item prices.

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. In general, the Engineer will seek the Contractor's agreement to the terms and the amount of equitable adjustment; however, if the parties are unable to agree on the terms or amount of equitable adjustment, the Engineer will unilaterally determine the amount of equitable adjustment in accordance with Sections 1-09.4 and, if applicable, 1-08.8. The Engineer's decision concerning an equitable adjustment of costs and time shall be final unless the Contractor files a claim and the claim is upheld pursuant to Section 1-04.5.

The Contractor shall proceed with the Work upon receiving:

1. A written Change Order approved by the Engineer, or
2. A written field directive from the Engineer before actually receiving the written Change Order.

Changes normally noted on field stakes or variations from estimated quantities other than noted above, will not require a written Change Order. These changes shall be made at the Bid item prices that apply. The Contractor shall respond immediately to changes shown on field stakes without waiting for further notice.

1-04.5 DISPUTE AND CLAIMS RESOLUTION PROCESS**1-04.5(1) SEQUENCE OF DISPUTE RESOLUTION PROCESS**

If a dispute occurs during the performance of the Contract, the Contractor shall follow the procedures outlined in Section 1-04.5(2). If the procedures outlined in Section 1-04.5(2) fail to provide a satisfactory resolution, the Contractor may then pursue the more formalized method outlined in Section 1-04.5(3), CLAIMS. If the procedures outlined in Section 1-04.5(3) fail to provide a satisfactory resolution, the Contractor may then pursue the method outlined in Section 1-04.5(4), MEDIATION. If the procedures outlined in Section 1-04.5(4) fail to provide satisfactory resolution, the Contractor may then pursue the procedures outlined in Section 1-04.5(5), LITIGATION. The Contractor agrees to follow this sequence of dispute escalation and claims resolution and by failing to follow such procedures, the Contractor completely waives any and all claim for protested Work.

1-04.5(2) NOTICE OF DISPUTE

If the Contractor disagrees with anything contained in a Change Order or any other written or verbal order from the Engineer, including any direction, instruction, interpretation, or determination by the Engineer, then prior to performing any of the Work that is subject to the dispute the Contractor shall:

1. file a signed and dated Notice of Dispute with the Engineer by the end of the Working Day immediately following the order, describing in detail the disputed Work and the nature of the dispute;
2. supplement the Notice of Dispute within ten (10) Working Days of its filing with a written statement providing the following:
 - a. the date of the supplemental written statement;
 - b. the date of the order to perform the disputed Work;
 - c. the nature and circumstances which caused the dispute;
 - d. the Contract provisions that relate in any way to the dispute;
 - e. the estimated additional dollar cost, if any, of performing the disputed Work and how that estimate was determined, in detail; and
 - f. 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

3. provide supplemental information if and when requested by the Engineer. Before final payment, the Contractor shall provide the Engineer a written statement of the actual adjustment of cost and/or Contract Time requested.

When performing any disputed Work, the Contractor shall keep complete records of actual costs and actual time incurred, identifying extra costs and extra time associated with the disputed Work. The Contractor shall permit the Engineer complete and unrestricted access to these and any other records the Engineer determines are necessary for evaluating the dispute.

Provided the procedures in this Section are followed, the Engineer will decide the dispute and notify the Contractor of his or her decision within ten (10) Working Days from the date the Contractor filed the supplemental written statement. If the Engineer rejects any part or all of the Contractor's request, the Engineer's notice will contain the reasons for the rejection. Payment for approved Work will be made in accordance with Section 1-09.4. In the event that the Engineer fails to decide the dispute within the ten (10) Working Days period, the Contractor may deem the dispute rejected and file a claim in accordance with Section 1-04.5(3).

Requests for extensions of Contract Time will be evaluated in accordance with Section 1-08.8.

In spite of any dispute, the Contractor shall proceed promptly and diligently with the disputed Work as the Engineer orders.

1-04.5(3) CLAIMS

If, after receiving the Engineer's decision under Section 1-04.5(2), the Contractor believes that either additional payment or an extension of the Contract Time is due, the Contractor may file a claim as provided in this Section. Claims of less than \$50,000 shall be filed within ten (10) Working Days of the date of the Engineer's written notice under Section 1-04.5(2). Claims equal to or greater than \$50,000 shall be filed within twenty (20) Working Days of the date of the Engineer's written notice. The Contractor waives any claim for additional payment if a claim is not filed as provided in this Section. All claims shall be in writing, shall contain sufficient detail to enable the Engineer to ascertain the basis and amount of the claim, shall be certified by the Contractor as stated below and shall be filed with the Engineer. No claim will be allowed after the Completion Date.

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

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 date on which facts arose which gave rise to the claim;
4. the name of each individual, official, or employee involved in or knowledgeable about the claim;
5. the specific provisions of the Contract which support the claim and a statement of the reasons why such provisions support the claim;
6. if the claim relates to a decision of the Engineer which the Contract leaves to the Engineer's discretion or as to which the Contract provides that the Engineer's decision is final, the Contractor shall set out in detail all facts supporting its position relating to the decision of the Engineer;
7. the identification of any documents and a written statement of the substance of any oral communications that relate in any way to the claim;
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 shall clearly state which part or parts of the industry standard the Contractor is relying upon);
9. if an extension of Contract Time is sought:
 - 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 specific provisions of Section 1-08.8 under which it is sought, and
 - d. the Contractor's analysis on the critical path of its accepted critical path schedule in effect at the time to demonstrate the reason for a time extension (see item 10g in this Section 1-04.5(3));
10. if additional compensation is sought, the exact amount sought and a breakdown of that amount into the following categories:
 - a. Direct Labor: Limited to the amount calculated in accordance with Section 1-09.6(2), excluding the 29% markup;
 - b. Direct "Materials": Limited to the amount calculated in accordance with Section 1-09.6(3), excluding the 21% markup;
 - c. Direct Equipment: Limited to the amount calculated in accordance with Section 1-09.6(4), excluding the 21% markup. The claim shall include the actual cost for each piece of equipment used in connection with the claimed amount or, in the absence of actual cost, the rates contained in the AGC/WSDOT Equipment Rental Agreement in effect when the Work was performed. The amounts claimed for any piece of equipment shall not exceed the rates contained in that Equipment Rental Agreement even if the actual cost for such Equipment is greater. The Engineer may audit the Contractor's cost records as provided in Section 1-09.12 to determine actual equipment costs. The Contractor's claim shall include the following information for each piece of equipment:
 - (1) detailed description (e.g., Motor Grader Diesel Powered Caterpillar 12 "G", Tractor Crawler ROPS & Dozer Included Diesel, etc.);
 - (2) the hours of use or standby; and
 - (3) the specific Day(s) of use or standby.

- d. Overhead and Profit: Markups for Project overhead, general company overhead, bonding, insurance, Business & Occupation tax, and profit shall not exceed the markups allowed in Section 1-09.6;
 - e. Subcontractor Costs: Payments Contractor makes to Subcontractors at any tier for performing Work included in the claim. This cost shall be calculated and itemized in the same manner prescribed for the Contractor.
 - f. Equipment Mobilization: If necessary equipment is not on the Project Site and it was not anticipated that the equipment would be required for the performance of other Work under the Contract, the amount for mobilization, as provided in Section 1-09.6(6);
 - g. If the claim relates to an alleged delay or other change in the Contract Time, the Contractor shall demonstrate the impact on the critical path of the accepted critical path schedule in effect at the time of the occurrence giving rise to the claim;
 - h. Other categories as specified by the Contractor;
 - i. What the changes to Contract Time and cost were as compared to doing the disputed Work without the Engineer directing, instructing, interpreting, or determining to change the Work; and
11. 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 compensation 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
 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 shall permit 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. The Contractor shall retain these records for a period of not less than three years after the Completion Date.

The Contractor shall only pursue administrative resolution of any claim with the Engineer or the designee of the Engineer.

The Contractor shall provide to the Engineer, a written statement detailing the actual adjustment requested in cost, or Contract Time, or both cost and Contract Time before final payment is released. Failure to submit such information and details as described for any claim shall operate as a waiver of the claims by the Contractor

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

- 1. within forty-five (45) Working Days from the date the claim is filed if the claim amount is less than \$50,000;
- 2. within ninety (90) Working Days from the date the claim is filed if the claim amount is equal to or greater than \$50,000; or
- 3. if the Engineer determines that the above constraints are unreasonable due to the complexity of the claim under consideration, the Engineer will notify the Contractor within fifteen (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.
- 4. If the Engineer fails to provide written notice within the time periods set forth above, the claim shall be deemed to have been denied and the Contractor may proceed to mediation in accordance with Section 1-04.5(4).

Full compliance by the Contractor with the provisions of this Section is a condition precedent to the Contractor’s right to pursue mediation or to seek judicial relief.

1-04.5(4) MEDIATION

If the Engineer denies the claim the Contractor shall, within thirty (30) Days of receiving the Engineer’s written notice of denial and prior to the initiation of any judicial proceedings, file a written notice in accordance with Section 1-05.15 of the decision to mediate its claim with a mutually acceptable mediator. The date the Contractor’s written notice is received by the Engineer shall be the date of filing the written notice. The failure to file the written notice within the time period stated above shall result in the Engineer’s decision rendered in accordance with Section 1-04.5(3) being final and binding on the Contractor and all its Subcontractors. The Contractor shall not be allowed to change the scope of the claim as originally presented. The mediation will occur within sixty (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. Each party may be represented at the mediation by lawyers. The parties shall each bear their respective costs incurred in connection with this procedure, except that they shall 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 provided in Section 1-04.5(5).

1-04.5(5) LITIGATION

If mediation does not resolve the disputed matter, the Contractor may serve and file a lawsuit in the Superior Court of King County, Washington. Such lawsuit shall be filed within one hundred eighty (180) Days of the Physical Completion Date. 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 shall result in the Engineer's decision rendered in accordance with Section 1-04.5(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 shall, upon demand by the Owner, be submitted in a single forum or the Owner may consolidate such claims or join any of the above-named parties in the same forum.

1-04.5(6) AUDITS

All claims by the Contractor for additional compensation shall be subject to audit in accordance with Section 1-09.12. In the event of an audit the Contractor shall make available to the Owner all documents that the Engineer requests within seven (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 permit Owner access to the books and records of the Contractor, or Subcontractor of any tier, shall constitute a waiver of the portion of the claim that cannot be documented and shall bar any recovery for any portion of a claim that cannot be documented.

1-04.6 INCREASED OR DECREASED QUANTITIES

Payment to the Contractor will be made only for the actual quantities of Work performed and accepted in conformance with the Contract. When the accepted quantities of Work vary from the original Bid quantities, payment will be at the Bid item prices for accepted Work unless the total quantity of any Bid item increases or decreases by more than 25 percent from the amounts contained in the Bid. In that case, the following adjustments will be made:

1. **Increased Quantities:** The Contractor will be entitled to an equitable adjustment for that portion of the actual quantity in excess of 125 percent of the original Bid quantity. The price for increased quantities will be determined by agreement of the parties or, where the parties cannot agree, by the Engineer based upon the actual costs to perform the Work, including reasonable markup for overhead and profit.
2. **Decreased Quantities:** The Contract will be equitably adjusted if the actual quantity of Work is less than 75 percent of the original Bid quantity. The equitable adjustment in the case of decreased quantities shall be based upon any increase or decrease in costs due solely to the variation of the estimated quantity. The total payment for any Bid item will be limited to no more than 75 percent of the amount originally Bid for the Bid item.
3. **Adjustment Limits:** The following limitations shall apply to the adjustment:
 - a. The Equipment rates shall be actual cost but shall not exceed the rates set forth in the AGC/WSDOT Equipment Rental Agreement in effect at the time the Change Order Work is performed as referenced to in Section 1-09.6.
 - 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 claim for consequential damages will be allowed because of any variance in quantities from those originally shown in the Contract.

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

The Owner will not adjust for increases or decreases if the Owner has entered the amount for the item in the Bid Form only to provide a common basis for Bidders.

1-04.7 DIFFERING SITE CONDITIONS "CHANGED CONDITIONS"

If the Contractor encounters:

1. pre-existing subsurface or latent physical conditions at the Project Site differing materially from those indicated in the Contract; 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,

Then, the Contractor shall, on the date of discovery or promptly the next Working Day and before such conditions are disturbed, provide written notice to the Engineer of the conditions encountered. Upon notification, the Engineer will promptly investigate the alleged changed condition. If the Engineer finds that conditions are materially different and cause a material increase or decrease in the Contractor's cost of, or the time required for, performing all or any part of the Work, whether or not changed as a result of such conditions, the Engineer will make an equitable adjustment in the payment or the time required for the performance of the Work. Extensions of time will be determined in accordance with Section 1-08.8. The equitable adjustment will be by agreement with the Contractor. However, if the Engineer and Contractor are unable to agree, the Engineer will determine the amount of the equitable adjustment in accordance with Section 1-09.4.

If the Engineer determines that differing site conditions do not exist, the Contractor will be so notified by written notice. Should the Contractor disagree with such determination, the Contractor may file a written notice of dispute with the Engineer pursuant to the requirements of Section 1-04.5. The Contractor shall proceed with the Work unless ordered to suspend that portion of the Work pending a decision as to the validity of any differing site conditions claim, or pending the execution of a Change Order, if the Engineer approves a claim for differing site conditions.

No claim of differing site conditions will be allowed unless the Contractor has given the written notice required above; provided, however, the time for giving the written notice may be extended by the Engineer for good cause. Time extensions will be evaluated pursuant to Section 1-08.8. 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 site 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 site condition shall not affect the Engineer's right to make an adjustment in costs or time.

No claim by the Contractor for an equitable adjustment hereunder will be allowed unless:

1. The Contractor has followed the claim procedures provided in Section 1-04.5, and
2. The claim is asserted in accordance with Section 1-04.5(3).

1-04.8 PROGRESS ESTIMATES AND PAYMENTS

Engineer-issued progress estimates or payments for any part of the Work shall 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 in accordance with Section 1-09.9(4).

1-04.9 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 indicated in the Contract.

1-04.10 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 shall be as follows unless the Engineer approves otherwise:

1. Used as selected material, pursuant to Section 2-03.3(10).
2. Delivered to the Engineer as salvage pursuant to Section 2-02.3(7).
3. Disposed of in accordance with Section 2-01.2.

1-04.11 ROADSIDE CLEANUP AND FINAL CLEANUP

From time to time or as may be ordered by the Engineer during the prosecution of the work, the Contractor shall cleanup and remove debris, refuse, and discarded materials of any kind resulting from the Work.

Disposal of waste shall be in accordance with Section 1-07.3.

The Contractor shall also perform final cleanup as provided 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 shall be left neat, clean, and presentable. The Contractor shall not remove warning, regulatory, or guide signs unless approved otherwise in writing by the Engineer. Failure to do the final cleanup may result in the final cleanup and disposal being done by the Owner and the cost thereof charged to the Contractor.

The Contractor shall at a minimum :

1. Remove and dispose all rubbish, surplus Materials not identified as salvage by the Owner, 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, flush the pavement clean and dispose of the wash water and debris;
4. Sweep and flush structure decks and properly dispose of wash water and debris;
5. Clean out from all Culverts and drains, inlets, catch basins, manholes 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 (Sections 2-01.2 and 2-03.3(13)), and any temporary waste sites created by the Contractor, is in accordance with 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 shall 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 accomplished.

All costs associated with cleanup and disposal shall be incidental to the Work and shall 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

The Engineer shall be satisfied that all Work is being done in accordance with the requirements of the Contract. The Contract gives the Engineer authority over the Work. Whenever it is so provided in this Contract, the decision of the Engineer shall be final, provided that such decision may be challenged in accordance Section 1-04.5.

The Engineer's decisions will be final on all questions including, but not limited to, the following:

1. Quality and acceptability of Materials and Work;
2. Measurement of Bid item Work;
3. Acceptability of rates of progress on the Work;
4. Interpretation of the Contract;
5. Determination as to the existence of differing site conditions;
6. Fulfillment of the Contract by the Contractor;
7. Payments under the Contract including equitable adjustments;
8. Suspension of the Work;
9. Determination as to Unworkable Days;
10. Reviews of submittals; and
11. 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 orders from the Engineer:

1. The Engineer, per Section 1-05.8, may use the Engineer's forces, other Contractors, or other means to accomplish the Work; and
2. The Owner, per Section 1-09.9(3), will not be obligated to pay the Contractor, and will deduct from the Contractor's payments, additional costs above the Contractor's bid prices that result when any other means must be used to carry out the Contract requirements or Engineer's orders.

At the Contractor's risk, the Engineer may suspend, per Section 1-08.6, all or part of the Work, 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 weather or other conditions are unsuitable; or
3. 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 approves or recommends any method or manner for doing the Work or producing Materials, the approval or recommendation shall not:

1. Guarantee that following the method or manner will result in compliance with the Contract;
2. Relieve the Contractor of any risks or obligations under the Contract; or
3. 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 complies with 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. An Assistant is not authorized to approve or accept any Work or Materials, or to issue instructions or advice, contrary to the provisions of the Contract.

Work performed or Materials furnished that at any time is found not to conform to the Contract shall be at the Contractor's risk and shall not be a basis for a claim, although an Assistant purports 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.

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 shall 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 fifteen (15) feet of an energized electrical transmission or distribution system as indicated by "marked for locate" per Section 1-07.17(1); or as otherwise deemed necessary by the Engineer.

The only exception shall be 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.

When the Work includes a substation, or a switchyard, or an energized vault, or Work within two (2) feet of an underground energized electrical distribution or transmission system, the Contractor shall provide a minimum seven (7) Working Days advance notice request for an Electrical Safety Observer. See Section 1-07.28 for notification requirements.

The Contractor shall 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 shall provide one (1) Working Day advance notice unless arranged otherwise with the Electrical Safety Observer. Failure to inform the Electrical Safety Observer, at least one (1) Working Day in advance of a change in the Contractor's schedule where an Electrical Safety Observer is not required, will result in the Owner backcharging the Contractor for the Electrical Safety Observer's services at the site.

The Electrical Safety Observer's involvement with site safety shall 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 shall have the authority, but not the duty, to stop Work if the Electrical Safety Observer judges that there is any hazard that immediately imperils life, health, or property.

The Contractor shall have sole responsibility for safety pursuant to the Contract. The presence or absence of an Electrical Safety Observer shall not alter the Contractor's responsibility for the occupational health and safety of individuals on the Project Site and shall not relieve the Contractor of any of its legal obligations for worker safety.

The Contractor shall designate a Contractor's On-Site Electrical Lead and shall ensure that each Subcontractor designates a Subcontractor's On-Site-Lead when Work requires an Electrical Safety Observer. The On-Site Electrical Lead shall be authorized to resolve safety-related issues raised by the Engineer, Assistant, or Electrical Safety Observer. The Contractor shall ensure that such On-Site Electrical Lead is physically present at the work requiring an Electrical Safety Observer. Each On-Site Electrical Lead, whether Contractor's or Subcontractor's, shall identify himself or herself 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 shall 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 onsite supervisory representative, shall complete and sign the Safety Watch Checklist and Certification of Training form provided by the Electrical Safety Observer before work begins for which an Electrical Safety Observer is required.

1-05.3 SUBMITTALS

1-05.3(1) GENERAL

The City encourages the use of environmentally friendly Materials. Whenever practicable, the Contractor shall use recycled and reusable products including recycled content paper on all documents submitted to the Owner or to the Engineer.

Section 1-05.3 does not address submittals or other documentation required by the Owner.

Section 1-05.3 addresses submittals required by the Engineer. See Section 1-08.3(2) for a list of the initial submittals the Contractor shall transmit to the Engineer. Each submittal shall be complete and in sufficient detail to allow the Engineer ready determination of compliance with Contract requirements.

Guaranty and warranty are addressed in Section 1-05.10.

A lump sum breakdown submittal (Section 1-09.3(2)) shall be submitted in accordance with this Section. Payment for any progress estimate that includes a lump sum Bid item, where more than one progress estimate is required to pay for that lump sum Bid item, will not be made until the required lump sum breakdown is submitted to, and accepted by, the Engineer.

Unless the Contract specifies otherwise:

1. The Contractor shall coordinate the scheduling, sequencing, preparing, and processing of submittals with the scheduling of and performance of the Work so that Work shall not be delayed by submittal processing. Failure to timely provide submittals required by the Contract may be cause for the Owner to withhold Contractor payments as specified in Section 1-09.9(3).
2. The Contractor shall prepare and update a Submittal Control Document in accordance with Section 1-05.3(9).
3. To better coordinate the progress of Work, submittals for related portions of the Work shall be submitted at the same time.
4. Submittals dependent on conditions, equipment or material presented in other submittals may be returned "Rejected" or "Revise and Resubmit" or "Make Correction Noted" as described in Section 1-05.3(4).
5. See Section 1-06.1 for the approval of material or equipment under "or equal" terms. The Contractor shall allow an additional ten (10) Working Days for the Engineer to review "or equal" submittals. Submittals requesting "or equal" approval shall identify the "or equal" items on the submittal cover sheet and shall contain sufficient documentation to ensure compliance with Contract requirements.
6. The Contractor forfeits any claim to compensation for extra costs or additional Contract Time associated with processing of or responding to requests for approval of "or equal" material or equipment, or resubmittals as specified in Section 1-05.3(4).
7. Each submittal copy shall have a submittal cover sheet as specified in Section 1-05.3(2).

The Contractor shall coordinate assembly of all submittals, including, but not limited to, those prepared by Subcontractor, Materialperson, manufacturer, or Professional Engineer. The Contractor shall examine and verify all submittals for accuracy, completeness, and compliance with Contract requirements before transmitting the submittal to the Engineer.

The Contractor shall sign a submittal cover sheet (Submittal Review Form) for each submittal item, thereby accepting responsibility for the correctness and completeness of the submittal. A copy of the Submittal Review Form is included in the Appendix of the Project Manual; however, the Contractor's standardized submittal transmittal form will be considered acceptable if the information provided meets the minimum requirements specified for "submittal cover sheet" in this Specification. One submittal cover sheet shall be filled out by the Contractor for each submittal item.

The Contractor shall retain a copy of each submittal returned by the Engineer at the Project Site, and shall allow the Engineer to see the returned submittal when requested by the Engineer.

1-05.3(2) SUBMITTAL COVER SHEET

Unless the Contract specifies otherwise, each submittal shall have a cover sheet. Multiple submittals without one submittal cover sheet for each submittal will be rejected. The submittal cover sheet may be a Contractor's standard form; however, the cover sheet shall, as a minimum, contain the following information:

1. Be numbered consecutively with a whole number beginning with "1". Where a resubmittal is required, the resubmittal shall be labeled with the same whole and "resubmittal decimal number". [Example – "Submittal no. 7"; "Resubmittal no. 7.1", "Resubmittal no. 7.2", etc.].
2. Contractor's name and address, and if not prepared by the Contractor, this information shall be supplemented with "prepared by" information, i.e., Subcontractor, Materialperson, manufacturer, or Professional Engineer who prepared the submittal, and that entity's name and address.
3. The title of the Project and PW# (public works number located on first page of Agreement Form).
4. Transmittal date of submittal.
5. Submittal description (see Section 1-05.3(6). If a resubmittal, a copy of the original submittal returned by the Engineer shall be included.
6. Contract reference(s) (Standard Specification Section(s), or Project Manual Specification Section(s), or Drawing sheet number(s), or Detail(s) on Drawings, or Note(s) on Drawings, etc.).
7. Bid item applicable or intended use.
8. As the Contract may require and other information for the Engineer's review.
9. A statement that the Contractor has reviewed and verified submittals by Subcontractor, Materialperson, manufacturer, and Professional Engineer meet Contract requirements.
10. Where a variation or clarification or verification or explanation or extra information is requested, such shall be clouded or highlighted on the cover sheet.
11. If submittal, or portion thereof, is prepared by a Professional Engineer, then provide such information as specified in Section 1-05.3(12).
12. Each submittal cover sheet shall have a clear space of no less than 2 inch by 3 inch for the Engineer's review stamp. In addition, Shop Drawings shall each also have a clear space of no less than 2 inch by 3 inch for the Engineer's review stamp preferably located in the lower, right-hand corner of each Shop Drawing sheet.

A sample submittal cover sheet will be located in the Appendix of the Project Manual.

1-05.3(3) CONTRACTOR SUBMITTAL DELIVERY, TIMELINES, NUMBER OF COPIES, BID ITEM REFERENCES, AND EXTRA SUBMITTALS

Submittal delivery: At the pre-construction conference, the Engineer may make other arrangements with the Contractor on various type submittal delivery methods.

All submittals and resubmittals shall be directed to the Engineer. The Engineer will date stamp the submittal cover sheet when the complete submittal is received by the Engineer on a Working Day before 2:00 PM pacific time. Submittals received on or after 2:00 PM will be date stamped the following Working Day.

Delivery in person: All non-bulk sample submittals:
 SPU Construction Management Front Desk
 Seattle Municipal Tower
 700 Fifth Avenue, 47th Floor
 Seattle, WA. 98124
 (206) 684-5068

Delivery by mail: All non-bulk sample submittals:
 SPU Construction Management
 Seattle Municipal Tower
 P.O. Box 34018
 Seattle, WA. 98124-4018
 (206) 684-5068

Delivery by Fax (206) 684-8581

Bulk sample submittals, unless the Engineer agrees otherwise at the Preconstruction Conference, include Mineral Aggregate, Hot Mix Asphalt, geotextile, pipe, and similar. Such samples shall be delivered to:
 SPU Materials Laboratory

707 South Plummer Street
 Seattle, WA 98134
 (206) 386-1800

Number of submittal copies:

Submittals shall consist of an original and 8 copies. Also see Section 1-05.3(10) Shop Drawings.

Resubmittals shall consist of an original and 8 copies, all showing required upgrade.

See Section 1-05.3(7) Submittal Return, for number of copies the Engineer returns.

Submittal Timelines: Unless otherwise specified in this Specification, the Contractor shall allow the Engineer ten (10) Working Days to review and to return the submittal to the Contractor.

Submittal timelines shall begin on the date stamped by the Engineer on the submittal cover sheet.

The Contractor shall timely transmit submittals to meet Contract Time, and shall take into consideration the possibility of resubmittal.

See Section 1-05.3(7) for Engineer submittal return process and timeliness.

1-05.3(4) RESUBMITTALS

Submittals returned to the Contractor marked "Rejected" or "Revise and Resubmit" will include Engineer comments for requiring a resubmittal. The Contractor shall address the Engineer's comments in its resubmittal, and the Contractor's correction shall be clearly identified in the resubmittal to assist the Engineer's review.

Unless the Contract specifies otherwise, submittals returned by the Engineer marked "Rejected" or "Revise and Resubmit" shall require a new submittal ("resubmittal") and shall be considered a new submittal as specified in Section 1-05.3(1) with new timelines as specified in Section 1-05.3(3). No extension of Contract Time will be allowed for resubmittals.

The cover sheet for resubmittals shall be clearly labeled "RESUBMITTAL", and shall include a copy the original returned submittal cover sheet including all Engineer comments

Resubmittals not conforming to these Specifications will be rejected, and shall be resubmitted until the Engineer determines the submittal conforms to these Specifications.

1-05.3(5) CONTRACTOR'S REQUESTS FOR INFORMATION AND SUBMITTAL DEVIATION

Contractor requests for written clarification on whether an item of Work requires a submittal shall be made, in writing, prior to or with the Contractor's Submittal Control Document, in accordance with Section 1-05.3(9).

The Engineer's review of requests for written clarification or submittal deviations shall not relieve the Contractor from responsibility for the submittal timeline requirements of the Contract, nor will review by the Engineer relieve the Contractor from responsibility for errors or omissions in submittals, or from responsibility for having complied with the provisions of Section 1-05.3.

The Appendix of the Project Manual will contain a copy of the Engineer's required written notice form titled:

"Request for Information/
 Design Clarification/Variation Request"

Each Contractor's Request for Information or Design Clarification/Variation shall contain this form, supplemented with other appropriate information as may be specified elsewhere and as may apply.

Such information request submittal found to contain error, or unapproved deviation or variation from the Contract, may be determined by the Engineer to be out of compliance with the Contract. The Contractor agrees that any costs and any delay associated with a non-conforming information request are the Contractor's sole responsibility and agrees that the Engineer has no requirement to extend Contract Time or to make additional payments of any kind.

If the Contractor considers any comment by the Engineer on the returned Contractor's extra information request submittal to constitute a Change Order, the Contractor shall make such written notice in accordance with Section 1-04.4.

Deviation From Returned Submittal: Where the Contractor intends to change, or deviate from, a previously reviewed submittal returned by the Engineer, the Contractor shall resubmit the originally reviewed submittal to the Engineer for additional review indicating the proposed changes or deviations from the originally reviewed submittal and shall clearly state reasons, additional calculations, additional details, as necessary to support such need for change or deviation.

Substitution: All materials, equipment, equipment assemblies, or methods proposed by the Contractor as a substitution for a specified item on an "or equal" basis shall be addressed in the submittal.

In making a request for substitution, in addition to the requirements in Section 1-06.1 and the Specification Section addressing the material or equipment or equipment assembly, the Contractor's submittal shall demonstrate the proposed substitution:

- (1) Is equal or superior in all respects to the material or equipment specified; and,
- (2) Has the same guarantee or warranty as the item specified

The Contractor shall waive all claims for additional cost and extension of time related to the substituted item .

1-05.3(6) TECHNICAL SUBMITTAL DESCRIPTIONS

Where a submittal contains information with more than one option (catalog cut, manufacturer's written instructions, recognized trade association standard, "specified designation", etc.), the option applicable to the submittal shall be clouded or highlighted.

Unless specified otherwise in the Contract, submittals shall have descriptions as follows.

- 1) Shop Drawings: See Section 1-05.3(10).
- 2) Product Data: Includes catalog cuts, illustrations, schedules other than as required by Section 1-08.3(1), diagrams, performance charts, instructions, and brochures illustrating size, physical appearance, and other characteristics of Materials or equipment for some portion of the Work. Also includes warranties when the Contract requires extended product warranties.

Where Product Data submitted is incomplete in describing compliance with all specified requirements, supplement with material prepared for the project that completes the information required by the Contract.

Product Data dimensions submitted shall match the dimensions indicated in the Contract (for example – English units = pounds, feet, etc., metric units = kilograms, centimeters, etc.).

Product Data shall include manufacturer's name, trade name, place of manufacture, and catalog model or number.

Measurement referencing designated standards organization's standards specified in the Contract shall be included in the Product Data. If such information is not in the Product Data, then such measurement shall be provided as specified in Section 1-06.5.
- 3) Samples: Includes physical samples of Mineral Aggregate, Material, equipment, and workmanship that illustrate functional and aesthetic characteristics of a product, and establish standards by which the Work can be judged.

Size or number of sample shall be as specified in the submittal Specification.

Color and similar type samples from the Materialperson to be used in selecting or approving colors for the applicable portion of the Work.

Field samples and mock-ups constructed on the Project Site to establish standards by which applicable portions of the Work can be evaluated.

Where samples show a range of variation that are unavoidable due to the nature of the material, the sample size shall include at least three (3) units showing the extremes and middle of the range.
- 4) Design Data: Several Standard Specifications require, and the Contract may specify, calculations, mix designs, analyses, or other data pertaining to a portion of the Work.
- 5) Test Reports: Report signed by authorized professional of private testing laboratory or certified individual that a Material, product or system identical to the material or product or system to be provided has been tested in accordance with specified requirements. May also include findings of a report on an actual portion of the Work or prototype prepared for the project before shipment to Project Site. May also include a finding of a test of a portion of Work at, or a sample of the Work taken from, the Project Site, and may be during or after installation. May also be an investigative report, a checklist, or an operational test procedure.

Also see Section 1-06.5.
- 6) Manufacturer's Certificate of Compliance: See Section 1-06.3.
- 7) Manufacturer's Written Instruction: Preprinted material describing installation of a product, system or Material, including special notices and Material Safety Data Sheets (MSDS) concerning impedances, hazards and safety precautions.
- 8) Operational Testing, and Operations and Maintenance Manual: See Section 1-05.11(3).
- 9) Critical Path Schedule: See Section 1-08.3(1).
- 10) As-Built Drawings: See Section 1-05.3(11).
- 11) Submittal Prepared By Professional Engineer: See Section 1-05.3(12).

1-05.3(7) ENGINEER'S SUBMITTAL REVIEW, ACTIONS POSSIBLE, AND SUBMITTAL RETURN

The Engineer's submittal review is to ensure compliance with the requirements of the Contract. The Engineer's review shall not extend to consideration of the integrity 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.

Actions possible: The Engineer will include on the returned submittal a list of options. Only one of the options will be checked. Unless the Contract specifies otherwise, the following notations shall be 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 obtain Materials or equipment, as contained in the submittal. Where more than one submittal is required for a portion of the Work or for a greater portion of Work containing the submittal portion, no portion of Work shall proceed until all submittals required of that Work portion are returned by the Engineer without requiring resubmittal.

The Contractor shall not revise in any way, a portion of the Work or fabrication based on submittal returned "No Exception Taken". Revisions shall only be made in compliance with the requirements of Section 1-05.3(5).

- 2) **"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 shall be resubmitted with appropriate changes. Submittals that are carelessly prepared or erroneous or illegible or lacking the Contractor's approval, are non-conforming and must be resubmitted.
- 3) **"Make Corrections Noted"**: Submittals returned and marked "Make Corrections Noted" authorize the Contractor to proceed with the portion of Work covered by the submittal with the correction noted. Before beginning such Work, the Contractor shall resubmit eight (8) copies of such submittal showing the noted correction. Should such correction not appear in the applicable portion of the Work, that portion of Work will be determined as unauthorized Work as specified in Section 1-05.7.
- 4) **"Submit Specified Item"**: Submittals returned and marked "Submit Specified Item" indicate an incomplete submittal and do not authorize the Contractor to perform that portion of the Work. The "specified item" must be resubmitted in accordance with Section 1-05.3(4).

Submittal return: The Engineer will return two (2) copies of a submittal to a location and by a method agreed to by the Engineer at the pre-construction conference. If no agreement is reached, the submittals will be returned to the Contractor's business address.

1-05.3(8) ACTIONS BY CONTRACTOR BEFORE SUBMITTAL RETURN BY ENGINEER

Unless the Contract specifies otherwise, the Contractor shall not purchase any Material's or equipment for incorporation into the Work, or begin fabrication of any Work requiring a submittal, until the Contractor has received an approved submittal for such portion of the Work.

1-05.3(9) SUBMITTAL CONTROL DOCUMENT

The Contractor shall reference its critical path schedule in effect at the time of the submittal.

At the pre-construction conference, the Contractor shall 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.

Unless the Contract specifies otherwise, for Bid Documents indicating Contract Time of less than two hundred (200) Working Days, the Contractor shall prepare and submit to the Engineer within fourteen (14) Days after the Notice to Proceed Date, a submittal control document in duplicate, listing all submittals and when these submittals shall be delivered to the Engineer.

For Bid Documents indicating Contract Time of two hundred (200) Working Days or more, the Contractor shall prepare and submit to the Engineer within thirty (30) Days after the Notice to Proceed Date, a submittal control document in duplicate, listing all submittals and when these submittals shall be delivered to the Engineer. The only exception is for portions of the Work scheduled to begin within the first sixty (60) Working Days. All submittals required for such Work shall be submitted at least ten (10) Working Days before that portion of Work is scheduled to begin.

The submittal control document shall identify the portions of the Work and Bid items that contain "or equal" substitutions (see Sections 1-05.3(6) and 1-06.1).

The submittal control document shall be coordinated with the Work and with the proposed progress schedule as discussed at the preconstruction conference (see Section 1-08.1(2)). The data in the submittal control document shall not relieve the Contractor of the obligation to comply with the requirements regarding Contract Time. The Contractor shall review the submittal control document at least every thirty (30) Days, update or correct the submittal control document as necessary, and shall submit eight (8) copies of the updated or corrected document to the Engineer along with any revised critical path schedule.

1-05.3(10) SHOP DRAWINGS

1-05.3(10)A GENERAL

The Contract may require portions of the Work be supplemented by Shop Drawings to detail and illustrate those portions of the Work. Shop Drawings shall be prepared by the Contractor, and may require additional preparation by a Subcontractor, Materialperson, or Professional Engineer when applicable.

1-05.3(10)B SHOP DRAWING SIZE AND LAYOUT

Shop Drawings may be on 24 x 36 sheets or, if adequately clear to the Engineer, on smaller sheets sized 8-1/2 x 11, or 8-1/2 x 14, or 11 x 17 as appropriate – all dimensions in inches.

The original shall be a reproducible original set such as mylar. Other types of reproducibles will be accepted provided they are on clear and permanent type material and the Engineer can readily produce copies and be suitable for microfilming (e.g., reprographic Mylar base film).

1-05.3(10)C SHOP DRAWING SUBMITTAL DETAILS

Before submittal of Shop Drawings, the Contractor shall have determined and verified all quantities, dimensions, specified performance criteria, installation requirements, Materials, catalog numbers and similar data and reviewed or coordinated each Shop Drawing with other Shop Drawings and with the requirements of the Contract. Also see Section 1-04.2 regarding the precedence of figured and scaled dimensions.

Copies of the Drawings and of Standard Plans as substitute for Shop Drawings will be rejected and shall require resubmittal.

1-05.3(10)D SHOP DRAWINGS VARYING FROM CONTRACT REQUIREMENTS

Submittal of a Shop Drawing that varies from the Contract requirements shall be considered as a request for submittal deviation and shall comply with the requirements of Section 1-05.3(5).

1-05.3(10)E SPECIFICATIONS REQUIRING SHOP DRAWING SUBMITTALS

Except as otherwise provided in the Contract, the following listed Specification Sections of the Standard Specifications contain Shop Drawing submittal requirements that may or may not be applicable to the Work in the Contract:

DIVISION 2 EARTHWORK

2-09.3(3)D Shoring and Cofferdams

DIVISION 6 STRUCTURES

6-01.9 Structures, General Requirements
 6-02.3(13)A Expansion Joints
 6-02.3(13)B Compression Seal
 6-02.3(16) Plans for Falsework and Forms
 6-02.3(17) Falsework and Forms
 6-02.3(24)A Reinforcement (General)
 6-02.3(25) Prestressed Concrete Girders
 6-02.3(26) Cast in Place Prestressed Concrete
 6-02.3(28) Prestressed Concrete Panels
 6-02.3(29) Downspouts
 6-02.3(34)A Removal of Concrete (Structures)
 6-03.3(7)A Shop Drawings (Steel Fabricating)
 6-03.3(7)B Erection Methods (Steel Structures)
 6-03.3(25) Welding and Repair of Welding
 6-03.3(27) High Strength Bolt Holes
 6-03.3(28) Shop Assembly
 6-03.3(32) Assembling and Bolting (Steel Structures)
 6-04.3(3) Shop Details (Treated Lumber)
 6-05.3(11)H Pile Driving from or near Adjacent Structures
 6-06.3(2) Metal Railings
 6-11.1(1) Precast Concrete Retaining Wall Systems

**DIVISION 7 STORM DRAIN, CULVERTS, SANITARY AND COMBINED SEWERS,
 WATER MAINS AND RELATED STRUCTURES**

7-02.3(1)A General (Placing Culvert Pipe)
 7-03.3(6) Alternate Installation (Structural Plate Pipe, Etc.)
 7-05.2 Material (MH, CB, and Inlets)
 7-05.3(1)K Joints
 7-05.3(1)L Shop Fabricated Corrugated Metal Manholes
 7-10.3(7)G2 Support System
 7-17.3(1)A7b Support System
 7-17.3(2)J Underground Construction

DIVISION 8 MISCELLANEOUS CONSTRUCTION

8-01.3(2) Temporary Erosion And Sediment Control
 8-30.1(3) Electrical Shop Drawings
 8-11.3(1)E Guardrail Shop Drawings
 8-14.3(7)B Wheel Chair Ramp
 8-14.3(7)F Curb Ramp Retrofit
 8-31.1(4)A Signalization Shop Drawings
 8-32.1(3) Pole and Pedestal Shop Drawings
 8-33.1(3) Electrical Conduit Shop Drawings

DIVISION 9 MATERIALS

9-15.4 Automatic Controllers (Irrigation)
 9-30.3(12)G Cast-in-place Concrete Valve Chamber
 9-31.3 Street Light Wiring
 9-31.5 Below Grade Wire Splice
 9-33.2(9) Bracket Arms

1-05.3(11) AS-BUILT RECORDS

"As-built records" may also be called "as-built drawings", "as-built documents", or "record drawings". Where Contractor provided as-built records are required in the Contract, the Contractor shall keep at the Project Site a set of the Contract Drawings, and Engineer reviewed Shop Drawings accurately marked with all changes or deviations from the original

Contract or from the Engineer reviewed Shop Drawings. These as-built records shall be kept up-to-date on a daily basis as the Work requiring as-built records progresses.

The Contractor shall submit to the Engineer an as-built record set of Drawings showing all as-built information required in the Contract prior to the Physical Completion Date. These as-built records shall be accurate, clean, clear, easily readable, and shall become the official as-built record set for the applicable portion of the Work.

Standard Specification Sections with specific Contractor provided as-built record requirements are as follows:

6-02.3(37)	Electrical Conduit in Concrete Structures five (5) Working Days before placing concrete)
6-03.2	Materials for Steel Structures (before the Physical Completion Date)
6-02.3(6)A	Electrical Wiring in Structural Concrete
6-03.3(7)A	Shop Drawings for Steel Structures (before the Physical Completion Date)
8-03.3(4)	Capped Irrigation Pipe
8-03.3(12)	Irrigation System Orientation five (5) Working Days before the training session)
8-03.3(13)	Irrigation System Operation five (5) Working Days before the training session)
8-31.3(5)B	Detector Loop Lead-In Cable (before Turn-on/Cut-over)
8-31.3(5)C	Detector Loop Inductance Testing at the Handhole (before Turn-on/Cut-over)
8-31.3(5)E	Detector Loop Inductance Testing at the Control Cabinet (before Turn-on/Cut-over)
8-31.3(5)F	Encapsulated Detector Loop
8-31.3(16)	Turn-on/Cut-over Procedure (before Turn-on/Cut-over)
8-31.3(17)	Final Inspection – Wiring one (1) Working Day after Turn-on/Cut-over)
8-33.3(2)A	Conduit Installation in Concrete Structures five (5) Working Days before placing concrete).

1-05.3(12) SUBMITTAL PREPARED BY PROFESSIONAL ENGINEER

Where the Contract requires a submittal prepared by a Professional Engineer, the Drawings and design calculations shall be prepared by (or under the direct supervision of) a Professional Engineer, with current license under Title 18 RCW, State of Washington, who is registered and qualified in the applicable branch of engineering, or as specified below. Each sheet of the Drawings shall carry the following:

1. Professional Engineer's original signature, date of signature, original seal (photocopies not accepted), registration number, and date of expiration,
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 number, Contract title, and sequential sheet number. These shall also be on all related documents, and
5. Identify where each Drawing sheet will be utilized by referencing the Contract Drawing sheet number and related item or detail.

Design calculations shall carry on the submittal cover sheet, the Professional Engineer's original signature, date of signature, original seal (photo copies not accepted), registration number, and date of expiration.

A State of Washington Professional Engineer, licensed under Title 18 RCW, State of Washington, who is registered and qualified in the applicable branch of engineering may be retained to check, review, and certify Drawings and calculations of an individual who is licensed in another state and when such Work was not prepared under the "direct supervision" of the Washington State Professional Engineer, provided that the following conditions are satisfied:

1. That the Work being reviewed was prepared in accordance with Washington law by an individual holding valid registration in another state as a civil or structural engineer,
2. The Washington State Professional Engineer conducts independent calculations and reviews all technical matters contained within the subject Work, Drawings, Contract Drawings, specifications, legal requirements, technical standards, other related documents; and has verified that the design meets all applicable specifications and is in agreement with the specific site conditions and geometry,
3. All Drawing sheets shall carry the Washington State Professional Engineer's original signature, date of signature, original seal (photo copies not accepted), registration number, and date of expiration,
4. Eight (8) copies of the Washington State Professional Engineer's independent calculations shall be submitted to the Engineer for review along with the Drawings. The independent calculations shall carry on the submittal cover sheet the Washington State Professional Engineer's original signature, date of signature, original seal (photocopies not accepted), registration number, and date of expiration., and
5. The Washington State Professional Engineer shall keep a signed and sealed copy of the Drawings, independent calculations, specifications, and other related documentation that represents the extent of the review.

1-05.3(13) CONTRACTOR'S FAILURE TO PROVIDE OR COMPLETE SUBMITTALS, AND PROGRESS OF THE WORK

All submittals required of the Contractor shall 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 Owner or the Engineer to meeting other obligations.

The Contractor agrees that failure to provide and complete all submittals is cause for the Owner 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 and to Contractor's resubmittal.

The Contractor shall not perform Work or obtain material or begin fabrication based on a required submittal until the Engineer has returned the submittal without requiring resubmittal.

If a submittal is required by the Contract, any related portion of Work performed by the Contractor prior to the Engineer's return of the submittal without requiring resubmittal, or as otherwise specified by the Engineer, shall be solely at the Contractor's risk and expense.

1-05.4 CONFORMITY WITH AND DEVIATIONS FROM DRAWINGS AND STAKES

Work performed shall be in conformity with 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 shall take full responsibility for detailed dimensions, elevations, and slopes measured from them.

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

Prior to undertaking each part of the Work, the Contractor shall 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 shall promptly provide written notice to the Engineer of any conflict, error, discrepancy, or omission that the Contractor discovers.

The Contractor shall 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 within the City of Seattle shall require NAVD88 as the vertical datum, and NAD83 (1991) as the horizontal datum.

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

The Engineer will furnish survey controls and offset points for Work areas at the Project Site as follows:

1. Two (2) intervisible horizontal control points for each continuous street between consecutive intersections, and no less than two (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 one 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. Two (2) vertical control points for each continuous street between intersections within the Project Site. A minimum of two (2) points per 1320 feet will be provided.
3. Offset points to establish line and grade for the following City of Seattle owned utilities:
 - a. Water Main, hydrants, valve boxes and chambers;
 - b. Storm Drain, inlets, catch basins, culverts, manholes, and Sewer, not including side Sewer; and
 - c. SCL electrical conduit and vaults.

The Standard Specifications also address additional survey controls provided by the Engineer for specific constructions (see Sections 2-06.3(1) and 2-10.3(4)) and, unless the Contract specifies otherwise, where the Engineer may provide additional staking (see Sections 2-08.3(1)A, 2-09.3(1)B, 4-04.3(5), 5-04.3(4)C1, 5-05.3(18), 5-05.3(19), 7-18.3(1)A, 8-11.3(3), 8-15.3(1), 8-15.3(5), 8-16.1, 8-18.3(1)).

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

Survey controls and offset points provided by the Engineer for the Contractor shall be preserved and not be disturbed.

Should any discrepancy in survey controls or offset points provided by the Engineer be identified by the Contractor, then upon discovery, the Contractor shall 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 shall be 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 compensation or delay due to error in the Engineer provided survey controls and offset points will not be allowed unless the original Engineer provided survey controls and offset points still exist undisturbed. For straight line and straight grade, no less than three (3) consecutive points shall be provided by the Contractor to determine variation from a straight line or grade.

The Contractor's surveyor shall be, or shall work under the direct supervision of, a Land Surveyor licensed under Title 18 RCW in the State of Washington and regularly performing survey in the State of Washington. The Contractor shall keep

updated survey field notes in a standard field book and in a format generally accepted in the Land Survey profession. These field notes shall include all survey work performed by the Contractor's surveyor in establishing line, grade and slopes for the Work. Copies of these field notes shall be provided to the Engineer upon request.

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

The Contractor shall submit any request for Engineer provided surveying services at least ten (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 shall be agreed to by the Contractor before such survey work begins. 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 Title 196 WAC, or of Ch 18.43 RCW, the Contractor shall, upon the Engineer's written notice, remove the individual or individuals doing the Contractor's survey work. Thereafter, the survey work may be completed by the Engineer by such means as the Engineer deems appropriate at the Contractor's sole expense, and all cost for completing the Contractor's survey work by the Engineer will be addressed in accordance with Section 109.9(3).

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

Upon request, the Contractor shall 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, shall be 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 in order 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 shall 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 shall remove or uncover any portions of completed Work for inspection by the Engineer. After inspection, the Contractor shall 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, shall be 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 shall be permitted to inspect the Work when the Contractor is advised by the Engineer to permit them to do so. The Contractor agrees that such inspection shall not make such representatives a party to the Contract, nor shall it 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 in 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 shall be 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.

Upon order of the Engineer, such Work or Material shall immediately be remedied, removed, replaced, or disposed of and all costs, including retesting costs as applicable, associated with such Work shall be at the Contractor's sole expense. Such Laboratory retesting costs of replaced or reconstructed Work or Material will be charged to the Contractor in accordance with the following schedule:

Test Name	Specification Section	Unit	Cost of Unit Retest
Field Soil Density Reading	2-03.3(14)E	Each	\$100.00
Concrete Pavement Coring	5-05	Each	\$200.00
Asphalt Pavement Coring	5-04.3(9)	Each	\$200.00
Soil/Aggregate Sieve Analysis	9-03.15	Each	\$150.00
Moisture-Density Curve	2-03.3(14)E	Each	\$250.00
L A Abrasion	9-03.15, 9-03.17	Each	\$150.00
Soundness	9-03.17	Each	\$100.00
Organic Content	9-14.1(4)	Each	\$50.00
Epoxy Pull Out Test	6-02.3(31)	Each	\$50.00
Asphalt Concrete Sieve Analysis	5-04.3(7)A		\$200.00
Asphalt Concrete Binder Content	5-04.3(7)A		\$100.00
Asphalt Concrete Air Void Analysis (V _A)	5-04.3(7)A		\$200.00

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 \$100.00 each visit.

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 shall 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 compensation 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 DEFECTIVE WORK AND UNAUTHORIZED WORK

If the Contractor fails to remedy defective Work or unauthorized Work or both as may apply 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 such means as the Engineer may deem necessary, including the use of Engineer forces.

If the Contractor fails to comply with a written notice to remedy what the Engineer determines to be an emergency situation, 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 refuses 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.

Direct or indirect costs incurred by the Engineer attributable to correcting and remedying defective Work or unauthorized Work, or Work the Contractor failed or refused to perform, shall be paid by the Contractor. Payment will be deducted by the Engineer from moneys due, or to become due, the Contractor. Such direct and indirect costs shall include in particular, but without limitation, compensation for additional professional services required, and costs for repair and replacement of Work of others destroyed or damaged by correction, removal, or replacement of the Contractor's unauthorized Work.

No adjustment in Contract Time or in compensation 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 nor shall the exercise of this right diminish the Engineer's right to pursue any other avenue for 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 shall be adequate for the purposes used, kept in good working condition, and operated by competent operators. The Contractor is alerted that several Specification Sections have additional specific equipment or machinery requirements. The Contractor is also alerted that several Specification Sections have requirements for the Engineer to have safe and convenient access to plant 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), 6-02.3(3).

At the Engineer's request, the Contractor shall 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 shall 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 to that normal 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 shall promptly replace rejected Equipment. Rejection and replacement of equipment shall give the Contractor no right to additional compensation or time.

1-05.10 GUARANTEES AND WARRANTIES

1-05.10(1) GENERAL GUARANTY AND WARRANTY

The Contractor shall 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.

If within one year after the Physical Completion Date, defective Work or unauthorized Work is discovered, the Contractor shall promptly, upon written notice of the Engineer, return and in accordance with the Engineer's instructions, either correct such Work, or if such Work has been rejected by the Engineer, remove it from the Project Site and replace it with non-defective and authorized Work, all 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 reserves the right to have defective Work and unauthorized Work corrected or removed and replaced as provided by Section 1-05.8.

The Contractor agrees the above one year limitation shall 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 one year but prior to the expiration of the legal time period set forth in RCW 4.16.040 limiting actions upon a Contract in writing, or liability expressed or implied arising out of a written agreement.

1-05.10(2) WARRANTY OF TITLE

The Contractor shall warrant good title to all Materials, Supplies, and equipment purchased for, or incorporated in, the Work. Nothing contained in this paragraph, however, shall defeat or impair the right of persons furnishing Materials or labor, to recover under any bond given 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 shall be inserted in all subcontracts and Material Contracts, and notice of its provisions shall be given 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 shall so 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; and
2. Only minor incidental Work, replacement of temporary substitute facilities, or corrective or repair Work remains to reach physical completion of the Work.

The Contractor's request shall list the specific items of Work in subparagraph two immediately above that remain to be completed in order to reach physical completion. The Engineer will schedule an inspection of the Work with the Contractor to determine the status of completion.

If, after inspection, the Engineer concurs with the Contractor that the Work is substantially complete, the Engineer will, by written notice to the Contractor, set the Substantial Completion Date. If, after this inspection, the Engineer does not consider the Work substantially complete, the Engineer will, by written notice, so notify the Contractor giving the reasons therefore.

Upon receipt of written notice concurring in or denying Substantial Completion, whichever is applicable, the Contractor shall pursue vigorously, diligently and without unauthorized interruption, the Work necessary to reach substantial and/or physical completion. The Contractor shall 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 shall 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 by the Contract has been completed. This Work shall include final cleanup (see Sections 1-04.11 and 1-07.24), providing the Engineer with all required submittals (see Section 1-05.3), completing operational testing and submitting operation and maintenance (O&M) manuals when specified in the Contract (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 (see Sections 1-04.11 and 1-07.24) is being arbitrarily withheld, the Engineer may, at his or her sole discretion, accept that portion of the Work involved.

The Physical Completion Date for the Contract will be determined as provided in Section 1-08.5.

When the Contractor considers the Work physically complete and ready for final inspection, the Contractor, by written notice, shall request the Engineer to schedule a final inspection. Within five (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 shall immediately take such corrective measures as are necessary to remedy the listed deficiencies. Corrective Work shall 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 seven (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 shall be deducted from moneys due or becoming due the Contractor. Such indirect or direct costs shall include in particular, but without limitation to, compensation 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 upon which the Work was considered physically complete. That date shall constitute the Physical Completion Date of the Contract, but shall not imply all the 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 Physical Completion Date, a complete and operable system with all of the 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 prior to the Physical Completion Date. Whenever items of Work are listed in the Project Manual for operational testing they shall be fully tested under operating conditions for the time period specified to ensure their acceptability prior to the Physical Completion Date. During and following the test period, the Contractor shall 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, shall 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 can not be established until testing and corrections have been completed to the satisfaction of the Engineer.

Prior to operational testing or as may be arranged by the Engineer, the Contractor shall submit to the Engineer, three (3) sets of operating and maintenance (O&M) manuals for the item to be tested. During operational testing, the Contractor shall 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 shall provide three (3) sets of Supplier provided amendment addressing all correction.

Each O&M manual shall include the following:

- (a) A title indicating its contents permanently labeled on the outside of the binder;
- (b) A cover sheet identifying equipment with the process or assembly with which it is used, according to:
 - (1) location,
 - (2) Specification Section number and title, and
 - (3) Engineer's Drawing (sheet) number;
- (c) A table of contents; and
- (d) A text as prepared by the manufacturer and including the following information or materials, as applicable:
 - 1) Equipment operating instructions including start-up and shut-down procedures, safety precautions, and instructions on specific controls;
 - 2) Electrical test reports, including electrical system and motor test reports;
 - 3) Mechanical test reports, including factory running tests and performance rating tests for motorized equipment;
 - 4) Shop Drawings;
 - 5) Assembly drawings;
 - 6) Parts list;
 - 7) Bill of Materials;
 - 8) Wiring diagrams;
 - 9) Maintenance instructions to cover any routine operation required to insure the satisfactory performance and longevity of the equipment, such as lubrication instructions, lists of lubricants, and belt tensioning;
 - 10) Maintenance summary forms;
 - 11) Manufacturer's warranty.

Manuals shall be bound in three-ring or spiral binders with plastic or other stain resistant covering. Manuals shall be 8-1/2 x 11 inches in size except for oversize Drawings which shall 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 shall 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 successfully complete operational testing, shall 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, shall not affect a manufacturer's guaranties or warranties furnished under the terms of the Contract.

1-05.12 COMPLETION

The Contractor must perform all the obligations under the Contract before the Completion Date can be established. A Certificate of Completion for the Work issued by the Owner will establish the Completion Date and certify the Work as complete. The Final Contract Price may then be calculated. The following must occur before the Completion Date can be established and the final Contract price calculated:

1. The physical Work on the Project site must be complete; and
2. The Contractor must furnish all documentation 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. Audits per Section 1-04.5(6);
 - b. Extension of time requests per Section 1-08.8;
 - c. Material certifications per Section 1-06.3;
 - d. Certified payrolls and prevailing wage statements per Section 1-07.9; and
 - e. Final Contract Payments Reporting Form per Section 1-08.1(3).

The issuance of a Certificate of Completion will not constitute acceptance of unauthorized Work or defective Work or Material.

The Contractor agrees that establishment of the Completion Date shall 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 compensation under Title 50 RCW or for industrial insurance and medical aid required under Title 51 RCW.

Failure of the Contractor to perform any or all of the Contractor's obligations under the Contract shall not bar the Owner from unilaterally certifying the Contract complete so the Engineer may calculate a Final Contract Price as provided in Section 1-09.9.

1-05.13 SUPERINTENDENTS, LABOR, AND EQUIPMENT

1-05.13(1) GENERAL

The Contractor shall 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 and the Engineer's Assistants in the administration of the Work.

The Contractor shall be present, in person, or be continuously represented by a duly authorized representative at the Project Site during progress of the Work. The Contractor shall designate in writing before starting the Work, a project manager or superintendent, who shall be experienced, capable of understanding the Contract, and able to supervise the performance of the Work. The Contractor's superintendent or project manager shall have full authority to represent and act for the Contractor. Written notice given to the project manager or superintendent shall be as binding as if given to the Contractor.

The Work shall be under the continuous supervision of competent personnel experienced in the class of Work being performed. Incompetent, careless, or negligent employees (including supervisors) shall be discharged by the Contractor upon written order of the Engineer. A superintendent that repeatedly fails to follow a written order, direction, instruction, or determination from the Engineer shall, upon written order from the Engineer, immediately be removed from the Project Site by the Contractor. The Contractor shall then designate in writing to the Engineer, a new superintendent. Failure to comply with such order shall be sufficient grounds for termination of the Contract.

Machinery and Equipment shall comply with the requirements of Section 1-05.9.

1-05.13(2) CONTRACTOR/SUBCONTRACTOR PERFORMANCE EVALUATION PROGRAM

The Department of Executive Administration is charged with the responsibility of ensuring that all public works improvement projects are Awarded to the lowest responsive, responsible Bidder, and are performed in compliance with the Contract documents, City ordinances, and state and federal laws and regulations. A mandatory, standardized system of evaluating Contractors' and Subcontractors' performance yields consistency, objectivity, fairness, and accountability.

The Contractor's performance and compliance with the technical terms of the Contract will be rated by, or at the direction of, the senior supervisor within the administrating department (i.e., the Senior Engineer, Architect, or project manager as appropriate) with concurrence by the Department Head or their designee. The Contractor or Subcontractor's compliance with social equity requirements will be evaluated by the Contracts Analyst in the Department of Executive Administration, Contracting Services with concurrence by the Senior Contracts Analyst.

The Owner is concerned with six major areas relative to the Contractor or Subcontractor's performance on a given project:

1. The Contractor's or Subcontractor's ability to effectively and efficiently schedule, administer, coordinate, finance, and manage its Work and the Work of its Subcontractors on the project;
2. The degree and extent of the Contractor's or Subcontractor's cooperation with the Owner, Engineer, their employees and consultants, and the public;
3. The Contractor's or Subcontractor's initiative in all aspects of its Work;
4. The quality of Material and workmanship and safe and timely completion of the final product; and
5. The Contractor enforces health and safety in conducting the Work.
6. The Contractor's compliance with social equity requirements and goals under Washington State law and the Seattle Municipal Code.

The Contractor Performance Evaluation Program is intended to:

- (a) Assist the Owner in exercising its discretion to determine a Contractor's qualifications and abilities to successfully perform a particular Contract;
- (b) Provide the Owner with a rational basis for determining whether or not:
 - (1) A Contractor can be relied upon to work responsibly, and
 - (2) To approve the Contractor's proposed principal Subcontractors;
- (c) Provide Contractors with a means of enhancing their reputation for qualification by receiving recognition for high standards of performance;
- (d) Encourage better working relationships between the Owner and Contractors;
- (e) Guide administering departments in approving, or not approving, proposed principal Subcontractors on a particular project;
- (f) Provide official, verifiable references for Contractors and Subcontractors who may be under consideration for Award of, or approval on, Contracts to be Awarded by other public agencies; and
- (g) Provide a history and an assessment of a Contractor's or Subcontractor's performance on prior City Contracts for use in suspension or debarment proceedings.

A "Deficient" or "Inadequate" report will be taken into consideration when determining Contractor qualifications in Awarding future Work. The full policy and sample form is located in the Appendix of the Project Manual.

1-05.13(3) ON-SITE EROSION CONTROL LEAD

The Contractor shall assign an On-Site Erosion Control Lead (ESC Lead) to the Work and shall identify the ESC Lead at the pre-construction conference.

The ESC Lead shall be given the authority and shall be responsible for ensuring compliance with, and updating as necessary, the Temporary Erosion and Sediment Control (TESC) Plan, as follows:

1. Preparing, maintaining, and updating a TESC file on-site that includes, but is not limited to:
 - a. TESC Plan,
 - b. Stormwater site plan,
 - c. TESC inspection reports (see item 3 below),
 - d. National Pollutant Discharge Elimination System construction permit (Notice of Intent), and
 - e. Other applicable permits.
2. Installing, maintaining, inspecting, repairing, and removing all temporary Erosion and Sediment Control Best Management Practices (ESCBMPs) included in the TESC Plan assuring continued performance of their intended function. All on-site erosion and sediment control measures shall be inspected;
 - a. at least once every five (5) Working Days,
 - b. each Working Day during runoff producing rain events, and
 - c. within 24 hours after a runoff-producing rain event.
3. Prepare a TESC Inspection Report after each inspection that shall include, but are not limited to:
 - a. When, where, and how ESCBMPs were installed, maintained, modified, and removed,
 - b. Repairs needed and repairs made,
 - c. Observations of ESCBMPs effectiveness and proper placement, and
 - d. Shall provide the Engineer a copy of this report the following Working Day.

1-05.14 COOPERATION WITH OTHER CONTRACTORS

The Owner reserves the right to 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 shall 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 shall be final, as provided in Section 1-05.1.

If the Contract gives notice of other work that may affect the Work, or other work is apparent from the Project Site investigation required by Section 1-02.4, the coordination of the Work shall be taken into account by the Contractor, and any resulting cost shall be included in the various Contract Bid items that make up the Work.

1-05.15 METHODS OF SERVING NOTICES

Written notice shall be considered delivered and service complete when:

1. Delivered by certified or registered mail to the other party at their last given address; or

2. Delivered in person to the other party; or
3. Delivered to authorized representative of the other party at the Project Site.

1-05.16 WATER AND POWER

The Contractor shall make necessary arrangements, and shall bear the costs for power and water necessary for the performance of the Work. See the exception for water in Section 2-07.

1-05.17 ORAL AGREEMENTS

No oral agreement or conversation with any officer, agent, or employee of the Owner, either before or after execution of the Contract, shall affect or modify any of the terms or obligations contained in the Contract. Such oral agreement or conversation shall be considered as unofficial information and in no way binding upon the Owner, unless subsequently put in writing

SECTION 1-06 CONTROL OF MATERIALS**1-06.1 SOURCE OF SUPPLY AND QUALITY OF MATERIALS**

The Owner encourages the use of environmentally friendly materials.

Whenever practicable, the Contractor shall use recycled and reusable products.

At the pre-construction conference (see Section 1-08.1(2)), the Contractor shall submit a completed Request for Acceptance of Material Sources (RAMS) form for the proposed sources for all Materials to be used on the Work, including fabricators and manufacturers. See Sections 1-05.3 and 1-08.3(2) for Material source (RAMS form) submittal requirements. If the source of the material is not the same as the manufacturer or fabricator incorporating the source material into its product, then both the manufacturer or fabricator, and the source(s) shall be provided. In such case, the RAM shall include where each specific material source is involved with the material.

Approval of a Material source shall not mean acceptance of the Material. The Material shall meet the Contract requirements.

If the Engineer determines that Material from an approved source:

1. is not in compliance with the Contract at any time, or
2. is not uniform and contributes to defective Work,

the Engineer has the right to require the Contractor to provide replacement Material from another source approved by the Engineer. Upon written notice provided by the Engineer, the Contractor shall provide replacement material from an approved source. The Contractor shall not have any right to additional payment or to additional Contract Time, including time required to gain approval of a replacement source or to acquire replacement material.

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

1. Shall be new unless otherwise specified in the Contract or specifically approved otherwise in writing by the Engineer,
2. Shall conform to the requirements of the Contract and be approved by the Engineer,
3. May be inspected or tested at any time during their preparation and their use including at the location of production, manufacture, or fabrication, and
4. Shall not be used in the Work if they become unfit after being previously approved.

Mention of manufacturers by brand name and model number is occasionally made in order to establish a basis of quality for certain items of material, equipment, or processes. Such mention is intended to include products of other manufacturers that will measure up to the designated standards of the product mentioned as an "or equal".

Wherever mention is made of a specific manufacturer, such mention shall be treated as if the phrase "or equal" appears thereafter whether or not in fact it does. The terms "or equal" and "or approved equal" shall be considered synonymous. If the Contractor prefers to use a different product than the one specified, the Contractor shall obtain the written approval of the Engineer before incorporating the product into the Work.

Where a Material or manufacturer is specified without substitution, there will be no consideration of substitute materials or manufacturers.

1-06.2 ACCEPTANCE OF MATERIALS**1-06.2(1) SAMPLES AND TESTS FOR ACCEPTANCE**

The Contractor shall 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 pursuant to Section 1-03.1(4), shall 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, shall 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 qualified tester will not be accepted for test, unless so permitted by the Engineer.

Material testing shall comply with any special 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.

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 shall be submitted prior to 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 exceptions 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 material is specified to conform to industry or technical society reference standards of designated recognized standards organizations, such as ASTM or AASHTO or ACI or AWWA etc., the Manufacturer's Certificate of Compliance shall indicate such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In lieu of the label or listing, the Manufacturer's Certificate of Compliance shall contain a statement from a testing laboratory stating that the Material or Material property specified has been tested in accordance with 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 shall 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 shall provide the additional information. The signature of a responsible corporate official of the manufacturer and supporting mill tests or documents shall be included. A Manufacturer's Certificate of Compliance shall be furnished with each lot of Material delivered to the Work unless the Contract specifies otherwise. The certified lot shall 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 reserves the right to 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 shall be handled and stored by the Contractor by methods that will 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 shall 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 shall 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, to make such accreditation or certification. Such accreditation or certification shall be current at the time of such testing and for the life of the Contract, whichever is greater.

Every test shall 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 shall 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 shall be performed in accordance with the specified test standard unless required otherwise in the Contract.

Unless the Contract specifies otherwise, results of testing shall be reviewed, approved, and stamped by a Professional Engineer with current license under Title 18 RCW, or by other certifying individual, who is qualified to review and approve such results or perform such testing. The testing shall be performed to the satisfaction of the Engineer, in accordance with the designated recognized standards organization's test.

The Contractor, the testing laboratory, and the technician as may apply, agree to let the Engineer visit the laboratory, and to observe the technician at 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 shall 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(s) used and that the testing was in compliance with the Contract;

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(s) 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 given to the sample, and any care given in preparing the sample not specified in the test standard, any deviations from the testing standard used in testing;
5. as the Contract may require.

1-06.6 SIEVES FOR TESTING

Sieves for testing shall comply with Section 9-03.15

SECTION 1-07 LEGAL RELATIONS AND RESPONSIBILITIES TO THE PUBLIC

1-07.1 LAWS TO BE OBSERVED

1-07.1(1) GENERAL

The Contractor shall observe and comply with all federal and State laws, tribal law, and with county and city resolutions, ordinances, and regulations that will in any way affect the Work.

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 deems that action 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.

Compensation for increased or decreased costs due to changes in law or taxes occurring after the Bid Opening Date shall be determined in accordance with Section 1-09.4(2).

1-07.1(2) SAFETY RULES AND STANDARDS

The Contractor shall be solely and completely responsible for:

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

These requirements shall apply continuously and not be limited to normal working hours. The Engineer's review of the Contractor's performance shall not include review or a determination of the adequacy of the Contractor's safety measures in, on, or near the Project Site.

The Contractor shall establish, maintain, and supervise:

1. A safe and healthy working environment;
2. An accident prevention program; and
3. 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 shall be 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 shall comply with the federal Occupational Safety and Health Act of 1970 (OSHA), including all revisions and amendments thereto; the provisions of the Washington Industrial Safety Act of 1973 (WISHA), as amended; and as a minimum, the requirements of Title 296 WAC, Department of Labor and Industries .

In addition, the Contractor shall 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 shall apply.

The Contractor shall 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 shall establish, publish, and make known to all employees, procedures for ensuring immediate removal to a hospital or doctor's care persons, including employees who may have been injured on the Project Site. Employees shall not be 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.

1-07.2 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 regarding the application of State taxes to a particular Contract or Bid item, it shall be the Contractor's responsibility to apply the correct interpretation of the laws and regulations relating to such taxes. Adjustments will not be made in 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 the Contractor is in doubt as to the tax procedures in any particular case, the Contractor shall 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, roads, etc., 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, the Contractor shall include Washington State Retail Sales Taxes in the various Bid item prices and other Contract amounts, including those that the Contractor pays on the purchase of Materials, equipment, and Supplies used or consumed in doing the Work.

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, upon Real Property. For Work performed in such cases, the Contractor shall 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 shall 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.

Exception: 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 taxes shall be included in the Bid item prices or in any other Contract amount.

1-07.2(4) SERVICES

The Contractor shall 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 WASTE MANAGEMENT AND DISPOSAL OF WASTE

1-07.3(1) GENERAL

All waste generated under this Contract shall be managed in accordance with all applicable local, State and federal regulations. Unless otherwise specified in the Contract, the Contractor is responsible for arranging the proper handling, storage, transporting and disposal of all wastes including processing and maintaining required documentation. This includes:

1. identifying and contracting with disposal sites that can legally accept the types of characterized wastes in performing the Work;
2. identifying and contracting with waste transporters qualified and licensed to transport these types of characterized wastes;
3. obtaining Waste Clearances (or other waste acceptance approvals) through the Seattle-King County Department of Public Health (SKCDPH) or other agencies as appropriate;
4. creating and processing all necessary documentation, such as Certificates of Disposal, sampling and analysis reports, Waste Clearance forms, Hazardous Waste Manifest, and others as applicable;
5. providing the Engineer timely notice for reviewing documentation before transporting; and
6. providing the Engineer copies of all documentation pertaining to waste generation and disposal.

The Waste Clearance Program Instructions and forms for SKCDPH are provided in the Appendix of the Project Manual. This information is provided for the convenience of the Contractor and the Contractor is solely responsible for verifying that it is still in effect. Additional copies of the forms or information regarding the forms may be obtained by calling SKCDPH at 206-296-4633. 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 a waste clearance. Copies of all waste clearance or acceptance forms along with any associated laboratory data shall be provided to the Engineer.

Disposal sites utilized under the Contract must be in compliance with applicable rules and regulations including local ordinances.

The selection of waste sites and their use shall at all times be subject to the approval of the Engineer.

Waste sites located within the City limits of Seattle are subject to the rules and regulations set forth in Seattle's grading and drainage control ordinance (Ord. No. 108080 as amended by Ord. No. 111043) and as otherwise provided in the Seattle Municipal Code Chapters 22.800 through 22.808, and shall require a grading permit issued to the property owner by the Director of the Department of Planning and Development.

Waste sites located outside the City limits of Seattle but within unincorporated King County, shall be subject to the rules and regulations set forth in the King County Grading Ordinance (Ord. No. 1488). Sites may also be subject to rules and regulations of a local governmental authority if located within its jurisdiction.

Effective June 1, 1991 and in accordance with SMC 21.36 as amended by Ordinance 115589, no waste generated within the City of Seattle shall be deposited in a waste disposal facility owned and operated by King County.

Additional options for disposal of wood debris from clearing and grubbing are specified in Section 2-01.2. Any action required to comply with any permit and/or any approval requirements in a Contractor-provided disposal site shall be performed by the Contractor at no additional cost to the Owner.

1-07.3(2) SUBMITTAL

At the Pre-Construction Conference, the Contractor shall submit to the Engineer a list of proposed waste disposal and recycle sites that shall accommodate 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 list shall identify each waste disposal and recycle site, and the estimated quantities and type of material to be wasted or recycled at each site. The list shall also 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 characterized waste.

The submittal shall also provide a management plan for any wastes that are to be stored on the Project Site prior to recycling or disposal. The management plan shall provide procedures to ensure that wastes are stored in a safe, secure manner that does not allow for leakage or other releases of waste material during storage. Unless otherwise specified in the Contract, the Contractor shall submit adequate details indicating where such temporary waste storage is proposed and the proposed controls at each location including required signs, placards, labels or other identifying marks. Waste storage areas shall be inspected at least daily. Also see Section 1-07.5(5) regarding spill prevention and control.

Should additional or alternate disposal and recycle sites, and transporters become necessary during the life of the Contract, the locations and information for each additional site, and qualifications and licenses of transporters shall be submitted to the Engineer for approval at least ten (10) Working Days prior to their use.

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

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

The Contractor shall also provide the Engineer with copies of the following documents:

- a. Certificates of Disposal (destruction / treatment / recycling) from the final disposal and treatment facility as applicable;
- b. Waste sampling and analysis reports as applicable; and
- c. Waste clearance or acceptance forms

1-07.3(4) RECYCLABLE MATERIALS

The City of Seattle encourages recycling of waste materials as may be permitted. Such Materials include asphalt concrete, Portland cement concrete, reinforcing steel, aggregate, and other Materials. A list of some recycling disposal sites will be provided, for the convenience of the Contractor only, in the Appendix of the Project Manual. It is the responsibility of the Contractor to verify the accuracy of this information prior to Bid. Any revenue obtained or expense incurred by the Contractor for recycling shall be the Contractor's alone.

1-07.3(5) RESERVED**1-07.4 SANITATION**

The Contractor shall 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 shall commit no public nuisance and, at all times, keep all sites clean, in a neat and sanitary condition, and dispose of all waste in a proper manner.

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 shall comply with all provisions of federal, State and statutes, City ordinances and any regulations pertaining to the prevention of environmental pollution and the preservation of public natural resources. Pursuant to RCW 39.04.120 such provisions as are reasonably obtainable are set forth below.

1-07.5(2) WATER QUALITY

The Contractor shall 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 shall:

1. Exercise precautions throughout the life of the Contract to prevent contamination, pollution, erosion, siltation, sedimentation, and damage to public and private property, drainage systems, surface waters, and groundwater pollution, erosion, siltation, and damage to property;
2. Provide for the flow of all watercourses, including but not limited to streams, ditches, Sewers, and 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 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; and
7. Make all applicable notifications required by Section 1-07.28.

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

- 1) The Washington State Department of Fish and Wildlife;
- 2) Those 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. Environmental Protection Agency);
- 3) The water quality standards of the State of Washington as set forth in WAC Chapters 173-200 and 173-201A;
- 4) For work done within the City of Seattle, SMC Chapters 22.800 through 22.808 and other SMC as may apply.
- 5) Any local statute, regulation, ordinance, or rules that stipulate the various type of discharge prohibited in public Sewer systems or any drainage ditch in the local jurisdiction.

State statutes on water pollution covering liability of the Contractor, penalty for violation, liability and damages for injury or death of fish, animals or vegetation are set forth in Chapter 90.48 RCW. As an aid to the Contractor, some though not all, 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:

- A. **State Department of Fish and Wildlife:** In doing the Work the Contractor shall:
 - a. Not degrade water quality in a way that would harm fish. (The Washington State Water Quality Regulations shall be in addition to other water quality criteria specified in the Contract for the Work.)
 - b. Promptly notify the Engineer if any fish are stranded by the Work.
 - c. If the Work has disturbed the vegetative cover of any stream bank or shoreline areas, replant the disturbed area with trees and other vegetation species selected compatible with area conditions as determined by the Engineer.
 - d. Provide an open water channel at the lowest level of any isolated water location in the channel remaining when the Work is complete.
 - e. Protect fish by preventing additional siltation build-up on the bed or bottom of any body of water.
 - f. Allow stream flow to continue for fish passage including use of bypass as the Work may require.
 - g. Keep all Equipment out of any flowing stream or other body of water, except when the Work requires.
 - h. 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 (except as the Contract may permit).
 - i. Dispose of any Project debris .
- B. **State Department of Ecology:** In doing the Work, the Contractor shall:
 - a. Obtain a waste discharge permit from the Department of Ecology before:
 - (1) Washing aggregate, and
 - (2) Discharging water into a ground or surface waterway from pit sites or excavations when the water contains turbidity, silt, or foreign materials.
 - b. Provide the Engineer with a copy of each waste discharge permit before starting the Work.
 - c. Control drainage and erosion to minimize the pollution of any waterway.
 - d. Dispose of all toxicants (including creosote, oil, cement, concrete, and water used to wash Equipment) in ways that will prevent them from entering State waters.
 - e. Dispose of all debris, overburden, and other waste materials in ways that will prevent them from entering State waters.

The Contractor shall 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 shall be responsible for controlling erosion, pollution, sedimentation, and runoff during the shutdown period.

In addition to other requirements in the Contract, this temporary Work shall include, but is not limited to, the following water quality considerations:

- A) **Diversion of Storm Water:** Storm water shall be diverted around the Project 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; constructing ditches, berms, culverts, etc. to control surface water; or constructing dams, settling basins, or energy dissipaters to control impacts of flow.
- B) **Surfacing Ground Water:** Surfacing ground water shall 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, it shall be handled as follows:
 - (1) When the ground water meets State Water Quality standards, it may bypass detention and treatment facilities and be routed directly to its normal discharge point at a rate and method that shall not cause erosion.
 - (2) Meet the side Sewer permit requirements for temporary dewatering (SPU Director's Rule 02-04 and DPD Director's Rule 3-2004).

- (3) Discharging turbid ground water shall comply with the requirements specified in subsection D) immediately following.
- D) **Turbid Water Treatment Before Discharge:** Determination of turbidity shall be at the discretion of the Engineer. Turbidity requirements are as follows;
- (a) for Lake Class Receiving Waters, turbidity shall not exceed 5 NTU over background conditions;
 - (b) for Class AA and Class A Waters, turbidity shall not exceed 5 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 10 percent increase in turbidity when the background turbidity is more than 50 NTU;
 - (c) for other classes of waters, refer to WAC 173-201A-045 and WAC 173-201A-030.
- The term turbidity means the optical property of sample demonstrating the scattering and absorption of light caused by suspended material as expressed in Nephelometric Turbidity Units (NTU) and measured with a turbidimeter calibrated within the 6 months prior to turbidity determination by a laboratory compliant with Ch 173-50 WAC. Turbidity reports shall be accompanied by a Manufacturer's Certificate of Compliance indicating laboratory accreditation and turbidimeter calibration as specified.
- Discharges to a State waterway caused by aggregate washing, drainage from aggregate pit sites and stockpiles, dewatering of pits and excavations, and other discharges shall not increase the existing turbidity of the receiving waters. Turbid water from the Project Site shall be treated before being discharged into stream or other State waters.
- Water discharged to a Storm Drain, must meet State Water Quality standards and have permission from the local jurisdiction (SPU when within the City of Seattle).
- Water discharged to a sanitary or combined Sewer must have permission from the local jurisdictions (meeting water quality requirements of both SPU and King County Industrial Waste Division for Work within the City of Seattle).
- Turbidity may be removed by the use of lagoons or holding ponds, settling basins/tanks, overflow weir, polymer water treatment, discharging to ground surface, by percolation, evaporation or by passing through gravel, sand or fiber filters.
- E) **Erosion and Sediment Control:** General requirements to manage, prevent and control erosion and to treat sediment are specified in Section 1-07.15.
- F) **Chlorine Residual:** Water containing chlorine residual shall 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 shall be periodically tested for chlorine residual.
- G) **Vehicle and Equipment Washing:** Water used for washing vehicles and equipment shall not be allowed to enter Storm Drains, streams or other State waters. Separation of petroleum products, fresh concrete products or other deleterious material from wash water is required prior to discharge. Detergent solution may be discharged into only sanitary Sewers, or held on the ground for percolation. A recirculation system for detergent washing is recommended. Steam cleaning units shall provide a device for oil separation.
- H) **Oil and Chemical Storage and Handling:** Handling and storage of oil and chemicals shall not take place adjacent to surface waters. The storage shall be made in dike tanks and barrels with drip pans provided under the dispensing area. Shut-off and lock valves shall be provided on tanks. Shut-off nozzles shall be provided on hoses. Oil and chemicals shall be dispensed only during daylight hours unless the dispensing area is properly lighted. Should an oil or chemical spill occur, the Contractor shall promptly make the notification in accordance with Section 1-07.28 item 10, stop the spilling, contain the spill, and then clean up any spilled materials. Fencing shall be provided around oil storage. Locks shall be provided on valves, pumps, and tanks.
- I) **Sewage:** If a pipe carrying sewage is encountered and repair or relocation work is required, the Contractor shall provide blocking and sealing of the said pipe. Sewage shall be pumped out, collected, and conveyed or pumped directly to a sanitary or combined Sewer system manhole for discharge. Existing sewerage shall 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 shall be removed to a disposal site. Equipment and tools in contact with the above materials shall be washed by pressure water lines and the attendant wash water discharged into a sanitary or combined Sewer for transmission to a sewage treatment plant.
- J) **Sawcutting, Planing, and Grinding By-Products:** The Contractor shall take special precautions to assure that concrete, asphalt, concrete by-products, or asphalt by-products from, or used in, the drilling, saw-cutting, grinding, or planing of asphalt cement or cement concrete pavements, sidewalks, curbs, etc. do not enter any Storm Drain, surface water, and natural drainage system. In as much as saw-cutting by-products increase the pH of the wastewater, filtering prior to discharge will NOT be acceptable. The Contractor shall provide a means for collecting, for on-site temporary storing as necessary, and for disposing of these by-products. Surfaces contaminated with these by-products shall be power washed and vacuum swept clean at least daily, and more frequently during wet weather.
- K) **Gutters and other Surface Drainage Channels:** All construction waste and stockpiling, and all byproduct entering gutters and other pavement surface drainage channels shall be prevented from entering any inlet, catch basin, or other drainage structure or feature. Material shall be removed from drainage channels on a regular basis. Temporary filters or filter materials shall 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 shall 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 Contractor shall conduct performance of the Work consistent with the applicable noise control levels set forth in SMC Chapter 25.08 or, if outside the City limits and in King County, Chapters 12.86 through 12.100, King County Code, including all reasonable measures for the suppression of noise resulting from Work operations including the equipping of engine driven equipment with such exhaust and air intake silencers designed to achieve the reasonable degree of silencing determined by Owner to be appropriately necessary.

1-07.5(5) SPILL PREVENTION AND CONTROL

An environmental spill shall be considered a release of contaminant or any Material that may be hazardous, or dangerous, or harmful to the environment.

In addition to the requirements specified in Section 1-07.5(2), the Contractor shall take precautions to assure that contaminants are under control and prevented from release. Contaminants anticipated for use in performing the Work (such as fuel, asphalt sealer, pesticide, lubricant, paint, etc.) shall be stored, handled, transported, used, and disposed of in accordance with each product's MSDS, manufacturer's recommendations, and applicable law, code, and regulation. Equipment (valves, pumps, switches, etc.) and Supplies (hose, containers, connections, etc.) shall be in good operating condition, leakproof, and shall be timely maintained as appropriate. MSDS information for each contaminant at the Project Site shall be centrally located at the Project Site and shall be readily accessible.

The Contractor shall have a trained on-site spill prevention and control coordinator at the Project Site when performing the Work. This coordinator shall ensure contaminants are accounted for and are safely stored.

The Contractor shall have readily accessible at an identified location on the Project Site, at least one Spill Kit containing Supplies appropriate for controlling, containing, and cleaning up contaminants used in performing the Work.

Should an environmental spill occur, the Contractor shall immediately contain the spill, and shall make the notifications in Section 1-07.28, item 10 as applicable.

Should contaminant or industrial waste enter a sanitary or combined Sewer, the Contractor shall immediately make the notification in Section 1-07.28 item 9.

In the event of any spill or discharge of a contaminant, the Contractor shall promptly take such steps as are reasonably designed to contain the spill or discharge, and shall thereafter promptly take such steps as are reasonably necessary to achieve the level of cleanup required under applicable federal, State and City laws and regulations. In addition, the Contractor shall follow any instruction provided by the Engineer or any agency having the authority to direct cleanup activities to containment and cleanup spills or discharges.

The Contractor shall submit to the Engineer for review within ten (10) Working Days after the Notice to Proceed Date, the Spill Prevention and Control Plan (SPC Plan) containing as a minimum, the following itemized information:

- A. The name of the Contractor's on-site person (on-site spill prevention and control coordinator) responsible for ensuring compliance with and performance of the Contractor's SPC Plan including how to timely contact (office phone and cell phone);
- B. The name and phone number of the Contractor's 24 hour/on call spill response Subcontractor";
- C. An itemized list of Supplies in a Spill Kit for use to control, contain, and cleanup contaminants anticipated for the Work, and the proposed location of this Spill Kit;
- D. A photo copy or other acceptable representation of a readily accessible and prominently visible weatherproof sign located with the Spill Cleanup Kit showing:
 - 1) the Contractor's on-site person with contact information,
 - 2) required notifications should a spill occur as indicated in this Section; and
- E. An adequate description of the SPC Plan addressing:
 - 1) controls and Supplies for preventing environmental spill,
 - 2) controls and Supplies for containing a spill should such occur,
 - 3) Supplies and procedure for clean up should a spill occur,
 - 4) regular informational training for all employed in the Work, and
 - 5) identify any additional and necessary precautions where near or over or beneath surface waters, Sewer and Storm Drain, natural drainage system, wetland, reservoirs, and similar areas and Structures.

In addition to the foregoing, the Owner may specifically require the Contractor to provide additional information which, in the sole judgment of Owner, are reasonably necessary to address containment of spills and discharges of contaminants.

1-07.5(6) ARCHAEOLOGICAL AND HISTORIC PRESERVATION

Should the Contractor discover during any construction activity or in any other way discover any artifacts, skeletal remains, or other archaeological resources (as defined under RCW 27.53.040) at the Project Site, it shall be the responsibility of the Contractor to both immediately cease construction activity at the discovery site and surrounding area, and promptly notify the

Engineer. If ordered by the Engineer, the Contractor shall suspend construction activity that, in the opinion of the Engineer, would be in violation of Chapter 27.53 RCW.

Suspension of this construction activity shall remain in effect until the Engineer has obtained permission to proceed from the State Historic Preservation Officer or from other authority.

1-07.5(7) THREATENED AND ENDANGERED SPECIES

The Contractor shall 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 (ESA), as may be applicable.

1-07.5(8) CONSTRUCTION WITHIN AND ADJACENT TO WATER

In addition to other requirements in Section 1-07.5, the Contractor shall comply with the Rivers and Harbor Act, the Clean Water Act, and the Water Resources Development Act, as may be applicable.

1-07.5(9) 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.

Disposal of material within a wetland area will not be allowed without a Section 404 permit issued by the U.S. Army Corps of Engineers and approval by the local agency with jurisdiction over the wetland.

1-07.5(10) LIABILITY AND PAYMENT

The Contractor shall be 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 may be 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 shall be considered as incidental to the Work and such costs shall be at the Contractor's sole expense.

1-07.6 PERMITS AND LICENSES

Unless otherwise specified in the Contract, the Contractor shall obtain all required permits and licenses for the performance of the Work, shall give any notices such permits and licenses may require, shall comply with all requirements of said permits and licenses, and shall not proceed with any portion of the Work until the requisite permit has been obtained and a copy delivered to the Owner. Permits and licenses obtained by the Owner will be referenced or included in the Contract. The costs of permits and licenses obtained by the Contractor shall be included in the Bid item prices for the Work.

The Owner will support the Contractor in efforts to obtain a temporary operating permit in the Contractor's name if:

1. A local rule or an agency policy prevents issuing the permit to a private firm;
2. The Contractor takes all action to obtain the permit;
3. The permit will serve the public interest;
4. The permit applies only to Work under the Contract;
5. The Contractor agrees in writing:
 - (a) to comply with all the issuing agency requires, and
 - (b) to hold the Owner harmless for any Work-related liability incurred under the permit; and
6. The permit costs the Owner nothing.

1-07.7 LOAD LIMITS

1-07.7(1) GENERAL

While moving equipment and Materials on any public Right-Of-Way, the Contractor shall 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. At the Engineer's request, the Contractor shall 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 shall apply to:

1. **Structures Designed for Direct Bearing of Live Loads:** On these Structures, the gross or maximum load on each individual vehicle axle shall not exceed the legal load limit by more than 35 percent. No more than one vehicle shall operate over any Structure at one time.
2. **Underpasses and Reinforced Concrete Box Culverts Under Embankments:** Over these Structures, maximum loads shall be 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 in accordance with Section 2-03.3(14).
 - 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 shall 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:
- a. For Class III reinforced concrete pipes, the embankment shall have risen above the top limit of compaction at least 6 feet.
 - b. For Class II reinforced concrete pipes, the maximum load for each axle shall be 80,000 pounds if outside wheel spacing is at least 7 feet on axle centers. In this case, the embankment shall have risen above the top limit of compaction at least 6 feet.

1-07.8 RESERVED**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 Chapter 39.12 (Prevailing Wages on Public Works), RCW Chapter 49.28 (Hours of Labor), and to RCW Chapter 49.46 (Minimum Wage Act) as amended or supplemented. On Projects funded in whole or part from federal monies, federal wage laws and rules shall also apply.

When the Work is subject to both the provisions of the State (RCW Chapter 39.12) and federal (Davis-Bacon and related acts) prevailing wage requirements, the Contractor and every Subcontractor must pay at least the State prevailing wage rates, if they are higher than the federal prevailing wage rates for the project unless specifically preempted by federal law. When the federal prevailing wage rates are higher than the State prevailing wage rates, the Contractor (and every Subcontractor) shall pay the federal rate as required by federal law.

The Contractor, any Subcontractor and all individuals and firms required to pay prevailing wages per WAC 296-127-010, shall not pay any laborer, worker, or mechanic less than the applicable prevailing hourly wage rates and fringe benefits for said worker's classification. Higher wages and benefits may be paid at the option of the employer.

Pursuant to the provisions of State law, the Contractor, every Subcontractor, and all other individuals or firms required to pay prevailing wages for Work performed on this Contract, shall be subject to investigation by the State of Washington Department of Labor and Industries for failing to pay the required prevailing wage to workers, laborers, and mechanics employed on the project. Such investigation may result in the State issuing a notice of violation in accordance with WAC 296-127-150.

To the extent an individual or firm required to pay prevailing wages is found by the Department of Labor and Industries to have violated the requirement to pay the prevailing rate of wage, the unpaid wages shall constitute a lien against the Contractor's Bond and retainage. Consistent with 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.

It shall be the sole responsibility of the Contractor to assign the appropriate classification to all laborers, workers or mechanics who perform any Work pursuant to this Contract, in conformance with the scope of work descriptions of the Industrial Statistician of the Washington State Department of Labor and Industries. It shall also be the Contractor's sole responsibility to ascertain the applicable prevailing rate of wage for each such classification. Laborers, workers, and mechanics must be paid in full at least once each week and in lawful money of the United States.

The Owner holds the Contractor responsible for compliance of all Subcontractors with payroll reporting requirements and payment of prevailing wages.

The Project Manual includes hourly minimum rates for wages and fringe benefits to be paid laborers, workers and mechanics employed in the Work as established by the State Department of Labor and Industries and described in Section 1-07.9(1)C.

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 the Department of Labor and Industries and published only on the first Business Day of February and the first Business Day of August of each year. All prevailing wage rates become effective thirty (30) Days after they are published. Current prevailing wage information may be obtained upon request from the:

Industrial Statistician
Department of Labor and Industries
ESAC Division
P.O. Box 44540
Olympia, WA 98504-4540
(360) 902-5335

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
 Employment Standards Administration
 Wage and Hour Division
 71 Stevenson Street
 Suite # 930
 San Francisco, CA 94105
 (415) 975-4851
 (415) 975-4539 FAX

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 shall calculate any amount above the minimums that have to be paid.

If the Contractor employs labor in a classification not listed in the Project Manual, the Contractor, on any projects where only State prevailing wage rates apply, shall request the Industrial Statistician of the Washington State Department of Labor and Industries to determine the correct prevailing wage rate for that classification and locality. If the project is funded in whole or part with federal monies, the Contractor shall request the Industrial Statistician of the Washington State Department of Labor and Industries to determine a State prevailing wage rate for that classification and locality and shall separately request the U.S. Department of Labor to determine a federal prevailing wage rate for that classification and locality. If those wage rates differ, the Contractor shall use the higher wage rate determined.

1-07.9(1)B 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 two (2) hours worked in excess of eight (8) hours per Day when the employer and employee voluntarily enter into an agreement wherein the employee will work up to ten (10) hours per Day in a four-day week to accomplish forty (40) hours of work.

Recognizing that there may be Days when a full ten (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; and
3. Be entered into individually with each employee; and
4. Be entered into separately for each public works project, except that an employer, at its option, may obtain an annual authorization; and
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 three (3) years from the Completion Date of the Work. Absence of an authorization record for an employee shall 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.

Working more than ten (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.

Notwithstanding the above provisions, overtime rates must be paid for all hours worked in excess of forty hours per week. For any overtime work performed on a federally funded project in accordance with 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 PCSD, physical address: Seattle Municipal Tower, Suite 4112, 700 Fifth Avenue, mailing address: P.O. Box 94687, Seattle, Washington 98124-4687.

1-07.9(1)C EFFECTIVE DATE FOR DETERMINING PREVAILING WAGES

In accordance with WAC 296-127-011, the effective date for determining State prevailing wages will be the Bid Opening Date, provided the Contract is Awarded within six months after Bids are due. If the Contract is not Awarded within six months after Bids are due, the effective date for determining prevailing wages shall be the Award Date of the Contract. If the Contract is not Awarded pursuant to Bids (e.g. emergency Contracts), the effective date for determining prevailing wages shall be the date when the Contract is executed.

For a project funded in whole or part with federal monies, the effective date for determining prevailing wages shall be ten (10) Days prior to the date Bids are due provided the Contract is Awarded within ninety (90) Days after Bids are due, unless the Engineer determines there is sufficient time to notify Bidders by Addendum of changes in the prevailing wage rates up to the date of Bid opening, in which case those changed prevailing wage rates shall apply. If the Contract is not Awarded within ninety (90) Days after the Bids are due, the effective date for determining prevailing wages shall be the Award Date of the Contract.

1-07.9(1)D PAYROLL REPORTS

On any project that is federally funded, payroll reports for the Contractor, every Subcontractor, and all other individuals or firms required to pay prevailing wages for Work performed on this Contract shall be submitted weekly to PCSD of the Department of Executive Administration, City of Seattle, Seattle Municipal Tower, physical address: Suite 4112, 700

Fifth Avenue, mailing address: P.O. Box 94687, Seattle, Washington 98124-4687 within 72 hours after the expiration of each pay period. On a non-federally funded project, the Owner and Engineer reserve the right to request payroll reports from the Contractor, every Subcontractor, and all other individuals or firms required to pay prevailing wages for Work performed on this Contract. When required or requested, the payroll reports shall contain the following information:

1. Name and residence address of each worker.
2. Social Security number of each worker.
3. Classification of work performed by each worker. The classification must be specific and match the classification categories listed in the Project Manual.
4. Total number of hours employed each Day.
5. Total number of hours employed during the payroll period.
6. Straight time and overtime hourly rate of wages paid to each worker.
7. Total or gross amount earned by each worker.
8. Deductions for Medical Aid, FICA, federal withholding tax, and any other deductions taken.
9. Net amount paid each worker.
10. Contractor's (or Subcontractor's) name and address.
11. Days and dates worked.
12. Date of final Day of pay period.
13. 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.

Payrolls may be submitted on federal payroll form WH-347 (or equivalent), which may be obtained by contacting the Government Printing Office's toll free number (866) 512-1800, 7:30 AM to 4:30 PM Eastern Time, or by accessing their web-site at <http://bookstore.gpo.gov>. 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 shall be labeled "Initial". The last payroll submitted for the Work for both the Contractor and each Subcontractor shall be labeled "Final". Payrolls shall be sequentially numbered for all periods in which Work is performed.

1-07.9(2) POSTING NOTICES

The Contractor shall post in a location acceptable to the Washington State Department of Labor and Industries ("State 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. The address and telephone number of the Industrial Statistician, State L&I (along with notice that complaints or questions about wage rates may be directed there).

1-07.9(3) APPRENTICES

A laborer, worker, or mechanic employed on the Work for whom an apprentice agreement is registered and approved by the State Apprenticeship Council pursuant to Chapter 49.04 RCW within 60 Days of hiring may be paid the applicable prevailing hourly rate for an apprentice of that trade. If formal registration with the State Apprenticeship Council is not accomplished within 60 Days of hiring, the laborer, worker or mechanic must be paid the prevailing hourly journey level rate for all hours worked on the Contract until an apprenticeship agreement is registered.

If the Contractor or Subcontractor of any tier make use of an apprentice on work also governed by federal wage rates and regulations, the Contractor shall present to the Owner written evidence of registration of such employees in a program approved by the Washington State Apprenticeship Council and recognized by the U.S. Bureau of Apprenticeship and Training. On any Project that is federally funded and where submission of payroll reports is required, such evidence shall be submitted with the first payroll upon which the name of the employee appears. In the absence of such a State apprenticeship council program, the Contractor shall submit evidence of approval and registration by the U.S. Bureau of Apprenticeship and Training.

1-07.9(4) PREVAILING WAGE DISPUTES

In the event any dispute arises as to what the prevailing wages are for this Contract, and the dispute cannot be resolved by the parties involved, the matter shall be referred to the Director of the Department of Labor and Industries of the State of Washington when such dispute involves State prevailing wage rates. In such case, the Director's decision shall be final, conclusive, and binding on all parties.

If the dispute involves a federal prevailing wage rate, the matter shall be referred to the U.S. Secretary of Labor for a decision. In such case, the Secretary's decision shall be 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 shall comply with whichever standard is higher.

1-07.9(5) REQUIRED DOCUMENTS

Before payment is made by the Owner of any sums due under this Contract, the Contractor and each Subcontractor regardless of tier shall submit to PCSD, a copy of a "Statement of Intent to Pay Prevailing Wages" (form F700-029-000), approved by the Industrial Statistician of the Washington State Department of Labor and Industries.

Upon completion of the Work and before any funds retained under RCW Chapter 60.28 can be released to the Contractor, the Contractor and each Subcontractor regardless of tier shall deliver to PCSD, a copy of a "Affidavit of Wages

Paid" (form L700-007-000), approved by the Industrial Statistician of the Washington State Department of Labor and Industries. These forms, along with other requirements outlined in Section 1.09.9(2), must be submitted by the Contractor to PCSD before any funds retained under RCW 60.28.011 will be released to the Contractor.

A fee of \$25.00 per each "Statement of Intent to Pay Prevailing Wages" and "Affidavit of Wages Paid" is required to accompany each form submitted to the State of Washington Department of Labor and Industries by the Contractor or any Subcontractor. The Contractor or Subcontractor, as applicable, shall be responsible for payment of these fees and shall submit all forms directly to the State of Washington Department of Labor and Industries for approval. The cost of these fees shall be included in the Bid item prices that comprise this Contract.

The required forms specified herein may be obtained from the Department of Labor and Industries at the following website:

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

Each progress estimate submitted to the Engineer for payment shall include or have attached a statement signed by the Contractor that the prevailing wages have been paid in accordance with the pre-filed Statement of Intent to Pay Prevailing Wages as specified in the first paragraph of Section 1-07.9(5), or the estimate will not be paid.

The following is a sample of the wording required:

"Project: _____ PW#: _____

I certify that the prevailing wages have been paid in accordance with the pre-filed Statement or Statements of Intent to Pay Prevailing Wages on file with the Purchasing and Contracting Services Division of the Department of Executive Administration for the period covering

_____, 20____ to
_____, 20____

Contractor Signature"

This letter shall be signed by an authorized representative of the Contractor prior to payment of any voucher pursuant to RCW 39.12.040.

Submittals shall be made to:

Purchasing and Contracting Services Division
City of Seattle Department of Executive Administration
physical address:
Seattle Municipal Tower, Suite 4112
700 Fifth Avenue

mailing address:
P.O. Box 94687
Seattle, Washington 98124-4687
Telephone (206) 684-0430
Fax (206) 684-4511

1-07.9(6) AUDITS

Payroll, wage, and cost records shall be retained, and may be audited or inspected, as permitted by Section 1-09.12.

1-07.10 RESERVED

1-07.11 EQUAL BENEFITS, AFFIRMATIVE EFFORTS, EQUAL EMPLOYMENT OPPORTUNITY, AND NON-DISCRIMINATION REQUIREMENTS

1-07.11(1) EQUAL BENEFITS

The Contractor shall comply with the requirements of 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 shall provide complete information and verification of the Contractor's compliance with SMC Ch. 20.45.

For further information about, SMC Ch. 20.45, and the Equal Benefits Program Rules call (206) 684-0430 or refer to <http://cityofseattle.net/contract/equalbenefits/>.

- A. Evaluation of the Contractor's compliance with the Equal Benefits requirement will be based on the following criteria:
1. A domestic partner is a person (same sex or opposite sex partner``) whose domestic partnership is registered either with the employer's internal registry or with a local government entity, pursuant to 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.
- B. Reporting Requirements: If applicable, the Apparent Low Bidder must submit the Equal Benefits Compliance Work Sheet and Declaration to the PCSD representative within seven (7) Working Days after receiving the request from the PCSD representative.
- C. Any violation of this Section shall be a material breach of Contract for which the City may:
1. 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; or
 2. Terminate the Contract; or
 3. Disqualify the Contractor from bidding on or being awarded a City contract for a period of up to five (5) years; or
 4. Impose such other remedies as specifically provided for in SMC Ch. 20.45 and the Equal Benefits Program Rules promulgated thereunder.

1-07.11(2) WOMEN AND MINORITY BUSINESS ENTERPRISE AFFIRMATIVE EFFORTS AND NON-DISCRIMINATION REQUIREMENTS

In SMC Ch. 20.42.010, the Owner has found that minority and women businesses are significantly under-represented and have been underutilized on City of Seattle contracts. Additionally, the Owner does not want to enter into agreements with businesses that discriminate in employment or the provision of services. The Owner intends to provide the maximum practicable opportunity allowed by law for increased participation by minority and women owned and controlled businesses, as long as such businesses are underrepresented, and to ensure that the Owner's contracting practices do not support discrimination in employment and services when the Owner procures public works, goods, and services from the private sector. The Owner will not enter into contracts with Contractors that do not agree to use Affirmative Efforts to employ women and minority group members as required under SMC Ch. 20.42 or who violate any provisions of that chapter, or those requirements set forth below.

The Contractor shall comply with the provisions of 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.

As used in this section, the term "minority business" means a business at least fifty-one percent of which is owned by minority group members."

The Contractor shall comply with the City's Fair Contracting Practices Ordinance law (SMC Ch. 14.10, as amended), which prohibits discrimination in contracting practices.

The Contractor shall not create barriers to open and fair opportunities for WMBEs to participate in any City contracts and to obtain or compete for contracts and subcontracts as sources of supplies, equipment, construction and services.

Contractor shall utilize Affirmative Efforts to promote and encourage participation by women and minority businesses on subcontracting opportunities within the Contract scope of work. Contractor agrees to such efforts as a condition of the Contract.

- A. Affirmative Efforts shall include efforts to achieve the activities specified in the Construction Outreach Plan the Contractor submitted in accordance with Section 1-03. This Construction Outreach Plan is a part of the Contract. Although it is not a requirement to actually achieve the goals set forth in the Construction Outreach Plan, the

Contractor agrees to make efforts to attempt to achieve any goals specified in the Construction Outreach Plan for subcontracting to women and minority-owned subcontractors portions of the scope of work that present subcontracting opportunities. The Contractor shall be solely responsible for any efforts made and costs incurred to meet such goals.

B. Reporting Requirements:

1. If applicable, the Contractor must submit a Constuction Outreach Plan as indicated in Section 1-02.1(4).
2. The Contractor's must submit the first Subcontractor Payment Report no later than the 15th of the first month after the Contract start date specified in the Notice to Proceed. Subsequent Monthly Subcontractor Payment Reports must be submitted by the 15th day of every month thereafter, until the Substantial Completion Date. When no work is performed during a reporting period, the subcontractor must submit monthly report(s) indicating that no work was performed. The Contractor must appropriately mark the "final" Monthly Subcontractor Payment Report to indicate that the subcontractor's work is complete.

1-07.11(3) EMPLOYMENT AFFIRMATIVE EFFORTS REQUIREMENTS

The City encourages Contractors to employ a workforce reflective of the region's diversity. The Contractor shall comply with all non-discrimination requirements as set forth in Federal, State, and City of Seattle laws and regulations. Historically, the City included the following Voluntary Goals for women and minorities on its construction contracts: 21% minority and 20% women, with a 4.5% subgoal of minority women. (NOTE: These Voluntary Goals are provided for historical information purposes only and are not to be considered as a utilization requirement by the Contractor.) The Contractor shall include a requirement in every subcontract that Subcontractors shall adhere to the non-discrimination requirements as set forth in Federal, State, and City laws and regulations.

The Contractor shall not discriminate against any employee or applicant for employment, and will make Affirmative Efforts to ensure that applicants are employed, and 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 Efforts shall include, but not be limited to the following: employment, upgrading, promotion, demotion, or transfer; recruitment or recruitment advertising, layoff or termination, rates of pay, or other forms of compensation and selection for training, including apprenticeship.

The City encourages the Contractor to meet the employment Voluntary Goals the Contractor specified in its Construction Outreach Plan. The Contractor shall be completely responsible for the Affirmative Efforts made to meet the Voluntary Goal; however, no utilization requirements or minimum level of women or minority employment is required under this Contract.

Equal Employment Opportunity Officer: The Contractor shall designate in its Construction Outreach Plan the Contractor's Equal Employment Opportunity Officer (hereinafter referred to as the "EEO Officer"). The EEO Officer shall possess the responsibility, authority, and capability for effectively administering and promoting an active program of equal employment opportunity, and for implementing any Voluntary Goals and Affirmative Efforts requirements of this Contract.

1-07.11(4) RESPONSIBILITIES

The Contractor shall ensure that all employees, particularly supervisors, are aware of, and adhere to their obligation to maintain a working environment free from discriminatory conduct, including, but not limited to, harassment and intimidation of minorities and women, or WMBE businesses.

1-07.11(5) RECORDS

The Contractor shall furnish to the Department of Executive Administration, upon request and on such form as may be provided, reports pertaining to participation or Voluntary Goals. The Contractor shall permit access to its records of employment, bidding, and subcontracting, and other pertinent data requested by the City to determine compliance with these requirements. Records shall be available at reasonable times and places for inspection by authorized representatives of the Owner.

The Contractor shall maintain, for at least 24 months after the Completion Date, 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. The Owner shall have the right to inspect and copy such records. The Contractor shall 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) VIOLATIONS

Any violation of the mandatory requirements of the provisions of this Section, or a violation of SMC Ch. 14.04, SMC Ch. 14.10, SMC Ch. 20.42, SMC Ch. 20.45 or other local, state or federal non-discrimination laws, shall be 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 compensation 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 in accordance with SMC Ch. 20.70.

1-07.11(7) TECHNICAL ASSISTANCE

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, and Affirmative Efforts provisions. Should a contractor desire assistance or information in recruiting, tutoring, and training or otherwise preparing potential employees and Subcontractors, a contractor may contact PCSD of DEA at 206-684-0430.

Examples of Affirmative Efforts: The following are examples of Affirmative Efforts the Bidder may utilize in achieving compliance with the requirements of this Section.

- a. Attending a pre-Bid or pre-solicitation conference, if scheduled by the Owner, to provide Project information and to inform WMBEs of contracting and subcontracting opportunities.
- b. Placing all qualified WMBEs attempting to do business in The City of Seattle on solicitation lists, and providing Written Notice of subcontracting opportunities to WMBEs Capable of performing the Work, including without limitation all businesses on any list provided by The City of Seattle, in sufficient time to allow such businesses to respond to the written solicitations.
- c. Breaking down total requirements into smaller tasks or quantities, where economically feasible, in order to permit maximum participation by small businesses including WMBEs.
- d. Establishing delivery schedules, where the requirements of this Project permit, that encourage participation by WMBEs.
- e. Providing WMBEs that express interest with adequate and timely information about plans, specifications, and requirements of this Project.
- f. Utilizing the services of available minority community organizations, minority contractor groups, local minority assistance offices, The City of Seattle, and other organizations that provide assistance in the recruitment and placement of WMBEs.

1-07.11(8) APPRENTICE UTILIZATION AND EEO REPORTING

The following Apprenticeship requirements apply to projects with an Engineer's Estimate of over \$1,000,000.00.

1-07.11 (8)A GENERAL

Notwithstanding any other provisions in the Project Manual, this Contract does not require any specific levels of utilization of minority and women as apprentices, except as may be specified in any federal regulations or statutes included or referenced in the Contract documents. All other requirements of the City's apprenticeship program shall apply as specified in the Contract documents. The City encourages the Contractor to employ a workforce reflective of the region's diversity. The Contractor shall adhere to all non-discrimination requirements as set forth in Federal and State laws and regulations and Seattle municipal code provisions.

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 as well as social vitality of the region. In addition, the Owner has determined that compliance by the Contractor with the apprentice utilization requirements of the Contract must be consistent with the provisions of Chapter 49.04 RCW and Chapter 296.04 WAC.

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.

Any questions, monthly reports, or other submittals regarding the apprentice utilization requirement of the Contract shall be directed to:

Purchasing and Contracting Services Division
 City of Seattle Department of Executive Administration
 Seattle Municipal Tower, Suite 4112
 700 5th Avenue
 P.O. Box 94687
 Seattle, Washington 98124-4687
 Telephone: (206) 634-0430

1-07.11(8)B APPRENTICE UTILIZATION REQUIREMENTS AND GOALS

The total Apprentice Utilization Requirement for this Project shall be:

15%

The Contractor shall ensure that the above percentage of the total Contract labor hours utilized on the Project are performed by apprentices registered with the Washington State Apprenticeship and Training Council, hereinafter know as SAC.

1. Total Contract labor hours include additional hours worked as result of Change Orders.

2. Total Contract labor hours 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 pursuant to the following criteria of WAC 296-127-015:

Two (2) supervisors (e.g. foreman, general foreman, superintendents, etc) are entitled to receive at least the journey level prevailing rate of wage for performing manual or physical labor:

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

The Contractor shall include the apprentice utilization requirements of Section 1-07.11(8)B 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 shall make good faith efforts to:

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

The Contractor shall ensure compliance with the apprenticeship training standards for each trade/craft classification used on the Project, as set forth by the Washington State Department of Labor and Industries.

1-07.11(8)C APPRENTICE UTILIZATION PLAN

On or before the date of the pre-construction meeting, the Contractor shall submit to the Department of Executive Administration, a comprehensive plan outlining how the apprentice utilization requirements will be met on the total Contract labor hours. The plan shall include the following information, on a form to be provided by the Owner or by accessing <http://www.cityofseattle.net/contract/apprentice.htm>.

1. A list of all trades/crafts to be used on the Project, including an estimate of labor hours by trade/craft and the total labor hours to be used.
2. An estimate of the number of apprentices for each trade/craft to be used on the Project.
3. An estimate of the number of apprentice labor hours and percentage to be used by each trade/craft on the Project. The combined total number of apprentice hours used must equal or exceed the required apprentice utilization percentage.
4. An estimate of the percentage of apprentice labor hours to be used by each trade/craft. The percentage of apprentice labor hours must be based on the estimate of total labor hours by each trade/craft.
5. An estimate of the state date for each trade/craft.
6. A description of efforts the Contractor intends to make to ensure that the apprentice utilization requirement and goals are met.
7. A description of any assistance the Contractor believes will be necessary from the Owner to meet the apprentice utilization requirement and goals.

The Department of Executive Administration will provide assistance in directing the Contractor to available resources for hiring apprentices.

The Contractor, the Engineer, and the Department of Executive Administration shall meet to discuss and modify the plan as may be appropriate.

1-07.11(8)D CHANGES TO THE APPRENTICE UTILIZATION REQUIREMENT

If, during the term of the Contract, the Contractor determines that it will be unable to meet the apprentice utilization percentage required by Section 1-07.11(8)B2, the Contractor may make a written request to the Engineer, (directed to the Department of Executive Administration), to reduce the required apprentice utilization percentage. The request shall include documentation of the Contractor's affirmative efforts to use SAC registered programs, union locals, and others. These documents must demonstrate that an inadequate number of apprentices are available to meet the required apprentice utilization percentage.

1-07.11(8)E MONTHLY EEO/APPRENTICE UTILIZATION REPORT

The Contractor shall submit to the Department of Executive Administration a Monthly EEO/Apprentice Utilization Report in an electronic format to be provided by the Owner, for the Contractor and all Subcontractors. The Monthly

EEO/Apprentice Utilization Report form shall be completed by the Contractor and all Subcontractors performing work on the Project during the reporting period. (Forms are available by calling (206) 684-0430 or by accessing <http://www.seattle.gov/contract/apprentice.htm>. The report shall be submitted by the 15th of the month following the reporting period to the Department of Executive Administration. A copy shall be sent to the Engineer.

The Contractor shall be responsible for reporting apprentice utilization data required by the owner beginning with the first day of work for each apprentice. The Contractor's first submittals are due at the end of the first month after the Notice to Proceed Date, and at monthly intervals thereafter, until the Physical Completion Date has been established. Subcontractor submittals are due at the end of the month after commencement of their work and monthly thereafter.

The Contractor shall report the following information on each apprentice:

1. Apprentice's Name
2. Social Security Number
3. Home Zip Code
4. Employment Status: New Hire or Existing Staff
5. Trade/Craft
6. State Apprentice Registration I.D. Number
7. Program Sponsor and/or Hiring Source
8. Apprentice Progression Period or Percentage
9. Ethnicity/Gender
10. Labor hours for Reporting Period by Ethnicity/Gender
11. Total labor hours and number of apprentice employees for reporting period by ethnicity/gender.
12. Total apprentice labor hours and number of employees to-date
13. Summary information as noted on the form.

The Contractor shall report the following information on journey level employees:

1. Labor hours for reporting period by ethnicity/gender, for each trade/craft.
2. Total journey level labor hours by ethnicity for each trade/craft.
3. Total labor hours and number of journey level employees for reporting period by ethnicity/gender.
4. Total journey level labor hours and number of employees to date.
5. Summary information as noted on the reporting form.

The Contractor shall submit such other information as may be requested by the Owner to verify compliance with the apprentice utilization requirements of the Contract. The Owner reserves the right to add, delete, change as necessary the information required by the Contractor on a Monthly EEO/Apprentice Utilization Report form.

1-07.11(8)F MONITORING

The Department of Executive Administration will verify the registration of each apprentice used on the Project with the Washington State Apprenticeship and Training Council.

The Department of Executive Administration will monitor the apprentice utilization data provided by the Contractor. In the event that the Contractor is deficient in the use of apprentices, the Department of Executive Administration and the Engineer will meet with the Contractor to discuss the reasons for the deficiency and help the Contractor develop a written plan for meeting the requirement.

The Owner will make routine visits to the Project Site for the purpose of confirming the use of apprentices.

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, shall be at the sole risk of the Contractor until the Completion Date. Until such date, damage to, or destruction of, either permanent or temporary portions of the Work, existing utilities, street improvements, Materials, or equipment and plant shall 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 shall be 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; provided, however, that this exception shall not apply should damages be by reason of the Contractor's failure to comply with the Contractor's contractual responsibilities or to perform sound engineering and construction practices in the conduct of the Work, or to take reasonable precautions under the circumstances.

4. Third party damage or vandalism occurring after the Physical Completion Date.

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

Damage qualifying under any of the exceptions listed in Section 1-07.13(1) above shall be corrected promptly when ordered by the Engineer, and compensation will be made in accordance with Section 1-04.4. Where public safety is affected and an emergency exists, the Engineer may elect to accomplish repair by means of Owner forces or other forces as permitted by Section 1-05.8.

Nothing contained in this Section shall be construed as relieving the Contractor of responsibility for, or damage resulting from, the Contractor's operations or negligence, or the operations or negligence of any of the Contractor's Subcontractors, nor shall the Contractor be relieved from full responsibility for making good any defective Work or unauthorized Work.

The Contractor shall bear sole responsibility for:

1. Damage to property located within or outside the Project Site limits caused by erosion, siltation, run-off, or other related cause as a result of any construction operation.
2. Any pollution of a river, stream, ground water, or other water that may occur as a result of any construction operation.

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

Upon written request, the Contractor may be relieved of the duty of maintaining and protecting certain portions of the Work, as described in this Section 1-07.13(2) that have been completed in all respects in accordance with the requirements of the Contract. If in the sole opinion of the Owner that the release will not affect any past, present or future claims rights of the City, and the Engineer provides written approval, the Contractor may be relieved of the responsibility for damage to said completed portions of the Work, but not 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 duty of maintenance and protection as provided in Section 1-07.13(1) above include but are not limited to the following:

1. The completion of at least two city blocks (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 public traffic to utilize a roadway facility during construction, the Contractor will be relieved of responsibility for damages to permanent Work by public traffic under the following circumstances:

1. The Work is in accordance with the Contract or approved Drawings.
2. The Work is on a section of roadway required by the Contract to be opened to public traffic, and
3. The traffic control is in accordance with the approved traffic control plans.

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

1-07.13(4) REPAIR OF DAMAGE

The Contractor shall promptly repair all damage to either temporary or permanent Work 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 in accordance with Section 1-04.4. Payment will be limited to repair of damaged Work only. 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 WATER POLLUTION, EROSION, AND SEDIMENTATION CONTROL

During construction, the Contractor shall incorporate practices that prevent erosion, or control erosion when prevention is unavoidable, and shall make every effort to maintain effective erosion and sediment controls throughout the Work including implementing timely corrective actions as may be necessary. Sediment shall be prevented from entering any surface water, drainage facility, and natural drainage system, and shall be prevented from transport to beyond the Project Site. Work shall comply with Director's Rules based on SMC Chapters 22.800 through 22.808 and other codes addressing grading, stormwater control, ground water control, and other construction controls.

The Contractor shall, submit to the Engineer for review, a Temporary Erosion and Sediment Control (TESC) Plan prepared in accordance with the above regulations, the requirements of Section 8-01, and as may be specified in the Contract. The TESC plan shall name and confirm qualifications for the Contractor's On-Site Erosion Control Lead (see Section 1-05.13(3)). The plan shall be compatible with and shall be coordinated with the Work and Work phasing ensuring a continuance of protection.

1-07.16 PROTECTION AND RESTORATION OF PROPERTY**1-07.16(1) PRIVATE AND PUBLIC PROPERTY**

The Contractor shall protect from damage or destruction, Real Property within or adjacent to the Project Site 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 shall ensure that interference with the use of such property is minimized.

The Contractor shall be aware that underground electrical transmission and distribution conduit and ductbanks are surrounded with cementitious fluidized thermal bedding that shall 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, or 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 shall 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.

The Contractor shall, at no additional cost to the Owner, provide and install safeguards acceptable to the Engineer to protect public and private property. 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 shall be terminated and damaged or destroyed property repaired and restored immediately to its former condition by the Contractor 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 permitted by Section 1-05.8.

The Owner is responsible for the establishment and maintenance of all Right of Way monumentation. Removal or destruction of monuments will not be allowed until the Engineer has witness monuments in place to perpetuate the position of the pre-existing monument. Unless the Contract specifies otherwise, a Contractor performing Work that includes the destruction or removal (even temporarily) of monuments shall at least four (4) Working Days in advance of monument removal or destruction, forward a copy of the initial DNR permit (Ch 332-120 WAC) to the Land Survey Manager, Seattle Public Utilities, physical address: Seattle Municipal Tower, 700 5th Avenue, or mailing address: PO Box 34018, Seattle, WA 98124-4018, and make the notification required in Section 1-07.28 item 17. Within five (5) Working Days after remonumentation, the Contractor shall make the notification specified in Section 1-07.28, item 17, and shall forward a copy of the follow-up DNR permit addressing remonumentation to the Land Survey Manager.

All cost to remonument removed or destroyed monumentation without making the required notification, and without providing copies of both the initial and follow-up DNR permit as required in this Section, shall be at the sole expense of the Contractor. Such cost shall include, but is not limited to replacement survey, survey supervision, remonumentation, necessary documentation and verification, and other direct expense to the Owner.

1-07.16(2) TREE, SHRUB, AND PLANT MATERIAL PROTECTION

Trees, shrubs, and other plant material not designated for removal shall be left in place and protected from damage through the use of protective and preventative measures including but not limited to one or more of the following:

1. Temporary construction fencing,
2. Temporary tie-up of low limbs,
3. Application of a 4 to 6" layer of mulch within the dripline of trees (or wood chips salvaged from site clearing and grubbing),
4. Planking over mulch to protect surface roots from compaction by construction activity,
5. Protection of exposed tree roots with mulch or plastic,
6. Root pruning (contact the Engineer at least two (2) Working Days in advance), and
7. Limb pruning (contact the Engineer at least two (2) Working Days in advance).

See Standard Plan nos. 132, 133, and 134 for tree protections.

Protective measures shall be in place prior to construction impacting said material, and shall apply to all trees and other planted areas.

No storage of equipment or Material shall be allowed within the areas shown on Standard Plan no. 133 that are not designated for removal unless the Engineer has provided advance approval. Steel or 4" thick timber planking, each piece having a minimum 8 square feet nominal, shall be used to support stabilizers or similar support mechanisms set within these areas, or set within a sodded planting strip.

For sidewalk, curb, pavement, driveway, and related construction where roots 2 inch diameter and larger are discovered, the Contractor shall promptly notify the Engineer.

Trenching or tunneling within the dripline of existing trees not designated for removal shall be in accordance with Standard Plan no. 133 defining clearance requirements by root zone. Excavation or tunneling of any kind within the "Critical Root Zone" will not be allowed, and when such excavation or tunneling is required and the Contract does not address, the Contractor shall provide at least two (2) Working Days advance written notice and receive approval of the Engineer. Excavation within the dripline of the tree shall require a submittal from the Contractor identifying the method by which all roots 2" and larger will be retained and protected. Tree root cutting will not be allowed.

Where construction activity involves the operation of equipment or redirection of traffic within the dripline of tree, the Contractor shall submit a plan to the Engineer for approval at least three (3) Working Days in advance addressing pruning and

tying of limbs, and identifying the professional tree service company whose past and current performance is in accordance with ANSI A300 Standards.

Tree and other plant material not ordered or designated for removal that are destroyed or irreparably damaged by the Work as determined by the Engineer, shall be replaced by the Contractor as the Engineer requires at no cost to the Owner. Unless otherwise required, replacements shall be of the same species and, as nearly as possible, the same size as the tree or plant to be replaced. The Contractor shall allow at least two (2) Working Days advance notice for inspection and approval of replacement stock by the Engineer. In addition to the restoration planting, the Contractor shall be assessed damages as the difference in the dollar value between the tree or plant being replaced and the tree or plant material provided based on the "Guide for Establishing Values of Trees and Other Plants" prepared by the Council of Tree and Landscape Appraisers, current edition should such difference be determined by the Engineer. Damages assessed will be deducted from moneys due or that may become due the Contractor.

Tree trimming or removal near overhead power lines requires the advance notification specified In Section 1-07.28, item 10. Tree trimming or removal near METRO or Benson Waterfront Street Car overhead trolley wires requires the advance notification specified in Section 1-07.28, item 2B.

1-07.16(3) FENCES, MAILBOXES, AND MISCELLANEOUS ITEMS

The Contractor shall enclose the work area by installing and maintaining temporary fencing when Work is within easements or abuts private property. The Contractor shall be liable for all damages arising from noncompliance with this Section.

The Contractor shall follow 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 shall make the notification required in Section 1-07.28. Information to be provided to the Post Office shall include the Location I.D. Number included on the box label or, if no label, the street location; date(s) needed for temporary relocation(s), and approximate date(s) the area(s) impacted by construction will be completed. All U.S. Postal Service Structure relocation will be done by the U.S. Post Office. Access to existing or temporarily relocated postal Structures shall not be impaired. Upon completion of the Work which required the relocation of mail receptacles, the Contractor shall notify the U.S. Postal Service that the box may be reinstalled.

Before any Work limits access to, or disturbs existing mail receptacles or newspaper boxes, the Contractor shall make the notifications required in Section 1-07.28. The temporary location shall not impair their accessibility and usefulness. As soon as possible, the receptacles or boxes shall be reinstalled at their original location, or at other locations directed by the Engineer. New supports or boxes will not be required unless the original boxes or posts were damaged by the Contractor. Replacement or repairs to supports or boxes damaged by the Contractor shall be at the Contractor's expense. Mailbox height shall be in accordance with U.S. Postal Service requirements.

The Contractor shall protect existing curb, gutter and sidewalk from damage utilizing timber pads if necessary.

Where sprinkler systems are encountered in the planting strip, the Contractor shall carefully remove the existing sprinkler system for reinstallation by the Contractor after the Work in the planting strip is complete.

1-07.16(4) 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 shall 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 in the Drawings for existing facilities and utilities are in accordance with available information obtained without uncovering, measuring or other verification.

The Contractor shall protect from damage private and public utilities including appurtenances thereto, and other facilities encountered during the Work. Utilities shall include, but are not limited to, 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; METROKC trolley lines and feeders; rail transit infrastructure and appurtenances; pipelines, and pipeline systems, and transmission pipelines, and underground facilities as each are defined in Ch 19.122 RCW; and other similar facilities and systems.

Cast iron Water Main and some Puget Sound Energy gas distribution facilities are known to be sensitive to excessive vibration, possibly resulting in leakage. The Contractor shall exercise appropriate care when construction is near such facilities and shall cooperate with these facility owners in protecting said infrastructure.

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 may be ordered by the Engineer. Where it is necessary to remove or relocate utilities and facilities in order 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 shall 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 prior to the Contractor beginning the Work at the point affected, the Contractor shall 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 in the Contract. The Contractor shall 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 in 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 shall be performed by the Contractor as extra Work pursuant to a Change Order.

The Contractor may encounter side Sewers during Work operations. Side Sewers typically extends 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 located at the Department of Planning and Development Side Sewer and Drainage counter located at Seattle Municipal Tower, 20th floor, or on-line at the DPD web-site (www.seattle.gov/dpd/Site_Development) or by e-mail request: sidesewerinfo@seattle.gov. It shall be the Contractor's responsibility to locate and protect these existing side Sewers.

The Contractor is also alerted to the existence of RCW Chapter 19.122, an act relating to governing exposure of underground utilities facilities and prescribing penalties for non-compliance. Section 1-07.28 herein 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 shall be borne by the Contractor. No excavation shall begin 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 Chapter 19.122.

The right is reserved to the Engineer and the owner of utilities and facilities, or their authorized agents, to enter upon 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 shall cooperate with forces engaged in this work and shall avoid any unnecessary delay or hindrance to work or monitoring being performed by other forces. It shall be 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 indicated in the Contract, the Contractor shall timely 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. See Section 1-05.3(5).

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 shall be the Contractor's responsibility to locate and protect these private water services from damage.

If it is necessary to provide temporary water supply connections due to conflict with private water-services during the course of construction, it shall be the responsibility of the Contractor to do so at no additional cost to the Owner.

In all cases, private water-service lines damaged by the Contractor shall be repaired by the Contractor at the Contractor's expense. The Contractor shall notify the Engineer immediately of any such damage and shall begin repairs immediately and work continuously until water service is restored. Repair of damaged private water-service lines shall be inspected by Seattle Public Utilities or applicable water utility prior to backfilling.

Except as otherwise provided in the Contract, all costs incurred by the Contractor in complying with requirements of this Section shall be 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 in accordance with Section 1-08.8.

1-07.17(2) UTILITY CLEARANCES

1-07.17(2)A WATER MAIN CLEARANCES

1-07.17(2)A1 GENERAL

All utilities, both public and private, passing over, under, or parallel to existing Water Main within clearances specified in this subsection 1-07.17(2)A shall be coordinated with Water Operations at least fifteen (15) Working Days in advance of construction for approval of, and coordination with, the Engineer. See Section 1-07.28, item 7 for required notifications. At a minimum, 5 foot separation horizontally from a ductile iron Water Main and 18 inch separation vertically under an existing Water Main shall be provided.

Notifications regarding shutdowns of Water Mains or obstructions of hydrants and valves or not meeting clearance requirements shall be in accordance with Section 1-07.28, item 7.

Except for other utilities identified in these 1-07.17(2) subsections with greater clearance requirements, horizontal and vertical clearances of 6 inches or more are desired between Water Mains and all other utilities. Except for gas utilities (Section 1-07.17(2)D) and for cast iron Water Main facilities (Section 1-07.17(2)A2), if a separation less than any specified clearance is unavoidable, the space between the Water Main and the other non-gas utilities shall be filled with polyethylene plastic foam material (see Section 9-05.10) before backfilling.

1-07.17(2)A2 WATER MAIN WITH SEWER, SIDE SEWER, STORM DRAIN, AND COMBINED SEWER

Where possible, Sewer and Storm Drain shall be laid at a lower invert elevation than Water Main.

See Standard Plan nos. 286a and 286b.

All Water Main shall 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 (5) 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 five (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 shall be constructed of ductile iron and shall 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, Water Mains passing under Sewer and Storm Drain shall be protected by providing:

- 1) A minimum vertical spacing of 18 inches between the bottom of the Sewer / Storm Drain, and the top of the Water Main, and
- 2) Adequate support for the Sewer and Storm Drain to prevent excessive deflection of joints and settling on the Water Main, and
- 3) The point of crossing centered between two 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 pursuant to SMC Chapter 21.16 shall apply:

- (1) Ductile or cast iron pipe shall be used 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 shall be laid at least 6 inches below and 12 inches 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 five (5) feet clear from the centerline of the Water Main.

1-07.17(2)A3 NEW WATER MAIN CLEARANCE WITH GAS MAIN

New Water Main to be installed crossing over or under existing gas facilities shall meet the minimum vertical clearance requirements of Section 1-07.17(2)D or Section 1-07.17(2)A whichever is greater. New Water Main installed within the specified vertical clearance of Section 1-07.17(2)D shall have a protective wrap provided and extend for the entire distance of all specified clearance.

New Water Main to be installed parallel to existing gas facilities shall be at least five (5) horizontal feet clear of the gas facility. If the minimum horizontal clearance is less than five feet but greater than three (3) feet as specified in Section 1-07.17(2)D, a protective wrap on the Water Main shall be provided.

The protective wrap shall consist of either a split PVC pipe or PVC wrapping of at least 0.04-inch thickness and shall be applied to all Water Main for a distance at least five (5) feet clear of the gas facility.

1-07.17(2)A4 CAST IRON WATER MAIN

Cast iron Water Main in Seattle's Rights of Way shall be protected as specified in Section 1-07.16(1).

Horizontal separation from cast iron Water Main shall be at least 10 feet.

The clearances stated in subsections 1-07.17(2)A1 shall 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 located at tees, bends, and dead ends. Standard thrust block applications are shown on Standard Plan nos. 300a, 300b, 300c, 330a, 330b, 331a, 331b, 3450a and 340b.

When smaller separations or clearances are unavoidable, the use of polyethylene plastic foam will not be allowed, and the Contractor shall notify the Engineer in accordance with Section 1-07.28 item 7.

Where cast iron water distribution and transmission pipe line exits and any excavation approved by the Engineer is within the clearances specified in subsection 1-07.17(2)A2, the Contractor's protective system shall be a support system (see Section 7-17.3(1)A7b), and shield systems will not be 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 inch or less, polyethylene plastic foam (see Section 9-05.10) shall be placed between the pipes as a cushion prior to backfilling.

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 shall make the notification specified in Section 1-07.28, item 6 as applicable.

See Section 1-05.2(2) for information regarding the Contractor's obligations for site safety and cooperation with SCL's Electrical Safety Observer when excavation is near an underground electrical facility.

Proposed tree planting, trimming or removal within 10 feet of overhead electrical lines less than 50Kv or within 16.5 feet of overhead power lines 50Kv or higher, requires the advance notification specified in Section 1-07.28, items 2 and 12 as applicable.

Trees proposed for planting, removal, or trimming within 10 feet of METRO trolley wire or Benson Waterfront Street Car overhead wire shall make the notification as specified in Section 1-07.28 item 2 as applicable.

Trees proposed for planting, removal, or trimming within 10 feet or more feet of varying voltage electrical transmission lines shall make the notification specified in Section 1-07.28 item 2 or 10 as applicable.

The Contractor shall not disturb the cementitious fluidized thermal backfill that surrounds underground electrical conduits and ductbanks.

1-07.17(2)D GAS MAIN CLEARANCES WITH HEAT GENERATING UTILITIES AND NON-HEAT GENERATING UTILITIES

Heat generating facilities shall include electrical distribution and transmission including grounds, steam facilities, and other heat generating sources.

Non-heat generating utilities clearance requirements:

- A. For high-pressure gas main and service lateral, and for gas transmission line:
1. If a utility is parallel to the gas facility, then horizontal clearance shall be at least three (3) feet.
 2. If a utility crosses over or under the gas facility, then vertical clearance shall be at least three (3) feet.
- B. For non-high pressure gas main and service lateral, and for other than gas transmission line:
- 1) If a utility is parallel to the gas facility, then horizontal clearance shall be at least one (1) foot.
 - 2) If a utility crosses over or under the gas facility, then vertical clearance shall be at least six (6) inch.

In no case, shall any utility 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 subsection, the Contractor shall make the notification required in Section 1-07.28, item 18, and shall come to agreement with the gas facility owner on protection to be provided before this construction begins.

The gas facility owner may require a protective split sleeve to surround the gas facility to a distance beyond specified clearances, and the Contractor shall provide such protection.

1-07.17(2)E TREE CLEARANCES

Planting of new trees shall meet the tree clearance requirements specified on Standard Plan no. 030.

1-07.17(2)F STANDARD LOCATION FOR UTILITIES – RESIDENTIAL STREET

Utilities located on residential streets shall meet the location standards and clearances specified on Standard Plan no. 030.

1-07.18 INSURANCE**1-07.18(1) COVERAGES AND LIMITS**

The insurance shall provide the minimum coverages and limits of liability set forth below. Providing coverage for these stated minimum limits of liability shall not relieve the Contractor, any Subcontractor of any tier or any of their respective insurers from liability for claims in excess of such limits. If Work is Subcontracted, applicable minimum coverages and limits of liability may be evidenced by any subcontractor provided that such insurance fully meets the applicable requirements set forth herein.

1-07.18(1)A COMMERCIAL GENERAL LIABILITY (CGL) INSURANCE

CGL insurance shall 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
8. Blasting (if explosives are used in the performance of the Work)

Such insurance must provide a minimum limit of liability of \$1,000,000 each Occurrence Combined Single Limit Bodily Injury and Property Damage (CSL) except \$1,000,000 each Offense Personal/Advertising Injury and \$1,000,000 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 \$1,000,000 CSL. If pollutants are to be transported, MCS 90 and CA 99 48 endorsements are required.

1-07.18(1)C STATE OF WASHINGTON STATUTORY WORKERS' COMPENSATION INSURANCE

The Contractor shall comply with Workers' Compensation coverage as required by Title 51 RCW (Industrial Insurance).

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(2) GENERAL REQUIREMENTS (DO NOT APPLY TO STATE OF WASHINGTON STATUTORY WORKERS' COMPENSATION INSURANCE)

The Contractor shall (1) not begin Work until certification of insurance as required in section 1-07.18(4) has been delivered to and approved by the Owner, and (2) keep required insurance in force at all times during the term of the Contract. The term "insurance" herein shall include but not be limited to self-insurance, alternative risk transfer techniques, capital market solutions or any other form of risk financing.

Each insurer must either be (1) authorized to do business in the State of Washington and maintain A.M. Best's ratings of A: VII or higher, or (2) procured as surplus lines under the provisions of chapter 48.15 RCW ("Unauthorized Insurers"), except as may otherwise be approved by the Owner.

The City of Seattle shall be included as an additional insured for primary and non-contributory basis as respects insurance coverages specified in sections 1-07.18(1)A (CGL insurance) and 1-07.18(1)B (Automobile Liability insurance). As respects CGL insurance, and Contractor's Pollution Liability Insurance (if required), such additional insured status shall (1) be evidenced by an ISO endorsement form CG 20 10 or equivalent endorsement or blanket additional insured language, (2) be primary and non-contributory as respects the Owner's insurance, and (3) contain a "cross liability" provision. ISO endorsement form CG 20 12 or equivalent endorsement or blanket additional insured language limiting additional insured status to governmental permitting shall not satisfy the requirements of this paragraph.

Written notice of cancellation must be actually delivered or mailed to the Owner not less than thirty (30) Days prior to the effective date of any cancellation except for cancellation for nonpayment of premium, which notice shall be not less than ten (10) Days prior to such date, unless a longer period of written notice is required under the provisions of Revised Code of Washington (RCW) 48.18.290 ("Cancellation by insurer."). Notice under this paragraph shall be sent by mail to the City of Seattle, Risk Management Division, P.O. Box 94669, Seattle, WA 98124, by fax to (206) 470-1270 or as an email attachment to RiskManagement@Seattle.Gov.

Failure on the part of the Contractor to maintain the insurance as required shall constitute a material breach of contract, upon which the Owner may, after giving five (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 shall (1) furnish financial information that the Owner may reasonably require to assess the Contractor's risk bearing capacity, and (2) 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(ies) meeting the requirements stated herein. The cost of any payments for defense and indemnity falling within the S.I.R. shall be the responsibility of the Contractor.

All costs for insurance shall be incidental to and included in the unit or lump sum prices of the Contract and no additional payment will be made.

1-07.18(3) SUBCONTRACTOR INSURANCE

Contractor shall contractually require that each subcontractor of every tier maintain at a minimum the insurance coverages specified in sections 1-07.18(1)A (CGL insurance) and 1-07.18(1)B (Automobile Liability insurance) and include the City of Seattle as an additional insured for primary and non-contributory limits of liability. As respects CGL insurance, and Contractor's Pollution Liability Insurance (if required), such additional insured status shall (1) be evidenced by an ISO endorsement form CG 20 10 or equivalent endorsement or blanket additional insured language, (2) be primary and non-contributory as respects the Owner's insurance, and (3) contain a "cross liability" provision. ISO endorsement form CG 20 12 or equivalent endorsement or blanket additional insured language limiting additional insured status to governmental permitting shall not satisfy the requirements of this paragraph. Upon request of the Owner, the Contractor shall cause evidence of such insurance to be provided to the Owner as specified in section 1.07.18(5).

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 shall not be 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 shall not apply and all insurance policies, with the exception of Professional Liability and Workers Compensation, shall 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 shall apply 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 pursuant to 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 shall deliver to the Owner certification of insurance meeting the requirements set forth herein when the Contractor delivers the signed Contract for the Work. The certification of insurance 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 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 and schedule of forms and endorsements.
4. Any other policy language or endorsements that documents compliance with the requirements herein.

At any time upon the Owner's request, the Contractor shall forward to the Owner a true and certified copy of any insurance policy(s).

1-07.18(6) RESERVED**1-07.18(7) RESERVED****1-07.18(8) INDEMNIFICATION**

The Contractor shall defend, indemnify and hold harmless the Owner and its officers, employees and agents from every claim, risk, loss, damage, demand, suit, judgment, attorney's fees, and expense of any kind, including but not limited to damages arising from bodily injury or death of persons and damage to or loss of use of property, arising out of or caused by the Work performed by Contractor, its agents, employees and Subcontractors upon public property including work arising under this Contract, or arising from any breach of Contractor's obligations under this Contract.

If the claim, risk, loss, damage, demand, suit, judgment, expense or action for injuries, death, or damage is caused by or results from the concurrent negligence of (a) the Contractor or its officer, agent, employee, or Subcontractor and (b) the Owner or its officer, agent or employee, these indemnity provisions shall be valid and enforceable only to the extent of the negligence or fault of Contractor and its agents, employees, and Subcontractors.

The Contractor shall also indemnify, defend, and save harmless any county, city or district and the officers and employees of said county, city or district connected with the Work within the limits of which county, city or district the Work is being performed hereunder all in the same manner and to the same extent as provided above for the protection of the Owner and the Owner's officers, employees and agents provided that no retention of money due the Contractor will be made by the Owner except as provided in RCW 60.28, pending disposition of suits or claims for damages brought against the county, city or district.

Contractor hereby assumes all risk of damage to its property, or injury to its officers, directors, agents, contractors, or invitees, in or about the project from any cause, and hereby waives all claims against the Owner. The Contractor further waives, with respect to the Owner only, its immunity under RCW Title 51, Industrial Insurance.

1-07.18(9) WORKER'S BENEFITS

The Contractor shall make all payments required for unemployment compensation 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 shall make the determination as to whether workers are to be 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 shall include in the Bid, all costs for payment of unemployment compensation and for providing either or both of the insurance coverages. The Contractor will not be entitled to any additional payment for: (1) failure to include such costs, or (2) determinations made by the U.S. Department of Labor or the Washington State Department of Labor and Industries regarding the insurance coverage.

The Public Works Contract Division of the Department of Labor and Industries will provide the Contractor with applicable industrial insurance and medical aid classification and premium rates. The "Request for Release" form of the Department of Labor and Industries is also for the purpose of obtaining a release with respect to the payments of industrial insurance and medical aid premiums.

1-07.19 GRATUITIES

The Contractor shall not extend any loan, gratuity, or gift of money in any form whatsoever to any employee or officer of the Owner; nor shall the Contractor rent or purchase any equipment or Materials from any employee or officer of the Owner.

1-07.20 PATENTED DEVICES, MATERIALS, AND PROCESSES

The Contractor shall assume 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

It shall be the Contractor's responsibility to maintain 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 the State Department of Labor and Industries, or both.

1-07.22 USE OF EXPLOSIVES

Explosives shall not be used 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 shall contain a special clause covering the blasting. Explosives shall be handled, marked, stored, and used in strict compliance with Chapter 296-52 WAC and such local laws, rules, and regulations as may apply. The stricter provisions shall apply. For Work within The City of Seattle, the Seattle Fire Code, Article 77, shall also apply and the individual in charge of blasting shall be certified by the Seattle Fire Department. In all cases, the individual in charge of blasting shall have a current Washington State Blaster Users License.

The Contractor shall obtain, comply with, and pay for such permits and costs as may be necessary in conjunction with blasting operations. Copies of the permits shall be furnished to the Engineer. For Work within the city limits of Seattle, a permit shall be obtained from the Seattle Fire Department.

The Contractor shall 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 shall be completed before construction on such Structures is undertaken. Explosives shall not be left unprotected along or adjacent to any existing public place.

The Contractor shall 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 shall 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 shall make the applicable notification(s) of Section 1-07.28 as may apply, and shall:

1. Conduct all operations with the least possible obstruction and inconvenience to the public.
2. Have under construction no greater length or amount of Work than can be continuously and vigorously prosecuted properly with due regards to the rights of the public.
3. To the extent possible, finish each section before beginning Work on the next.
4. Minimize the disruption of public 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 next 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 shall 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 shall also maintain roads, streets, sidewalks, bikeways, and paths adjacent to the Project Site when they are affected by the Contractor's operations. 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 1-04.11).

If the Contractor fails or refuses to clean the streets, trucks, or equipment as required by the Engineer, the Engineer may order the Work suspended at the Contractor's risk until compliance with the Contractor's obligation is assured. Alternately, the Engineer may order 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, shall be deducted from moneys due or to become due the Contractor on progress estimates. The Contractor shall have no claim for delay or additional costs if the Engineer chooses to suspend the Contractor's Work until compliance is achieved.
 - d. 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 shall be responsible for scheduling when to renew striping and pavement marking, subject to the Engineer's approval.
 - e. Providing access at all times to emergency traffic such as police, fire, and disaster units.
 - f. Coordinating construction operations with all disposal firms and transit bus service that may be operating within the Project Site. If METROKC operates in the area of Work, the Contractor shall 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 modify METROKC 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 should be made aware of, or requesting a temporary weekend-only diesel bus for an electric trolley), the Contractor shall make the notification in accordance with Section 1-07.28, item 2.

- g. The Contractor shall be liable for any damage to property or persons, resulting from failure to comply with Subsection 1-07(23)(4)(f).
 - 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. Make the required notification(s) 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. The Contractor shall post 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 shall not exceed 2 blocks in length at any one time unless approved otherwise by the Engineer;
 - d. Make the required notification(s) 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; and
 - f. Providing another access before closing an existing one whenever the Contract calls for removing and replacing an abutting owner's access. The existing access shall not be closed until the replacement access facility is available; and
6. When traffic must pass through grading areas, the Contractor shall:
- 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 permit 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 permit 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 public traffic; and
 - b. Settle dust with water, or other dust palliative, as the Engineer may order.
8. If grading Work is on or next to a roadway in use, the Contractor shall finish the grade immediately after rough grading and place surfacing Materials as the Work proceeds.
9. Conduct all operations to minimize any drop-offs ("drop-off" is 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 shall also protect drop-offs left exposed to traffic during non-working hours as follows:
- a. Drop-offs up to 0.20 foot may remain exposed with appropriate warning signs alerting motorists of the condition.
 - b. Drop-offs more than 0.20 foot that are in the traveled way will not be allowed unless motorists are informed about the danger of a drop-off immediately ahead of them with appropriate warning signs and protection is provided as indicated 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 will not be allowed unless motorists are informed about the danger of a drop-off immediately ahead of them with appropriate warning signs and further protected by having one of the following:
 - (1) Channeling devices (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 shall be the posted speed "number" in miles per hour. Signs, warning of pavement drop-off, shall 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 required at the beginning of the barrier facing oncoming traffic. For night use, the barrier shall have standard delineation such as paint, reflective tape, lane markers, or warning lights.
 - d. Drop-offs more than 0.50 foot not within the Traveled Way shall be marked with appropriate warning signs and further protected as indicated in the immediately preceding subparagraphs c(1) or c(2) if all of the 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 three (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 one side of the roadway.

- e. Drop-offs more than 0.50 foot that are not within the Traveled Way and are not otherwise covered by the immediately preceding subparagraph d above shall be both protected with appropriate warning signs and with protections as specified in item c(2) this subsection.
- 10. Open trenches within the traveled way shall have a steel plate cover placed and anchored over them. A wedge of suitable material, if required, shall be placed for a smooth transition between the existing surface and the steel plate. Warning signs shall be used 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, shall 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.

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 upon a sidewalk, walkway or crosswalk area, special consideration must be given to pedestrian safety. Maximum effort must be made to separate pedestrians from the Work area.

Protective barricades, fencing, and bridges, together with warning and guidance devices and signs, shall be utilized so that the passageway for pedestrians is safe and well defined. Whenever pedestrian walkways are provided across excavations, they shall be provided with suitable handrails. Footbridges shall 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 shall be provided at the entrance and exit of all raised footbridges, again to prevent tripping. Adequate illumination and reflectorization shall be provided during hours of darkness. All walkways shall 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 shall be 8 feet.

Where walks are closed by construction, an alternate walkway shall be provided, preferably within the planting strip. Where it is necessary to divert pedestrians into the roadway, barricading or channeling devices shall be provided to separate the pedestrian walkway from the adjacent vehicular traffic lane. At no time shall pedestrians be diverted into a portion of a street used concurrently by moving vehicular traffic.

At locations where adjacent alternate walkways cannot be provided, appropriate signs shall be posted at the limits of construction and in advance of the closure at the nearest crosswalk or intersection to divert pedestrians across the street.

Physical barricades shall be installed to prevent visually impaired people from inadvertently entering a closed area. Pedestrian walkways shall be wheelchair accessible at all times. Pedestrian access shall be maintained to all properties adjacent to the construction site.

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 Engineer, will be indicated in the Contract, but may not always be shown on the Drawings. The Contractor's construction activities shall not be allowed beyond these restrictions to access. 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 prior to commencement of construction, and the Engineer is informed of such arrangement prior to use of said property.

Generally, the Engineer will have obtained, prior to Bid opening, all Real Property rights (both permanent and temporary) necessary for carrying out the Work. Exceptions to this will be noted in the Contract or brought to the Contractor's attention by a duly issued Addendum.

Whenever any of the Work is accomplished on or through property other than public street Right of Way, the Contractor shall meet 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 Drawings will include notes whenever necessary Real Property rights have not been acquired prior to the Advertisement for Bids. The Contractor shall 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 Engineer in obtaining Real Property rights, the Contractor will be entitled to an extension of time. The Contractor agrees that such delay shall not be a breach of Contract.

Each property owner shall be notified in advance of the Contractor's entry onto that owner's property pursuant to Section 1-07.28. This includes entry onto private property where private improvements must be adjusted.

The Contractor shall be 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 shall file with the Engineer a written statement granting permission by the property owner for such property use. Upon vacating the private property, the Contractor shall file with the Engineer a written release from the property owner. Each property disturbed or otherwise interfered with by the Contractor for reasons of construction pursued under this Contract shall require a written permission and written release. The written permission and written release shall 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 1-04.11 has been satisfactorily accomplished. The written permission and written release shall 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 (see Section 1-05.11(2)).

1-07.25 OPENING OF SECTIONS TO TRAFFIC

The Owner reserves the right to use and open any portion of the Work before the Physical Completion Date. This action will not cause the Owner to incur any liability to the Contractor except as may otherwise be provided in the Contract.

If the Engineer opens any portion of the Work prior to 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 shall be performed at Bid item prices for Bid items of Work involved. No additional compensation 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.

1-07.26 NO WAIVER OF OWNER'S LEGAL RIGHTS; ASSIGNMENT OF CLAIMS FOR DAMAGES FOR ANTI-TRUST LAW VIOLATIONS

The Owner shall not be 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 shall not be 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 shall operate as 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 shall not be 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 shall plan and schedule Contractor Work activities to conform to and allow time for notifications, approvals, reviews, and other conditions of the Contract.

The Engineer will initially notify public and private entities having facilities in the street Right of Way of:

1. The approximate time the Work will begin.
2. What the project scope of Work is.
3. Utilities in the street Right of Way that require relocation.
4. Any other particular problems the Engineer anticipates may occur.

Thereafter the Contractor shall make the following notifications regarding Work performed in City Right Of Way, as applicable. Notification shall give the time of commencement and completion of the Work, Work hours, location of the Work, names of streets affected by the Work, schedule of operation, routes of detours, closures, etc.

1. **For Work on Roads and Highways outside the Seattle City limits:** Notifications shall be provided in accordance with permit and other requirements of the agency having jurisdiction over those roads and highways. The Contractor shall become familiar with those requirements prior to starting Work.
 - A. **Outside Seattle City Limits:** For Work on roads and highways outside the Seattle City limits but within King County, notifications shall be made as indicated below, as otherwise indicated 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 shall be notified at least two (2) Working Days in advance:
 - (1) King County Roads Division (206-296-8100),
 - (2) King County Fire Marshall's Office (206-296-6675), and
 - (3) King County Police (1-800-344-4080 or 206-296-3311).
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 shall provide SDOT (206-684-7623 Monday to Friday 8:00 am to 5:00 PM) with at least 24-hours advance notifications before the start of Work within the street Right of Way and immediately after the Work is complete. 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. **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).
- (2) Both within and outside the boundaries of Seattle City Limits: The Contractor shall notify the agencies set forth in both preceding items 1 and 2A(1).
- B. Complete closure of any arterial within the Seattle City Limits: Provide 72-hours advance notice to SDOT (206-684-7623 Monday to Friday 8:00 am to 5:00 PM) and the applicable agencies listed under paragraph 1.A.(1) above.
- C. Complete closure of any local-access street, alley, or sidewalk within the Seattle City Limits: Provide 24-hours advance notice to SDOT (206-684-7623 Monday to Friday 8:00 am to 5:00 PM).
- D. To Restrict Parking on any street within the Seattle City Limits: Provide 48-hours advance notification to SDOT (206-684-7623 Monday to Friday 8:00 am to 5:00 PM). To arrange for inspection of "No Parking" (T-39) easels and other parking related signs by a parking enforcement officer or uniformed peace officer, contact 206-386-9012 after placing the easels and at least 24 hours in advance of the effective date of enforcement on the easels. (see Section 1-10.2(5)C, item 3).
3. **Signage, Parking Pay Stations, Parking Meters, Salvaging Decorative Pavement Material:**
- A. Parking Meters, 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: five (5) Working Days advance notice is required for the following:
- 1) To request covering of parking meter(s) and placing no parking markers on "numbered" base plates where parking pay stations exist, contact 206-684-5086 (see Section 1-10.2(5), item 3.).
 - 2) To request removal of parking meter(s), parking pay station(s), and sidewalk containing D-22 signage and "numbered" base plate, contact 206-684-5370. Also see Section 2-02.3(3)F.
 - 3) After completion and acceptance of newly constructed sidewalk, to request installation of parking pay station, D-22 signage, and "numbered" base plates, contact 206-684-5370.
- B. Traffic Signs and Street Designation Signs: See Section 8-21.3(1)B1.
- C. Salvaging Brick, Cobblestone, and Granite Curb: See Section 2-02.3(7)E.
4. **Disruptions to, or service modification requests for METROKC transit and Benson Line Waterfront Streetcar service and facilities:**
- A. Contact 206-684-2732 or "construction.coord@kingcounty.gov" for the following:
- 1) Short term closure or temporary relocation of a bus stop requires a minimum five (5) Working Days advance notice;
 - 2) Removal of bus shelter at bus stop requires a minimum fifteen (15) Working Days advance notice;
 - 3) The request for assignment of diesel coaches for electric coaches on electric trolley routes (weekend only – no weekday diesel coach substitution) shall be made by no later than 10:00 AM on the Tuesday prior to the weekend requested.
 - 4) Bus route road closure resulting in traffic detour requires a minimum seven (7) Working Days advance notice. If transit is to be granted access during this closure, this notification is still required.
- B. Contact 206-263-6580 for overhead power wire requests as follows:
- 1) Overhead power line modification or outage requests for the electric bus require a minimum ten (10) Working Days advance notice. See item 3) immediately following.
 - 2) Any construction or equipment operating within ten (10) feet of any electric bus overhead power line requires a ten (10) Working Day advance notice.
 - 3) Requests for overhead power line modification or outage may have an associated cost payable by the requesting party and such requests may require additional information be provided. Scheduling is dependent upon King County METROKC Transit Power Distribution's ability to accommodate such requests. The Contractor shall be prepared to accommodate such scheduling in the Work as required in Section 1-08.3(1).
5. **Property access restrictions:** Provide abutting property owners and tenants of impending access restrictions. Advance notification shall be 24-hours for residential property and 48-hours for commercial property.
6. **Emergency Work for Pavement or Sidewalk Problems:** Provide immediate notification to: During the Day notify SDOT (206-684-7623 Monday to Friday 8:00 AM to 5:00 PM, all other times 206-386-1218).
7. **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 shall 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 shall not operate, and shall not restrict access to, any water valve owned by the Seattle Public Utilities. Notifications shall be as follows:
- 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 given to fire agencies by SPU Water Operations. At least five (5) Working Days advance notice before any request to shutdown or otherwise interrupt water service or, restrict access to hydrants and valves is required. Where Water Main shutdowns are requested in commercial and industrial areas, additional advance notification is required on a project specific basis. All Work impacting water service or water service connection shall require a minimum three (3) Working Days advance

notice to the Engineer for advisories and coordination with Water Operations. Pavement construction impacting castings and Structures connected to the water distribution or water transmission system requires five (5) Working Days advance notice to the Engineer for Water Operations advisories.

- 2) **Outside SPU Water Service Franchise Area:** Seattle-King County Department of Public Health (206-296-4722). At least 24 hours advance notice is required.
 - 3) **Boundaries of SPU Water Service Franchise Area:** The Contractor shall notify the agencies set forth in paragraphs 1) and 2) above.
- B. **Application for New and Temporary Water Service:** Contact SPU Customer Service at 206-684-5800.
- C. **Water Mains and Clearance with other Utilities:**
- 1) When proposed underground utilities are within the clearance limits of water pipe other than cast iron (Section 1-07.17(2)A), any required Contractor notification will be addressed in the Contract.
 - 2) When excavation is proposed near a cast iron water pipe (Section 1-07.17(2)A2), Contractor required notification will be addressed at the pre-construction conference (Section 1-08.1(2)).
- D. **Backflow Prevention Assembly (BPA) Inspection:** When a backflow prevention assembly is required in any temporary or permanent connection with a Water Main, the Contractor shall request inspection by making the following notification at least two (2) Working Days in advance of making the connection to the Water Main (see Sections 2-07.3(1), 8-03.3(1), 8-03.3(8), and 9-30.16):
- 1) Denny Way and north – 206-233-2635, or
 - 2) South of Denny Way – 206-684-3456.
- E. **Hydrant permit for temporary withdrawal of water:** See Section 2-07.3(2).
8. **Electrical Safety and Service:**
- A. **Electrical Safety Observer:** To schedule an Electrical Safety Observer, notify Seattle City Light at least seven (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 other than street lighting and signals (see Section 8-30.1(1)) and other than irrigation (see Section 8-03.3(1)), contact 206-684-3000 at least thirty (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 per Section 1-07.17(2)C, the Contractor shall notify Seattle City Light at least ten (10) Working Days in advance of the excavation as follows:
- | | |
|----------------------------|-----------------|
| At and North of Denny Way: | (206) 615-0600. |
| South of Denny Way: | (206) 386-4200. |
- D. **Power Lines and Trees;** See items 2B and 12 this Section.
- E. **Replacement of Casting and Covers,** 1. For Seattle City Light (SCL) replacement of casting and covers, notification of adjustment shall be directed to SCL utility castings electrical reviewer at phone number (206) 684-4911 at least seven (7) Working Days in advance of the scheduled work. 2. For Puget Sound Energy (PSE) replacement casting and covers, notification of adjustment shall be directed to PSE utility castings at phone number (360) 394-6635 at least five (5) Working Days in advance of the scheduled work.
9. **Sanitary Sewer Spills:** In the event of a sanitary Sewer spill immediately notify:
- A. Seattle-King County Department of Public Health (206-296-4632).
 - B. METROK (206-263-3801).
10. **Chemical, Oil, Hazardous Substance, or other Contaminant Spill or Discharge or Release:** Whenever the Contractor first becomes aware of a chemical, oil, hazardous substance, or other contaminant or environmental spill or discharge or release, immediately notify:
- A. Engineer, and
 - B. If into Lake Union, Ship Canal, or Puget Sound:
 - a U.S. Coast Guard (206) 217-6232) or the National Response Center, Washington, D.C. 1-800-424-8802 (operated 24 hours a Day), **and**
 - b Washington State Department of Ecology (425) 649-7000) **and**
 - c Seattle Harbor Patrol (206) 684-4071.
 - C. If into any sanitary Sewer or combined Sewer:
 - a King County Industrial Waste (206) 263-3000) Monday to Friday 8:00 to 5:00 AM,
 - b West Point Treatment Plant (206) 263-3801 all other times.
 - D. If into Storm Drain, sanitary Sewer, combined Sewer, side Sewer, rivers, streams, lakes other than Lake Union:
 - a Washington State Department of Ecology (425) 649-7000, **and**
 - b Seattle Public Utilities (206) 386-1800, **and**
 - c Seattle Surface Water Quality Hotline (206) 684-7587.
 - E. For flammable or hazardous materials: - Seattle Fire Department 911.
11. **Seattle Monorail:** When Work is within 10 feet of any portion of the monorail Structure above ground, or is within 20 feet of any portion of the monorail Structure below ground, the Contractor shall contact Seattle Monorail at 206-448-2259 at least ten (10) Working Days in advance of construction.

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 16.5 feet of overhead power lines 50Kv or higher, contact Seattle City Light at least seven (7) Working Days in advance at 206-386-1663. See Sections 1-07.16(2) and 1-07.17(2)D.
13. **Underground Utility Locator:** The Contractor shall call the Utilities Underground Location Center 1-800-424-5555 not less than two (2) or more than ten (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 shall be provided individually to the utility. See Section 1-07.17(1).
14. **Entry onto Private Property:** Each property owner shall be given 48 hours advance written notice prior to entry by the Contractor (see Section 1-07.24).
15. **U.S. Postal Service Collection Boxes, Mail Receptacles, and other Structures:** U.S. Postal Service collection box and other Structures requiring temporary relocation to accommodate construction, the Contractor shall contact 206-768-4368 at least five (5) Working Days in advance for coordination. Only the U.S. Post Office will move postal property (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)), the Contractor shall provide at least ten (10) Working Days advance notice to 206-386-1206 for coordinating temporary signal wire disconnect and temporary signal timing requirements.
17. **Survey Monumentation:**
- A. When proposed construction or other activity requires removal or destruction of a monument, the Contractor shall provide a minimum four (4) Working Days advance notice to the Engineer to allow SPU survey crews to provide witness monuments before such construction or activity. Contact 206-684-5073 or 206-684-4674 (see Section 1-07.16(1)).
- B. When survey monument cases are installed and monumentation is ready for installation, the Contractor shall contact 206-684-5073 or 206-684-4674 at least three (3) Working Days in advance.
18. **Gas Main, Transmission line, and Service Lateral:** At least three (3) Working Days both before removals over underground gas facilities and before excavation or new facility construction, are within the clearances of gas infrastructure as specified in Section 1-07.17(2)E, the Contractor shall contact 1-888-Call-PSE (1-888-225-5773).

1-07.29 RESERVED

1-07.30 RESERVED

SECTION 1-08 PROSECUTION AND PROGRESS

1-08.1 PRELIMINARY MATTERS

1-08.1(1) COPIES OF CONTRACT

The Engineer will issue to the Contractor, without charge, the following number of Contract sets:

- | | | |
|----|--|---------|
| 1. | Full-size Drawings (22-inch x 34-inch) | 2 Sets |
| 2. | Reduced Drawings (11-inch x 17-inch) | 10 Sets |
| 3. | Project Manual | 10 Sets |

The Contractor may purchase from the Engineer additional copies of Drawings and Project Manuals by submitting a request in writing to the Engineer stating the type and number of each document. The Contractor will be charged reproduction and binding costs for each document requested based upon the following:

- | | | |
|----|-----------------|--------------------------------------|
| 1. | Project Manuals | \$0.05 per page |
| 2. | Drawings | Current rate (per square foot basis) |

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

The Contractor may also purchase Drawings directly from the:

Records Vault Counter
Seattle Public Utilities
Seattle Municipal Tower, Suite 4700
700 Fifth Avenue
Seattle, WA. 98104-1709

Payment shall be made by cash or check only. Checks shall be made payable to The City of Seattle.

1-08.1(2) PRECONSTRUCTION CONFERENCE

After the Contract has been executed, but before the Contractor begins 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, the critical path, and as required by the Engineer;
2. To establish a working understanding among the various parties affected by the Work;

3. To establish and review procedures for progress estimates and cut-off dates, notifications, approvals, reviews, submittals, etc.;
4. To establish normal working hours for the Work;
5. To review safety standards, traffic control, and maintaining cleanliness;
6. To review temporary water pollution/erosion control plans and related permits, as applicable;
7. To review Material sources as may be applicable; and
8. To discuss such other related items as may be pertinent to the Work.

The Contractor shall prepare and submit the following at the preconstruction conference:

- a. A breakdown of all lump sum Bid items;
- b. A list of all portions of the Work to be subcontracted and the name of the proposed Subcontractors;
- c. A preliminary schedule of submittals (Section 1-05.3);
- d. A list of waste, recycle, and disposal sites, as applicable (see Section 1-07.3);
- e. Preliminary critical path schedule and three week forward / one week back look ahead schedule (Section 1-08.3); and
- f. A preliminary plan for temporary erosion and sediment control, and identification of the On-Site Erosion Control Lead (see Sections 1-05.13(3), 1-07.15, 8-01).

1-08.1(3) SUBCONTRACTING

Work done by the Contractor's own organization shall account for at least 30 percent of the Awarded Contract Price. The Contractor may subtract (from the Awarded Contract Price) the cost of any subcontracted Work the Contract specifically designates may be first excluded from the Awarded Contract Price before computing this percentage.

Work shall not be subcontracted, regardless of tier, without written consent of the Engineer. A request to subcontract shall be made on the "Subcontractor Approval Application Form" provided by the Engineer. If the Engineer requests, the Contractor shall provide proof that the Subcontractor has the experience, ability, and equipment the Work requires. Each subcontract shall 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.

Along with the request to subcontract, the Contractor shall submit the names of any contracting firms a Subcontractor proposes to use (i.e. second- and lower -tier Subcontractors). Collectively, these second and lower tier Subcontractors shall 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 shall meet the same requirements as first-tier Subcontractors.

Consent to subcontract will not be given unless the Engineer is satisfied with the proposed Subcontractor's prior performance, equipment, experience, and ability to perform the Work. Approval to subcontract shall not:

- 1) Relieve the Contractor of any responsibility to carry out the Contract;
- 2) Relieve the Contractor of any obligation or liability under the Contract and the Contractor's bond;
- 3) Create any Contract between the Owner and the Subcontractor; or
- 4) 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 plants;
- (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 shall be 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 in accordance with Chapter 296-127 WAC. If this should occur, the provisions of Section 1-07.9, as modified or supplemented, shall apply.

When a portion of the Work that has been subcontracted by the Contractor is not being prosecuted in a manner satisfactory to the Engineer, the Subcontractor shall be removed and replaced immediately upon the Engineer's written order, and shall 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 in accordance with the requirements of the Contract or is otherwise undesirable or unacceptable, the Engineer will so advise the Contractor by written notice. The Contractor shall 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 shall ensure that such Owner's right is included in each subcontract and sub-subcontract for any portion of the Work.

The Contractor's cost records pertaining to any Subcontracting of this Contract shall be open to inspection, subject to retainage periods, and the other requirements of Section 1-09.12.

By no later than 30 Days after the Physical Completion Date, the Contractor shall submit to the Owner a completed Final Contract Payments Reporting Form, listing the name of and dollar amount paid to each Subcontractor and Materialperson utilized by the Contractor providing more than \$2,500 worth of goods and/or services on the project, as well as the dollar amount paid to the Contractor. A sample of the form is included in the Sample Forms section of the Project Manual. The Owner will not establish the Completion Date until the completed Final Contract Payments Reporting Form has been received.

1-08.1(4) HOURS OF WORK

Except in case of emergency or unless otherwise approved by the Engineer, the normal hours of Work shall be between 6:00 a.m. and 7:00 p.m. on any Working Day and shall consist of 8 hours, exclusive of a lunch period of not more than one hour. The normal hours of Work shall be established at the preconstruction conference or prior to the Contractor commencing the Work and shall not be changed or extended without approval of the Engineer.

Permission to work other than the normal hours and Working Days may be given subject to certain conditions set forth by the Owner in its sole discretion.

SMC Chapter 25.08 specifies maximum permissible sound levels for sound sources located within the Seattle City Limits or King County. Permission to work outside normal hours of Work may be withdrawn at any time if the Contractor exceeds the specified maximum permissible sound level or if a complaint is received from the public or an adjacent property owner. The Contractor shall have no claim for damages or delay should such permission be withdrawn.

Any request to perform Work on Saturdays between 6:00 a.m. and 7:00 p.m. only, shall be submitted to the Engineer no later than noon on the Working Day prior to the Saturday that the Contractor is requesting permission to work.

A request for approval to work on any such Day or at such time shall be submitted to the Engineer no later than ten (10) Working Days prior to 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 longer than an 8-hour period on any Working Day, such work shall be considered as overtime work. On all such overtime work, the Contractor shall reimburse the Engineer for the full costs of straight time with benefits plus overtime for employees of the Owner who are required to work overtime hours on any project-related construction activity.

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 shall not be assigned without written consent of the Owner. Consent will not be given 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 given written notice, to the extent permitted by law. Assignment of monies shall be subject to all set-offs, withholdings, and deductions provided by law and under the Contract.

1-08.3 CONTRACTOR'S REQUIRED CRITICAL PATH SCHEDULE AND SUBMITTALS

1-08.3(1) CRITICAL PATH

The Contractor shall prepare initial, revised, and updated critical path schedules and shall submit to the Engineer eight (8) copies of colored graphic schedule charts and data printouts, and one (1) electronic copy on floppy disc in a format compatible with MS Office. Printouts shall include separate sorts by Activity Number and Total Float. The initial critical path schedule shall be submitted for the Engineer's review and acceptance no later than fourteen (14) Days after receipt of the Notice to Proceed. On major Projects of two hundred (200) Working Days or more, the Contractor will be allowed thirty (30) Days after the receipt of Notice to Proceed to submit a critical path schedule, but shall submit a preliminary schedule within fifteen (15) Days after the Notice to Proceed showing work activities during the first sixty (60) days of construction.

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 the Engineer's resources will be available to meet the accelerated critical path schedule. No additional compensation or time will be allowed if the Contractor is not able to meet its accelerated critical path schedule due to the unavailability of the Engineer's resources or for other reasons beyond the Engineer's control.

The critical path schedule, and any revised critical path schedule, shall:

1. Show completion of all Work within the Contract Time;
2. Show the proposed order and interdependence of the Work activities or the sequence in which the Work is to be accomplished including how the start of one work activity is restrained by the completion of other work activities;
3. Show the projected starting and completion times for:
 - a. Major phases of the Work;
 - b. All Work activity components integral to the major Work phases;
 - c. Milestone, time frame, and order of work when required in the Contract;
 - d. The total project completely planned and scheduled;
 - e. The critical path as indicated by a single path of critical Work activities; and;

- f. All utility relocation work that is to occur within the Contract Time.

The Contractor shall provide sufficient Material, equipment and labor, and shall provide the necessary coordination among Subcontractors, Materialpersons, and other necessary entities, to meet the completion times in this, and any revised, critical path schedule.

As the Work proceeds, the Contractor shall submit eight (8) copies of the revised critical path schedule(s) to the Engineer for review and acceptance. These revised critical path schedules shall reflect any change in the proposed order of the Work, any construction delay, or other condition that may affect the progress of the Work. The revised critical path schedule(s) shall not conflict with any time and/or order-of-work requirement in the Contract. The Contractor shall promptly notify the Engineer of any proposed revision to the accepted critical path schedule in effect, and shall submit the revised critical path schedule within fourteen (14) Days of giving notice. The Owner will make no payment under this Contract until a critical path schedule has been submitted, and reviewed and accepted by the Engineer. If the Engineer deems that the critical path schedule, or any revised critical path schedule, is not acceptable, the Engineer may request the Owner to withhold payment of progress estimates until an acceptable critical path schedule has been submitted by the Contractor. The project's critical path schedule shall be maintained by the Contractor during the duration of the Project so that an accurate indication of Project progress is available. When required by the Engineer during the course of the Work, the Contractor shall furnish to the Engineer within fourteen (14) Days after the Engineer's written notice, eight (8) copies of the critical path schedule in effect at the time.

The Engineer's review and acceptance of any critical path schedule shall not transfer any of the Contractor's responsibilities to the Owner. The Contractor, alone, shall remain responsible for adjusting forces, equipment, Materials, deliveries, staging, Work schedules, and as necessary to ensure completion of the Work within the time(s) specified in the Contract.

1-08.3(2) CONTRACTOR'S FIRST SUBMITTALS

Contractor submittals shall comply with the requirements of Section 1-05.3.

The following list contains submittals that are common to typical Work and unless the Contract specifies otherwise, have been identified as submittals to be first transmitted in preparing for and aiding with the administration of the Contract.

1. A method of removal and/or demolition plan and schedule,
2. Copies of permits required by the Contractor (Section 1-07.6),
3. Temporary Erosion and Sediment Control Plan (TESC Plan) (Section 8-01.3(2),
4. Traffic control plan, schedule, and safeguards to be used (Sections 1-07.23 and 1-10),
5. Materials catalog-cuts,
6. Sources of Materials (RAMS form) (Section 1-06.1),
7. Submittal Control Document (Section 1-05.3(2)B),
8. Critical Path Schedule (Section 1-08.3(1)), and
9. Spill Prevention and Control (SPC) Plan (see Section 1-07.5(5)).

The listed submittals that are applicable to the Work, and other submittals the Contract may identify as requiring early transmittal, shall be transmitted to the Engineer within fourteen (14) Days of the Notice to Proceed Date in the Notice to Proceed. On Projects of two hundred (200) Working Days or more, the Contractor will be allowed thirty (30) Days from the Notice to Proceed Date to transmit these submittals.

1-08.4 NOTICE TO PROCEED AND PROSECUTION OF THE WORK

Notice to Proceed will be given after the Contract has been executed and the Contract Bond and evidence of insurance have been approved and filed by the Owner. No portion of the Work shall begin within the Project Site or within sites furnished by the Engineer until the Contractor has been given the Notice to Proceed. The Contractor shall bear all risks for any portion of the Work begun outside such areas and for any Materials ordered before the Notice to Proceed has been given.

The Contractor shall begin the Work on the Notice to Proceed Date unless otherwise agreed. Thereafter, Work shall be prosecuted vigorously, diligently, and without unauthorized interruption until physical completion of the Work (see Sections 1-05.11(2) and 1-08.5). The Contractor shall not voluntarily shut down or slow Work operations without requesting and obtaining prior approval of the Engineer. Such approval shall not relieve the Contractor from the contractual obligation to complete the Work within the Contract Time.

1-08.5 TIME FOR COMPLETION

The Work shall 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", shall begin on the Notice to Proceed Date, and shall end on the Contract Completion Date.

The Contract Time has been established to allow for periods of normal inclement weather that, from historical records, are to be expected during the Contract Time, and during such periods, Work is anticipated to be performed. Each successive Working Day, beginning with the Notice to Proceed Date and ending with the Physical Completion Date, shall 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;
2. The Contract Time in Working Days;
3. The number of Working Days remaining in the Contract Time;

4. The revised Contract Completion Date as applicable;
5. The number of Non-Working Days; and
6. Any partial or whole Days during the immediately preceding week that the Engineer declared to be an Unworkable Day.

The Contractor will be allowed ten (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.

This weekly report will be correlated with the Contractor's current accepted critical path schedule.

1-08.6 SUSPENSION OF WORK

The Contractor shall 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. Unusually severe weather or such other conditions beyond the control of the Contractor has occurred that will, in the opinion of the Engineer, prevent satisfactory, safe, and timely performance of the Work.
2. The Contractor has failed to perform a material requirement of the Contract or failed to perform a written order given to the Contractor by the Engineer.

Suspension of the Work by the Engineer for either of the conditions 1 or 2 specified immediately above shall not be grounds for any claim by the Contractor for damages except as provided hereinafter.

Periods of suspension due to condition 1 in this Section will be considered excusable and counted as Unworkable Days if, prior to the suspension, the Contractor, in the Engineer's opinion, was performing the Work vigorously, diligently, and without unauthorized interruption in accordance with the Contractor's current accepted critical path schedule in effect at the time. Otherwise, the suspension may be considered non-excusable and all or part of the suspension period may be counted as Working Days. The Engineer will set the number of Unworkable Days (or parts of Days) by deciding how long the suspension delayed the entire project.

The periods of suspension due to condition 2 in this Section will be considered a non-excusable delay. This lost work time shall not relieve the Contractor from any contractual responsibility.

Requests for adjustments in the Contract Time or costs as a result of suspensions or delays to the Work will be evaluated pursuant to Section 1-08.8

1-08.7 MAINTENANCE DURING SUSPENSION

In preparing for or during suspensions of the Work (as described in Section 1-08.6), the Contractor shall do whatever is necessary to prevent damage to or deterioration of the Work. The Contractor's safety and maintenance responsibilities shall 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 shall provide a safe, smooth, and unobstructed roadway, sidewalk, and path for public use through the construction area during suspension of the Work as required by Section 1-07.23. This may include a temporary road or detour.

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 shall maintain the temporary roadway or detour in use during suspension. In this case, the Contractor shall bear the maintenance costs. If the Contractor fails to maintain the temporary roadway or detour, the Owner will do the maintenance work and deduct all resulting costs from payments due to the Contractor pursuant to 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:

1. The Traveled Way and shoulders, and detour surface;
2. Roadway drainage along and under the traveled roadway or detour; and
3. All barricades, signs, and lights needed for directing traffic through the temporary roadway or detour in the construction area.

The Contractor shall protect, maintain and bear the costs of doing 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 shall accept the traveled roadway or detour as is, when the Work resumes. The Contractor shall make no claim against the Owner for the condition of the roadway or detour.

After any suspension, the Contractor shall retain the 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 considers the Contract Time as sufficient to do all the Work. For this reason the Engineer will not grant a time extension for any reason other than those listed 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 compensation 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 shall submit to the Engineer a written notice requesting an adjustment in the Contract Time, in the costs, or both. To be considered, the request shall be submitted to the Engineer no later than ten (10) Days after the claimed suspension or delay occurs. The request shall state the reasons why the adjustment should be granted. Upon receipt, the Engineer will evaluate the Contractor's request and determine if the:

1. Cost, time, or both:
 - a. The portion of the Work that was delayed on the critical path of the critical path schedule in effect at the time as specified in this Section below;
 - b. Has increased as a result of such suspension or delay;
 - c. 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; and
 - d. Was not an Unworkable Day;
2. Performance was not suspended or delayed by any other cause; and
3. Adjustment is not 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, 2, and 3 immediately above, the Engineer will make an adjustment in Contract Time, or in cost, or in both (excluding profit) and modify the Contract accordingly. No adjustment will be allowed for any cost that was incurred by the Contractor more than ten (10) Days prior to the date the Engineer received the Contractor's written notice requesting an adjustment. The reasons for and times of extensions shall be determined by the Engineer and such determination shall be final pursuant to Section 1-05.1. Any disagreement with the Engineer's determination shall be pursued in accordance with Section 1-04.5.

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 shall be 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 utilize 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 compensation or granting of both will be made by Change Order, except that time extensions and/or payment of additional compensation for suspensions of the Work on Days determined by the Engineer to have been Unworkable Days shall be in accordance with this Section 1-08.8.

1-08.8(2) NON-EXCUSABLE DELAYS

Non-excusable delays shall be 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 will not entitle the Contractor to an extension of time and will not be 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 provided in Section 1-05.3"; and
8. Rejection of faulty or inappropriate equipment as provided 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 shall be those delays caused by one or more factors beyond the control and without fault or negligence of the Contractor. Excusable delays:

1. May be compensable; and
2. Will entitle the Contractor to an extension of time:
 - a. 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
 - b. The Contractor has submitted a request for an extension of time within the prescribed time limits.

Excusable delays shall be limited to:

1. Acts of nature; or
2. Acts of the public enemy; or
3. Acts of a government in its sovereign capacity; or

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; or
5. Unforeseeable conditions not the fault of the Contractor;
6. Fires, floods due to nature or other casualty for which the Contractor is not responsible; or
7. Epidemics; or
8. Quarantine restrictions; or
9. Unusual transportation delays (freight embargoes); or
10. Strikes or combined actions of labor; or
11. Unusually severe weather as defined in the next to last paragraph in this Specification Section, provided that:
 - a. The Engineer has not already allowed it as an Unworkable Day under Section 1-08.5; and
 - b. The Contractor had 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 11b above with a written notice approving that time as an Unworkable Day or portion thereof; or
12. Any other conditions for which the Contract permits time extensions such as:
 - a. Section 1-04.4 if a change increases the time to do any of the Work including unchanged Work; or
 - b. Section 1-04.5:
 - (1) If increased time is part of a dispute that is found to be valid; or
 - (2) If a dispute or claim also involves a delay in completing the Contract and the dispute or claim proves to be valid; or
 - c. Section 1-04.6 if increases in the quantities of any Bid item of Work exceed 25 percent and these increases caused a delay in completing the Contract; or
 - d. Section 1-04.7 if a changed condition is determined to exist that caused a delay in completing the Contract; or
 - e. Section 1-05.3 if the Engineer's review does not approve properly prepared and acceptable Shop Drawings within the specified time frame; or
 - f. Section 1-07.13 if the performance of the Work is delayed as a result of damage by others not party to the Contract; or
 - g. Section 1-07.17 if the removal or the relocation of any utility by forces other than the Contractor caused a delay; or
 - h. Section 1-07.24 if a delay results from all the Right of Way necessary for the construction not being purchased and the Project Manual does not make specific provisions regarding unpurchased Right of Way; or
 - i. 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. Exceptional 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.

Foreseeability shall modify all factors in determination of entitlement to an excusable delay.

Normal inclement weather that, from historical records, is to be expected and during which the Work is anticipated to be performed shall not be considered unworkable or unusually severe weather. The Contractor shall consider normal inclement weather in the preparation of the critical path schedule and if the Contractor elects not to perform the Work during periods of normal inclement weather, the Contractor will not be entitled to an extension of time for these periods of non-work. Unusually severe weather, as determined by the Engineer, is weather disturbance during which the Contractor is unable to perform the Work in strict accordance with the requirements of the Contract (see this Section 1-08.8(3)A item 11) including but not limited to:

1. Prolonged periods of snow;
2. Freezing temperatures; or
3. Above-average rainfall.

The Contract cannot be terminated for an excusable delay.

1-08.8(3)B COMPENSABLE DELAYS

Compensation 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. Compensation 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 shall not be considered a delay or suspension of the Work as defined in this Section. If the Contractor believes an excusable delay is compensable, the Contractor shall 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, shall be subject to the limitations provided 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 in accordance with the dispute resolution procedures specified in Sections 1-04.5.

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 shall be entitled to compensation from the other, over the period of time that concurrency of delay exists.

Time is of the essence to the Contract. Delays inconvenience the public and increase the time needed for administration, engineering, inspection and supervision.

Because it is impractical to calculate the actual cost of delays, Liquidated Damages have been agreed upon to provide compensation for damages resulting from failure to complete the Contract on time. Such obligation shall not be construed as a penalty.

The Contractor:

1. Shall pay Liquidated Damages for delay or for overruns in the Contract Time as set forth below; and
2. Authorizes the Engineer to deduct these damages from any money due or to become due to the Contractor.

For overruns in Contract Time occurring before the Substantial Completion Date and for overruns in Contract Time occurring before the Physical Completion Date, the applicable Liquidated Damages set forth in Section 4 of the Agreement Form will apply.

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.

1-08.9 VACANT

1-08.10 TERMINATION OF CONTRACT

1-08.10(1) TERMINATION FOR DEFAULT

The Owner may terminate the Contract 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 in accordance with 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, order 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; or
7. If the Contractor otherwise violates in any material way any material provision or requirement of the Contract.

Once the Owner determines that sufficient cause exists to terminate the Contract, written notice will be given to the Contractor and its Surety indicating that the Contractor is in breach of the Contract and that the Contractor is to remedy the breach within fifteen (15) -Days after the written notice is delivered. In case of an emergency such as potential damage to life

or property, the response time to remedy the breach after the written notice may be shortened. If the remedy does not take place to the satisfaction of the Engineer, the Engineer, by serving written notice to the Contractor and Surety, may either:

1. Transfer the performance of the Work from the Contractor to the Surety; or
2. 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 shall be deducted from any money due or coming due to the Contractor or Surety under the Contract.

If the Owner elects to pursue one remedy, it will not bar the Owner from pursuing other remedies on the same or subsequent breaches.

Upon receipt of a written notice that the Work is being transferred to the Surety, the Surety shall enter upon the Project Site and take possession of all Materials, tools, and appliances for the purpose of completing the Work pursuant to the Contract and employ by contract or otherwise any person or persons satisfactory to the Engineer to finish the Work and provide the Materials without termination of the Contract. Such employment shall not relieve the Surety of its obligations under the Contract and the Contract Bond. If there is a transfer to the Surety, payments on progress estimates covering the Work subsequent to the transfer shall be 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 correct any material breach 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 shall not be entitled to receive any further payment on the Work until the Work has been fully performed. The Contractor shall bear 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 in the Contract, the Contractor shall be liable for whatever amount of such damages accrues through the Substantial Completion Date. After all the 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 shall be jointly and severally liable to the Owner and shall pay the difference to the Owner on demand.

In exercising the Engineer's right to prosecute the Work to physical completion, the Engineer shall have 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 Owner takes Bids for remedial work or physical completion of the project, the Contractor shall not be eligible for the Award of such contract.

In the event the Contract is terminated, the termination of the Contract shall not affect any rights of the Owner against the Contractor. 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 shall be the same as if the written notice of termination had been issued pursuant to Termination for Public Convenience in Section 1-08.10(2). This result shall apply 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 under the provisions of Section 1-08.8.

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 in the interest of 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 other than the Contractor; or
3. The Owner determines that such termination is in the best interests of the Owner.

1-08.10(3) PAYMENT FOR TERMINATION FOR PUBLIC CONVENIENCE

Whenever the Contract is terminated in accordance with 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 provided 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 shall 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 shall provide the minimum detailed information required by Section 1-04.5(3). The claim shall be submitted promptly but in no event later than sixty (60) Days after the effective date of termination. The Contractor shall pursue resolution of the claim through the established administrative channels of the Owner. The Contractor shall 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 per Section 1-09.12. Subject to the provisions of Section 1-05.1, the decision of the Engineer shall be final.

1-08.10(5) TERMINATION FOR DELAYS DUE TO LITIGATION

Pursuant to RCW 60.28.080, if the delay caused by litigation exceeds six months, the Contractor may then elect to terminate the Contract and receive payment in proportion to the amount of the Work completed plus the cost of the delay. Amounts retained and accumulated under RCW 60.28.011 shall be held for a period of sixty (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 shall not relieve the:

1. Contractor of any responsibilities under the Contract for Work performed; or
2. Surety or Sureties of obligations under the Contract 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 amount of the Work accomplished. In such case, whatever amount of the Contractor's compensation has been retained and accumulated pursuant to RCW 60.28.011(7) shall be held for the statutory period of sixty (60) Days following the establishment of the Completion Date. In the event that the Work shall have 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 pursuant to the provisions of SMC CH. 20.70. The debarment provisions are specified in Contractor/Subcontractor Performance Evaluation Program located in the Appendix of the Project Manual.

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 shall be defined as follows in all measurements under this Section:

1. **Lump Sum (when used as a Bid item of payment):** Complete payment for the work described for that item in the Contract.
2. **Gauge:**
 - a. **In the measurement of plates:** the U.S. Standard Gauge.
 - b. **In the measurement of galvanized sheets used to manufacture corrugated metal pipe, metal plate pipe Contracts and arches, and metal cribbing:** that specified in AASHTO M 36, M 167, M 196, M 197, or M 219.
 - c. **In the measurement of wire:** that specified in AASHTO M 32.
3. **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 will not be acceptable for Material to be passed through mixing plants.

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 shall be a calculation from the neat dimensions shown on the Drawings or as altered 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:** Pipe Contracts, guardrail, under drains, etc. shall be measured parallel to the Structure's base or foundation, unless the Drawings require otherwise.
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 utilizing 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 shall 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.

Minor incidental construction items for which the Contract requires measurement by weight may, at the Contractor's request and with the Engineer's approval, be converted to weight from volume measurements using the factor of 1.25 tons per cubic yard of volume measure.

For each item listed below, the Engineer will use the method of measurement described:

1. **Structures:** Measured on the neat lines shown in the Drawings or as altered by the Engineer. When a complete structure or structural unit is specified as the unit of measurement, the unit shall include all fittings and accessories.
2. **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.
3. **Standard Manufactured Items:** Fence, wire, plates, rolled shapes, pipe conduit, etc., when specified shall be measured by the manufacturer's identification of gage, unit weight, section dimension, etc. The Engineer will accept manufacturing tolerances set by each industry unless cited Specifications require more stringent tolerances.
4. **Portland Cement:** Measured by the pound, ton, or sack. A sack shall mean a sack weighing 94 pounds.
5. **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 Gallons
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 in the Drawings or set by the Engineer.
2. Materials wasted, used, or disposed of in a manner 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.
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 shall 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, shall be furnished, erected and maintained by the Contractor, or shall be certified, permanently installed commercial scales.

Each truck to be weighed shall bear a unique identification number. This number shall be legible and in plain view of the scale operator. Trucks used to haul Material being paid for by weight shall be weighed empty at least twice daily or at such times as the Engineer directs. Duplicate weight tickets shall be prepared and accompany each truckload of Material delivered to the project. The duplicate weight tickets shall be submitted to the Engineer on the Day of delivery. The tickets shall be legible and contain the following information:

1. Preprinted ticket serial number,
2. Identification number of truck/truck trailer,
3. Date and hour of weighing,
4. Type of Material,
5. 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.

6. Weighman's identification,
7. Item number,
8. Contract number,
9. Unit of measure,
10. Legal gross weight in remarks section, and
11. Location of delivery (station or by street name).

The net weight of Material measured by the ton that is being placed in each truck shall be printed on the ticket by an automatic weighing device from a certified scale.

Scales shall:

- 1) Be accurate to within one-half 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, and
- 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 shall 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 shall be weighed on an accurate, approved scale by qualified operators employed by the Contractor. Scale locations require the Engineer's approval.

Each scale shall be designed to support a weighing hopper. The arrangement shall make it convenient for the operator to remove Material from the hopper while watching readout devices. Any hopper mounted on a platform scale shall have its center of gravity directly over the platform centerline.

Marked intervals on the readout device shall be spaced evenly throughout and shall be based on the scale's nominal rated capacity. These intervals shall be at least 1-pound, but shall not exceed one-tenth of 1 percent of nominal rated capacity.

An agent of the scale manufacturer shall test and service any batch scale before its use at each new site and then at 6-month intervals. The Contractor shall provide the Engineer a copy of the final results after each test. Whenever the Engineer requests, the Contractor's operator(s) shall test the scale while the Inspector observes.

Portland or asphalt cement shall be weighed on a scale not used for other materials.

1-09.2(3) SPECIFIC REQUIREMENTS FOR PLATFORM SCALES

Platform scales shall be certified scales that automatically print the net, tare, and gross weights on the ticket and shall 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 shall be off the platform at the time of weighing.

A platform scale operator shall be designated 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 shall 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 shall be taken two or more times daily.

Each commercial and certified weigher shall check the scales at least daily. The scales check methods and documentation procedures for scale checks and recording tare weights shall be approved by the Engineer. Checks shall 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 shall include a scale house with a floor space of at least 6 by 10 feet. The scale house shall be wind and weather tight, shall have windows for light and ventilation, shall include a door, and shall be lockable. It shall include a table, a chair, electrical power, and a space heater. The Contractor shall provide a rest room near the scale house.

Platform scales shall 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 shall have graduated intervals of no more than 40 pounds. When testing the scales, the weights shall be read and recorded to the nearest 20 pounds and during weighing operations, weights shall be read and recorded to the nearest hundred weight (cwt.).

Before use at a new site and every six months thereafter, the scales shall be approved in accordance with 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 shall meet 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 shall 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 shall be available for review by the Engineer. The test chain shall be clearly marked with its calibration. The test chain shall be carried in a suitable container and shall be immediately available for testing of the best 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 $\pm 0.5\%$ 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 (i.e. 200 lbs.) 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 beginning and end of each check period. The number of check loads may be increased by the Engineer should the test results fluctuate.

The Contractor shall 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 shall 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 shall be marked with hauling conveyance equipment number.

The recording tape, odometer, totalizer, calibration adjustment and clock-time imprinter shall be secured and locked. All keys shall 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 underweighing, the scales shall 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) will not be permitted to operate and all Materials received subsequent to the last previous corrected weighing accuracy test will be reduced by the percentage of error in excess of one-half of one percent. No payment will be made for Materials received by weight which have not been weighed in accordance with 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 shall, at the Engineer's option, thereafter utilize 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 shall be 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 shall receive and accept compensation 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 in consequence of the suspension or discontinuance of the Work as specified in the Contract.

The payment of any estimate or retained percentage shall 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 shall be full compensation 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 same as though the Bid item were to read "in place".

The term, "lump sum", when used as a Bid item or Bid items of payment means full compensation for the Work described for that Bid item(s) in the Contract.

Unless modified otherwise in the Contract, the Bid items listed or referenced in the "Payment" clause of each Section of the Standard Specifications, will be the only Bid items for which compensation 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, then payment for that Work will be made in accordance with 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 compensation 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:

- 1) "For Structure", or "For Concrete Barrier", or "For Bridge", etc. with the intent of clarifying specific use; and/or
- 2) "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 shall 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 shall be considered as including all of the Work required, specified, or described in that particular Section. Payment items will generally be listed generically in the Specifications, [e.g., "Manhole (type)"] and specifically in the Bid form (e.g., "Manhole, Type 202A"). When items are to be "furnished" under one payment item and "installed" under another payment item, such items shall be furnished FOB to the Project Site, or, if specified in the Contract, delivered to a designated Owner site. Materials to be "furnished", or "furnished and installed" under these conditions, shall be the responsibility of the Contractor 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 when provided for in the Specifications.

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

The Contractor shall submit at the preconstruction meeting a breakdown of costs for each lump sum Bid item. The cost breakdown shall list the labor, equipment, Material, Supplies, profit and overhead for the Bid item in a form acceptable to the Engineer. These costs will then be used as a guideline for determining partial payments or deductions for authorized changes in the Work. The Engineer will not make progress payments on lump sum Bid item Work where that Work extends through more than one monthly progress estimate without the required lump sum breakdown.

1-09.4 EQUITABLE ADJUSTMENT FOR CHANGES

1-09.4(1) CHANGES IN CONTRACT WORK

Payment for work pursuant to a Change Order (other than deleted work) shall be full compensation for any such change. The amount of payment shall be determined by one or more of the following methods:

1. by Bid item prices contained in the Bid;
2. by unit prices mutually agreed upon;
3. by mutual acceptance of a lump sum price; or
4. by Force Account.

When the Work performed can be measured and paid for at Bid item prices or unit prices in methods (1) and (2), it will be measured and paid for at such prices. When payment is by lump sum in method (3), the Contractor shall provide substantiation of the lump sum price in accordance with Section 1-09.3(2). Payment by methods (1), (2), and (3) shall include all costs for overhead and profit except that any mark-ups for overhead and profit included in any computation requested to justify a lump sum agreed price shall be limited to those permitted for method (4) force account. If the Contractor and Engineer are unable to agree on compensation by methods (1), (2), or (3), then the Engineer will determine the compensation, or if deemed appropriate by the Engineer, compensation will be paid by method (4) force account.

When payment for extra work is by lump sum, agreed price or by Bid item prices mutually agreed upon, the Contractor shall include in the agreed price(s), retail sales tax on taxable materials when such extra work is for improving public roads. When the extra work is for water systems, sanitary Sewer systems, sewage disposal facilities, electrical distribution and transmission systems, or other work not related to public roads, the Contractor shall not include retail sales tax in the agreed price.

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 in accordance with 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 compensation under the provisions of this Section.

Within the above conditions the Owner will adjust compensation 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 provided in Section 1-04.4. The Owner may terminate the Contract in whole or part as provided in Section 1-08.10. When the Contract is terminated in part, the partial termination shall 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 in accordance with 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 in accordance with 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 one Bid item in the case of a deletion or partial termination shall not 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 shall not 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 shall 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 prior to the date the Work was terminated as provided in Section 1-08.10(2) by the Owner or deleted as provided in Section 1-04.4 by the Engineer, will either be purchased from the Contractor by the Owner at the actual cost and shall become the property of the Owner, or the Owner will reimburse the Contractor for the actual costs connected with returning these Materials to the Materialperson.

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. If so, then the objective of Section 1-09.6 is to reimburse the Contractor for all costs associated with force account Work, including costs of labor, small tools, Supplies, equipment, specialized services, Materials, applicable taxes and overhead and to include a profit commensurate with those costs. The amount to be paid shall be determined as specified in Sections 1-09.6(2) through and including 1-09.6(7).

1-09.6(2) LABOR

Labor reimbursement calculations shall be based on a Contractor's "Project Labor List" (Contractor's List) prepared and submitted by the Contractor before the Contractor commences force account Work (see "Contractor's Project Labor List" Form located in the Appendix of the Project Manual). Once a Contractor's List is accepted by the Engineer, it shall be used to calculate force account labor payment until a requested revised Contractor's List is submitted and accepted. The Engineer may compare the Contractor's List to payrolls and other documents and may, at any time, request the Contractor to submit a revised Contractor's List. The Contractor may also submit a revised Contractor's List at any time for review and acceptance without such a request from the Engineer. Payment calculations made by the Engineer prior to acceptance of a revised Contractor's List shall not be adjusted as a result of a revised Contractor's List.

To be accepted, the Contractor's List must be accurate and meet the requirements of this Section 1-09.6(2). The Contractor's List shall include regular time rates and overtime rates for all employees (or work classifications) expected to participate in force account Work. These rates shall include the basic wage and fringe benefits, the current rates for Federal Insurance Compensation (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 compensation. These rates shall also include an allocation of costs of safety training and health testing. This allocation shall assure that the amount included for force account is reasonably proportional to the total costs applied to all Work.

In the event that an acceptable initial Contractor's List or requested revised Contractor's List is not submitted to the Engineer at the time that force account calculations are begun, the Engineer will develop an Engineer's "Project Labor List" (Engineer's List) unilaterally, utilizing the best data available, that will be used until an initial Contractor's List is submitted and accepted, or requested revised Contractor's List is submitted and accepted. Calculations prepared using the Engineer's List will not be revised as a result of differences with an initial, or requested revised, accepted Contractor's List that is not timely submitted.

The hourly rates established in the current accepted "Project Labor List" shall be applied to the hours of work recorded by the Engineer. The hours of work shall include all hours that are contractual obligations of the Contractor or are customary payments by the Contractor to all employees.

In addition to compensation for direct labor costs defined above, the Owner will pay the Contractor 29 percent of the sum of the costs calculated for labor reimbursement to cover project overhead, general company overhead, profit, bonding, insurance, Business & Occupation tax, and any other costs incurred.

1-09.6(3) MATERIALS

The Owner will reimburse invoice cost for Contractor-supplied "Materials". For the purpose of Section 1-09.6(3), "Materials" shall be Materials and Supplies as defined in Section 1-01.3 of the Standard Specifications. This cost shall include freight and handling charges and applicable taxes. Before force account Work is started, the Engineer may require the Contractor to obtain multiple quotations for the "Materials" to be utilized and the Engineer may select the Materialperson with prices and terms most advantageous to the Owner.

The Engineer will provide a list of the types and quantities of Contractor-supplied "Materials" witnessed by the Engineer as being utilized in force account Work. This list will be furnished promptly after the "Material" is incorporated or used, on a daily basis unless another time frame is mutually agreed upon. The Contractor may propose corrections to this list, shall provide prices for the "Materials" and other costs, and shall return the list to the Engineer. To support the prices and other costs, the Contractor shall attach valid copies of Materialperson invoices. If invoices are not available for "Materials" from the Contractor's stocks, the Contractor shall certify actual costs (at a reasonable level) by affidavit. The Engineer will review the prices and other costs, and any Contractor-proposed corrections and, if reasonable, approve the completed list. Once approved, the prices will be utilized in the calculation of force account reimbursement for "Materials".

If, in the case of non-invoiced "Materials" supported by Contractor affidavit, the price appears to be unreasonable, the Engineer will determine the cost for all or part of those "Materials", utilizing the best data available.

The Owner reserves the right to provide "Materials". In this case, the Contractor will receive no payment for any costs, overhead, or profit arising from the value of the "Materials" themselves. Additional costs to handle and place Owner furnished "Material" shall be compensated as described in Section 1-09.6.

In addition to compensation for direct "Materials" cost, the Owner will pay the Contractor 21 percent of the sum of the costs calculated for "Materials" reimbursement to cover project overhead, general company overhead, profit, bonding, insurance, Business & Occupation tax, and any other costs incurred.

1-09.6(4) EQUIPMENT

The Owner will reimburse the Contractor for the cost of equipment utilized in the force account Work. The Equipment provided by the Contractor shall be of modern design and in good working condition. For the purpose of Section 1-09.6(4), "provided" shall mean 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 rented with operator shall not be included here, but shall be considered a service and addressed in accordance with Section 1-09.6(5).

The amount of payment for any Contractor-owned Equipment that is utilized shall be determined according to the version of the AGC/WSDOT Equipment Rental Agreement which is 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) shall be full compensation for all fuel, oil, lubrication, ordinary repairs, maintenance, and all other costs incidental to furnishing and operating the equipment except labor for operation.

Payment for rented equipment will be made on the basis of a valid invoice, covering the time period of the force account Work. Before this Work is started, the Engineer may require the Contractor to obtain multiple quotations for the rental of equipment to be utilized and the Engineer may select the Materialperson with prices and terms most advantageous to the Owner.

In addition to the payments for Contractor-owned and rented equipment, one or more lump sum payments may be made for small tools. The amount to be paid shall be determined as outlined in the AGC/WSDOT Equipment Rental Agreement.

Regardless of whether the equipment is rented or owned by the Contractor or a Subcontractor of any tier, the Owner will add a single 21 percent to equipment costs to cover project overhead, general company overhead, profit, bonding, insurance, 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.

Current copies of the Rental Rate Blue Book and the AGC/WSDOT Equipment Rental Agreement will be maintained by the Engineer, and are also available for inspection at each of the offices of the Associated General Contractors of America (in Seattle, Spokane, Tacoma, and Wilsonville, Oregon).

1-09.6(5) SERVICES

Compensation under force account for specialized services shall be made on the basis of an invoice from the providing entity. A "specialized service" shall be one which is typically billed through invoice in standard industry practice. Before force account Work is started, the Engineer may require the Contractor to obtain multiple quotations for the specialized service to be provided and the Engineer may select the provider with prices and terms most advantageous to the Owner.

Except as noted in the paragraph immediately below, the Owner will pay the Contractor an additional one-time 21 percent of the sum of the costs included on invoices for specialized services to cover project overhead, general company overhead, profit, bonding, insurance, Business & Occupation tax, and any other costs incurred.

When a provider of specialized services is compensated through invoice, but acts in the manner of a Subcontractor as described in Section 1-09.6(7), then markup for that invoice shall be in accordance with 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 shall be listed in those Sections of the force account summary and paid accordingly.

1-09.6(7) CONTRACTOR MARKUP ON SUBCONTRACTOR'S WORK

When Work is performed on a force account basis by one or more approved Subcontractors, by a lower-tier Subcontractor or Materialperson, or through invoice by firm(s) acting in the manner of a Subcontractor, the Contractor will be allowed an additional markup, from the following table, applied to the costs computed for Work done by each Subcontractor in Sections 1-09.6(2) through and including 1-09.6(5), to compensate for all administrative costs, including project overhead, general company overhead, profit, bonding, insurance, Business & Occupation tax, and any other costs incurred.

A 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.

Markups on amounts paid for work performed by each Subcontractor on each force account and calculated through Sections 1-09.6(2) to and including 1-09.6(5):

On amounts up to \$25,000	12%
On amounts equal to or greater than \$25,000 up to \$100,000	10%
On amounts equal to or greater than \$100,000	7%

The amounts and markup rates shall be calculated separately for each Subcontractor on each force account item established.

The payments provided above shall be full payment for all Work done on a force account basis. The calculated payment shall cover all expenses of every nature, kind, and description, including those listed above and any others incurred on the Work being paid through force account. Nothing in Section 1-09.6 shall preclude the Contractor from seeking an extension of time or time-related damages to unchanged Work arising as a result of the force account Work. The amount and cost of any Work to be paid by force account shall be computed by the Engineer, and the result shall be final as provided in Section 1-05.1.

A Bid item which has been Bid at a Bid item price in the Bid will not be paid as force account unless a change as defined in Section 1-04.4 has occurred and the Specifications require a payment adjustment. Bid items which are included in the Bid Form as force account or which are added by Change Order as force account may, by agreement of the parties at any time, be converted to agreed Bid item unit prices or Bid item lump sum prices applicable to the remaining Work.

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 before 10 percent of the Awarded Contract Price is earned from Contract Bid items other than mobilization not including payment for Material on hand.

Based on the Bid item lump sum price for "Mobilization", progress estimates will be made as follows:

1. When 5 percent of the Awarded Contract Price is earned from Contract Bid items other than mobilization excluding amounts paid for Materials on hand, 50 percent of the amount Bid for mobilization, or 5 percent of the Awarded Contract Price other than mobilization, whichever is the least, will be paid.
2. When 10 percent of the Awarded Contract Price is earned from Contract Bid items other than mobilization excluding amounts paid for Materials on hand, 100 percent of the amount Bid for mobilization, or 10 percent of the Awarded Contract Price other than mobilization, whichever is the least, will be paid.
3. When the Physical Completion Date has been established for the Project, all remaining amount in the mobilization Bid item will be paid.

1-09.8 PAYMENT FOR MATERIAL ON HAND

Progress estimates, to a maximum of 90% 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 upon 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:

- The storage of Materials is required for more than 30 Days, and
- The Material is segregated from materials for any other project, and
- The Material is tagged, labeled, or otherwise identified as belonging to the project, and
- 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 shall be considered as included in the Bid item price.

The cost of Materials on hand will be determined by invoices from a Materialperson in sufficient detail to determine the actual cost. The Contractor shall furnish the Engineer an invoice for the Material marked "paid" within sixty (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 will not be eligible for future payment as Material on hand.

Requests for payment for individual items or group of items of Material on hand, amounting to an invoice total of less than \$2000 will not be considered by the Engineer in the progress estimate for payment. 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.

1-09.9 PAYMENTS

1-09.9(1) PROGRESS ESTIMATES

Payments for completed Work and Material on hand will be based upon progress estimates prepared by the Engineer and signed by the Contractor. A progress estimate cutoff date will be established at the preconstruction meeting.

Within three (3) Days after the progress estimate cutoff date (but not more often than once a month), the Contractor shall submit to the Engineer for review, an Application for Payment. The Application for Payment, filled out and signed by the Contractor, shall cover the Work completed for the payment period prior to the progress estimate cutoff date. Application for Payments that include Force Account Work shall be accompanied by documentation supporting the claim for payment.

Payment requested for Materials and equipment on hand shall be in accordance with Section 1-09.8. The initial progress estimate will be made not later than thirty (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 prior to 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 ninety percent (90%) of invoiced cost of Material delivered to the Project Site or other storage area pursuant to 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 in accordance with the progress estimate less:

1. Five percent (5%) for retained percentage.
2. The amount of progress payments previously made.
3. Funds withheld by the Owner for disbursement in accordance with the Contract.

Progress payments for Work performed shall not be 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 the requirements of RCW 39.04.250.

1-09.9(2) RETAINAGE

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 not to exceed five percent (5%) of the monies earned by the Contractor. Such retainage shall be used as a trust fund for the protection and payment of:

1. Claims by the State with respect to taxes imposed pursuant to Title 82 RCW that may be due from such Contractor; and
2. The claims of any person or persons, mechanic, Subcontractor or Materialperson who shall perform any labor under such Contract or the doing of said Work, and all persons who shall supply such person or persons or Subcontractors with provisions or Supplies for carrying on such Work.

Monies reserved under provisions of Chapter 60.28 RCW shall, at the option of the Contractor, be:

1. Retained in a non-interest-bearing fund by the Owner; or
2. 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 the provisions of a public improvement contract shall be paid to the Contractor; or
3. 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 shall 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.

Retainage will not be reduced for any reason below the minimum limit provided by law.

The Contractor shall designate the option desired on the Agreement Form at the time the Contractor executes the Contract with the Owner. The option selected shall be considered part of the Contract. If the Contractor chooses option 2 or 3, the Contractor shall assume 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.

Release of retained percentage will be made sixty (60) Days following the Completion Date pursuant to the provisions of Chapters 39.12 RCW, 39.76 RCW, and 60.28 RCW provided the following conditions are met:

1. On Contracts totaling more than \$20,000.00, a release has been obtained from the Washington State Department of Revenue (RCW 60.28.051).
2. No claims, as provided by law, have been filed against the retained percentage (RCW 60.28.021).
3. Affidavit of Wages Paid is on file with PCSD for the Contractor, each Subcontractor regardless of tier, and for any other individual or firm covered under Chapter 39.12 RCW.

In the event one or more claims are filed, the Contractor will be paid such retained percentage less an amount sufficient to pay such claims together with a sum determined by the Engineer sufficient to pay the cost of foreclosing on claims and to cover attorney's fees.

Pursuant to Sections 1-07.9(5) and 1-07.18(9) the Contractor is responsible for submitting to the State Department of Labor & Industries a "Request for Release" form in order for the Owner to obtain a release from that department with respect to the payments of industrial insurance medical aid premiums. The Owner will ensure the Washington State Employment Security Department and City of Seattle Finance Division of the Department of Executive Administration are notified of Contract completion in order to obtain releases from those departments.

1-09.9(3) OWNER'S RIGHT TO WITHHOLD AND DISBURSE CERTAIN AMOUNTS

In addition to moneys retained pursuant to RCW Ch. 60.28 and subject to RCW 39.04.250, RCW Ch. 39.12, and RCW Ch. 39.76, the Contractor authorizes the Owner or Engineer to withhold progress payments due or deduct an amount from any payment or payments due the Contractor that, in the Owner's or Engineer's opinion, may be necessary to cover the Owner's costs for or 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. Utilizing material, tested and inspected by the Engineer, for purposes not connected with the Work (Section 1-05.6);
4. Landscape damage assessments per Section 1-07.16;
5. For overtime work performed by City personnel per Section 1-08.1(5);
6. Anticipated or actual failure of the Contractor to complete the Work on time:
 - a. Per Section 1-08.8 Time Extensions and Delays – Entitlement and Compensation; or
 - b. Lack of construction progress based upon 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 upon 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 provide the Engineer with a field office when required by the Contract.
 - b. Failure of the Contractor to protect survey stakes, markers, etc., or to provide adequate survey work as required by Section 1-05.5.
 - c. Failure of the Contractor to correct defective or unauthorized Work (Section 1-05.8).
 - d. Failure of the Contractor to furnish a Manufacturer's Certificate of Compliance in lieu of Material testing and inspection as required by Section 1-06.3.

- e 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 required by Section 1-07.9.
- f Failure of the Contractor to pay worker's benefits (Title 50 and Title 51 RCW) as required by Section 1-07.18(9).
- g Failure of the Contractor to submit and obtain approval of, and revise as required, a progress schedule per Section 1-08.3.
- h Failure to meet Non discrimination requirements as required in Section 1-07.11.
- i Failure of the Contractor to comply with the outcome of mediation as provided for in Section 1-09.14 for the resolution of payment disputes. In this instance, the withholding of funds shall be consistent with the terms of the mediation settlement, including any cost of the mediation.
- j Failure of the Contractor to timely comply with submittal requirements, including providing the Engineer with updates to the submittal control document (Section 1-05.3).

The Contractor authorizes the Owner or Engineer to act as agent for the Contractor disbursing such funds as have been withheld pursuant to this section to a party or parties who are entitled to payment. Disbursement of such funds, if the Owner or Engineer elects to do so, will be made only after giving the Contractor fifteen (15) calendar Days prior written notice of the Owner's intent to do so, and if prior to the expiration of the fifteen (15) -calendar Day period:

- 1) no legal action has commenced to resolve the validity of the claims, and
- 2) the Contractor has not protested such disbursement.

A proper accounting of all funds disbursed on behalf of the Contractor in accordance with this section will be made. A payment made pursuant to this section shall be considered as payment made under the terms and conditions of the Contract. The Owner shall not be liable to the Contractor for such payment made in good faith.

If legal action is instituted to determine the validity of the claims prior to expiration of the fifteen (15) Day period mentioned above, the Owner or Engineer will hold the funds until determination of the action or written settlement agreement of the parties.

1-09.9(4) FINAL PAYMENT

Upon issuance of the Certificate of Completion by the Owner the Final Contract Price will be calculated based upon a final progress estimate made by the Engineer. Acceptance by the Contractor of the final payment shall be and shall operate as a release to the Owner from the Contractor:

- 1) All claims and all liabilities of the Owner, other than claims in stated amounts which have been asserted pursuant to the Dispute and Claim Resolution process as described in Section 1-4.5:
- 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) shall not:

- 1) Release the Contractor or the Contractor's Surety from any obligation required under the terms of the Contract or the Contract Bond; or
- 2) Preclude the Owner from recovering damages, setting penalties, or obtaining such other remedies as may be permitted by law.

Before the establishment of the Completion date by the Owner, the Contractor shall satisfy the final Contracts reporting requirements of Section 1-08.1(3).

1-09.10 RESERVED

1-09.11 RESERVED

1-09.12 AUDITS

1-09.12(1) GENERAL

The Contractor's wage, payroll, and cost records on this Contract shall 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 three years after the Completion Date. The Contractor shall retain these records for that period. If requested, the Contractor shall promptly furnish copies of these records to the Owner. The Contractor shall 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 shall provide adequate facilities, acceptable to the Owner, for the audit during normal business hours and shall make a good faith effort to cooperate with the auditors.

If an audit is to be commenced more than sixty (60) calendar Days after the Completion Date, the Contractor will be given 20 Calendar Days Written Notice of the time when the audit is to begin. 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 shall be retained until such litigation, claim, or audit involving the records is completed.

1-09.12(2) CLAIMS

All claims, and documentation for mediation, filed against the Owner shall be subject to audit at any time following the filing of the claim or request for mediation as applicable. Failure of the Contractor or, if applicable, a Subcontractor of any tier 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 permit the auditor access to the books and records of the Contractor, Subcontractor of any tier, or their agents shall constitute a waiver of a claim and shall bar any recovery thereunder.

The Contractor shall 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.
5. Earnings records .
6. Payroll tax forms.
7. Material invoices and requisitions.
8. Material cost distribution worksheet.
9. Equipment records (list of company equipment, rates, etc.).
10. Vendors, rental agencies, Subcontractors, and agents invoices.
11. Subcontractor agreements and, pursuant to Section 1-07.12, payment certifications (including those of 2nd 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, if it deems appropriate, additional financial statements for 3 years preceding execution 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.

1-09.13 RESERVED**1-09.14 PROMPT PAYMENT TO SUBCONTRACTORS AND MATERIAL PERSONS****1-09.14(1) GENERAL**

The purpose of this Section is to provide an additional mechanism for Subcontractors and Materialpersons (collectively referred to in this Section as "Subcontractors") to be paid promptly by the Contractor, for work satisfactorily completed, after the Contractor has received payment from the Owner. It is not the Owner's intent to monitor and enforce contractual obligations between the Contractor and Subcontractors, or to require any additional documentation to be submitted to the Owner to implement the provisions of this Section. Nothing in this Section shall be construed to negate the rights or importance of Subcontractors filing a claim against the bond or retainage in accordance with the provisions of State law in order to protect their legal rights.

1-09.14(2) PROGRESS PAYMENTS

Within ten (10) Working Days of receipt of a progress payment from the Owner that include dollars for work performed by a Subcontractor, the Contractor shall pay such Subcontractor, less any applicable retainage, out of such amounts as are paid by the Owner, for all work satisfactorily completed by the Subcontractor, provided that the Subcontractor has complied with the applicable terms of its subcontract with the Contractor. If the Contractor fails or neglects to make such payment within ten (10) Working Days, the Contractor shall pay to the Subcontractor interest computed at one percent per month on amounts due for the period beginning on the Day after the required payment date and ending on the Day on which payment of the amount due is made.

1-09.14(3) UNSATISFACTORY PERFORMANCE BY SUBCONTRACTOR

If the Contractor determines that the Subcontractor did not satisfactorily perform all or a portion of the work identified in the progress payment, the Contractor shall, consistent with RCW 39.76.011, provide written notification to the Subcontractor and Owner of the remedial actions that must be taken by the Subcontractor as soon as practicable after determining the cause for withholding payment to the Subcontractor, but before the due date for the Subcontractor payment. The Contractor shall pay the Subcontractor within eight (8) Working Days after the Subcontractor satisfactorily completes the remedial action

identified in the written notice. If the Contractor does not comply with the remedial action notice and payment requirements of this Section, the Contractor shall pay the Subcontractor interest on the withheld amount from the eighth Working Day at an interest rate that is equal to the amount set forth in RCW 39.76.011(1) until payment is made.

1-09.14(4) RETAINAGE PAYMENT

The following procedure shall apply to all subcontracts entered into as a part of this Contract:

Requirements: The Subcontractor shall make a written request to the Contractor for the release of the Subcontractor's retainage or retainage bond.

Within ten (10) Working Days of the request, the Contractor shall determine if the subcontract has been satisfactorily completed and shall inform 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 shall be released by the Contractor within ten (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 shall release the Subcontractor's retainage or retainage bond within eight (8) 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.

Conditions: This clause does not create a contractual relationship between the Owner and any Subcontractor as stated in Section 1-08.1. 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 shall continue to process the release of that retainage based upon the Completion Date of the project as defined in 1-08.5 Time for Completion and in accordance with the requirements and procedures set forth in Chapter 60.28 RCW.

1-09.14(5) INCORPORATION OF PROVISIONS

The Contractor shall include either specifically in each of its subcontracts a provision setting forth the payment and interest penalty clause of this paragraph, 1-09.14, or in each of its subcontracts a provision incorporating by reference all the terms of its contract with the Owner. In addition, the Contractor shall 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.

1-09.14(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, shall take precedence over the provisions of this Section.

1-09.14(7) MEDIATION TO RESOLVE PAYMENT DISPUTES

If a Contractor fails to pay a Subcontractor as required by this Section, a Subcontractor may require that the dispute be submitted to mediation for resolution. Upon request, the Engineer shall provide a Subcontractor with a list of potential mediators to contact.

SECTION 1-10 TEMPORARY TRAFFIC CONTROL

1-10.1 GENERAL

Installation and maintenance of temporary traffic control for pedestrian and vehicular traffic within the public Right of Way shall be performed in accordance with the "Manual on Uniform Traffic Control Devices for Streets and Highways" (MUTCD) as supplemented by the current edition of The City of Seattle "Traffic Control Manual for In-Street Work" (hereinafter referred to as the "Seattle Traffic Control Manual") and such additional requirements as may be included in the Contract. The "Manual on Uniform Traffic Control Devices for Streets and Highways" may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington, D.C. 20402. The City of Seattle "Traffic Control Manual for In-Street Work" may be obtained from the office of the SDOT, at 206-684-5086.

The Contractor shall:

1. Provide flaggers, signs, and other traffic control devices not otherwise specified as being furnished by the Engineer.

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 permit:
 - a. The maximum number of traffic lanes normally available to be opened in the direction of the heaviest flow of traffic during the peak hours.
 - b. 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 to be prohibited adjacent to the Work area.
 - c. 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.
 - d. Clean up spillage from trucks on the pedestrian or driving surface adjacent to the work area. See Sections 1-07.5 and 1-07.23.
 - e. Provide safe and protected pedestrian ways. See Section 1-07.23.
 - f. Not park or place construction equipment to create an unnecessary sight distance or other safety obstruction to vehicular or pedestrian traffic.
 - g. Maintain work area traffic control devices in a proper condition on an "around the clock" basis whether or not work is actively being pursued. In addition, the Contractor shall assure that tools and equipment are properly stored and excavation bridging is secure and adequately covering 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. On-site or off-site detours required or necessitated by the Work, including side street crossings, temporary bridges, utilization of one or more lanes of the construction area for maintenance of through traffic, and related traffic control shall be the responsibility of the Contractor.

1-10.2 TRAFFIC CONTROL MANAGEMENT

1-10.2(1) GENERAL

All projects in street areas will be inspected with regard to type and placement of pedestrian and vehicular traffic control devices. Traffic control devices not meeting the requirements of the Seattle Traffic Control Manual shall be considered non-standard. Non-standard traffic control devices shall not be used unless specifically approved for use, in writing, by the Engineer.

The Contractor shall patrol the traffic control area as often as necessary, but at least daily, and reset all disturbed signs and traffic control devices. Signs and other traffic control devices shall be removed or covered during periods when they are not necessary.

Before beginning Work, the Contractor shall designate an individual or individuals to perform the duties of Traffic Control Manager (TCM) and Traffic Control Supervisor (TCS). These individuals shall be in charge of and responsible for traffic control. A TCM and TCS are required on all Projects that require traffic control. The TCM can also perform the duties of the TCS. The Contractor shall identify no more than six alternate employees that can assume the duties of the assigned or primary TCM and TCS in case of the primary person's inability to perform. Such alternates shall be trained and certified to the same degree as the primary TCM and TCS.

The Contractor shall maintain 24-hour telephone numbers at which the TCM and TCS can be contacted and be available upon the Engineer's request at other than normal working hours. The TCM and TCS shall have the appropriate personnel, Equipment, and material available at all times to correct any deficiency in the traffic control system. The Engineer will furnish the Contractor a similar list of the Engineer's employees and their telephone numbers.

1-10.2(2) TRAFFIC CONTROL MANAGER (TCM)

The duties of the TCM shall include:

1. Discussing proposed traffic control measures and coordinating implementation of the Contractor-adopted traffic control plan(s) with the Engineer.
2. Coordinating all traffic control operations, including those of Subcontractor, Materialperson, and any adjacent construction or maintenance operations.
3. 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 METROKC transit and Benson Line Waterfront Trolley, see Sections 1-07.23(1) and 1-07.28, item 2).
4. Overseeing all requirements of the Contract that contribute to the convenience, safety, and orderly movement of vehicular and pedestrian traffic.
5. Having the latest adopted edition of the Seattle Traffic Control Manual and applicable standards and Contract available at all times on the project.
6. Attending all project meetings where traffic management is discussed.
7. Review TCS's diaries daily and be responsible for knowing "field" traffic control operations.

1-10.2(3) TRAFFIC CONTROL SUPERVISOR (TCS)

A TCS shall be on the project whenever traffic control labor is required or as authorized by the Engineer.

The TCS shall personally perform all the duties of the TCS. During non-work periods, the TCS shall be able to be on the Project Site within a 45-minute period after notification by the Engineer.

The TCS's duties shall include:

1. Inspecting traffic control devices and nighttime lighting for proper location, installation, message, cleanliness, and effect on the traveling public. Traffic control devices shall be inspected each work shift except that Class A signs and nighttime lighting need to be checked only once a week. Traffic control devices left in place for 24 hours or more should also be inspected once during the non-working hours when they are initially set up (during daylight or darkness, whichever is opposite of the working hours).
2. Preparing a daily traffic control diary, which shall be submitted to the Engineer no later than the end of the next Working Day to become a part of the project records. The Contractor may use WSDOT Forms 421-040A and 421-040B or the Contractor's own form if it is approved by the Engineer. The TCS shall include in the diary such items as:
 - a. 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 utilized at night, and
 - e. Observations of traffic conditions.
3. Ensuring that corrections are made if traffic control devices are not functioning as required. The TCS may make minor revisions to the traffic control plan to accommodate site conditions as long as the original intent of the traffic control plan is maintained and the revision has concurrence of the Engineer.
4. Attending traffic control coordinating meetings or coordination activities as authorized by the Engineer.

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.

A reflective vest and a hard hat shall be worn by the TCS.

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 required by Section 1-07.23,

the Engineer shall have the option to do one or any combination of the following:

1. Suspend the Work without further notice to the Contractor or the Contractor's Surety until the Contractor complies with the Engineer's order (see Section 1-08.6),
2. Immediately provide an off-duty uniformed peace officer at no additional cost to the Owner, or
3. Provide, erect, maintain and remove barricades, signs and lights at no additional cost to the Owner by Owner forces or by others, and
4. Deduct all costs related to items 1, 2, and 3 from any progress payments due or coming due the Contractor as provided in Section 1-09.9(3).

The above options shall 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 shall develop, adopt, and submit to the Engineer a specific traffic control plan or plans for protecting and controlling pedestrian and vehicle traffic during construction operations. A separate traffic control plan is required for each work location within the street Right of Way. Typical plans may be submitted for areas with identical traffic requirements. Typical plans shall be clearly labeled to indicate all locations the plan is to represent. Traffic control plans shall take into consideration any street and lane closure or other restrictions that may be specified in the Contract.

Submittal shall be made at least ten (10) Working Days before planned implementation to allow for Engineer evaluation of the proposed vehicular and pedestrian routing, flagging, and placement of signing and other traffic control devices. The Contractor shall not begin Work in the street Right of Way until an approved Traffic Control Plan for the specific location has been returned by the Engineer. Submittal shall be in accordance with Section 1-05.3 except no more than two reproductions will be required for any Traffic Control Plan Shop Drawing size.

Traffic Control Plans shall indicate:

1. Vehicular 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 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 bus stop zones,
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, and
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 one or more of the figures included in the Seattle Traffic Control Manual without modification, the Contractor may reference the applicable figure number, shown in the manual, at the appropriate location on the Drawings. When this procedure is used, variable distances such as minimum length of taper shall be specified by the Contractor. The spacing proposed for barricades and cones shall also be specified.

If the Contractor's proposed pedestrian or traffic control measures differ from the traffic control requirements in the Seattle Traffic Control Manual, the Contractor's alternate Traffic Control Plan shall 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 shall be developed in accordance with the same established standards for plan development demonstrated by the figures in the Seattle Traffic Control Manual. Acceptance of alternative traffic control measures shall be entirely at the discretion of the Engineer. The Contractor shall have no claim for an equitable adjustment:

- 1) For using alternative measures.
- 2) If the proposed alternate measures are rejected or modified.
- 3) If requests to use non-standard traffic control devices are rejected or modified.

The Contractor shall 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 located in Section 1-07.28.

1-10.2(5)B CONFORMANCE TO ESTABLISHED STANDARDS

The condition of signs and traffic control devices shall be new or "acceptable" as defined in the book Quality Standards for Work Zone Traffic Control Devices, and will be accepted based on a visual inspection by the Engineer. The Engineer's decision on the condition of a sign or traffic control device shall be final. When a sign or traffic control device becomes classified as "unacceptable" it shall be removed from the project and replaced within 12 hours.

The book, Quality Standards for Work Zone Traffic Control Devices, is available by writing to the American Traffic Safety Service Association, 5440 Jefferson Davis Highway, Fredericksburg, VA 22407, at (540) 898-5400, and Fax (540) 898-5510.

Requests to use non-standard traffic control devices shall be submitted with the Traffic Control Plans or by submitting a modification to the traffic control plan.

1-10.2(5)C TRAFFIC CONTROL RESTRICTIONS

In addition to any street and lane closure restrictions specified in the Contract, traffic control plans shall be developed to comply with the following restrictions:

1. **Arterial Paving:** Arterial approaches to the streets being paved shall 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. Prior to the closure of any arterial cross street the Contractor shall submit to the Engineer a traffic control plan for the location detailing the traffic controls to be used to reroute traffic. Traffic shall not be rerouted without approval of the traffic control plan by the Engineer. The Contractor shall have 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, no Work shall be scheduled 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 AM to 9:00 AM and from 4:00 PM to 6:00 PM with the following exceptions:
 - a. For the Central Business District peak hours are from 6:00 AM to 9:00 AM and 3:00 PM to 6:00 PM.
 - b. For Aurora Avenue peak hours are from 6:00 AM to 9:00 AM and 3:00 PM to 7:00 PM.

The Contractor shall discontinue Work if conflict exists with special events such as parades, sporting events, miscellaneous rallies, and large public meetings or with seasonal conditions, such as Christmas. Information concerning such events can usually be obtained from 206-684-5098.

No construction activities will be allowed on any portion of a project that lies within the Central Business District or the Pioneer Square area during the Christmas season, 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, 1st 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, 2nd Avenue and 2nd Avenue South on the east, Columbia Street on the north and King Street on the south.

3. **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 parking meters are present, the Contractor shall 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 shall apply to SDOT for "no parking markers" restricting such parking. Where no meters, parking pay stations, and D-22 signage and "numbered" base plates are present, the Contractor shall contact SDOT so that the Contractor may install "NO PARKING" (T-39) easel signs. Signs must be inspected by a parking enforcement officer or uniformed peace officer 24 hours prior to enforcement. See Section 1-07.28, item 1 for notification requirements.

"NO PARKING" signs shall conform in message, dimension and color as indicated in Part V of the "Seattle Traffic Control Manual". Spacing of signs shall be in accordance with Project Site conditions.

"NO PARKING" (T-39) easel signs should be installed at an approximate interval of 50 feet to 75 feet, with a minimum of four units, per each full block. For partial block parking prohibition, R-101's or T-39's should be installed at approximately 50-foot intervals with R-160 signs at the terminus as shown in Figure V-1 of the "Seattle Traffic Control Manual".

The employees of the Contractor shall 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.

1-10.3 FLAGGING, SIGNS, AND OTHER TRAFFIC CONTROL DEVICES

1-10.3(1) FLAGGING

1-10.3(1)A GENERAL

Flaggers shall have a current certification (flagging card) from the State Department of Labor and Industries (WAC 296-155-305), except where the flagging job requires a uniformed off-duty peace officer. The Contractor shall furnish all personnel for flagging and for the setup and removal of all temporary traffic control devices and construction signs necessary to control traffic during construction operations. Prior to performing any traffic control Work on the Project Site, these personnel should be trained with the video, "Safety in the Work Zone" produced jointly by WSDOT and Laborers' International Union of North America. The video is available from WSDOT's Engineering Publications Office, Transportation Building.

Pursuant to WAC 296-155-305, flaggers and spotters shall possess a current flagging card issued by the State of Washington Department of Labor and Industries. Current flagging cards from Oregon and Idaho are also acceptable. The flagging card shall be immediately available and shown to the Engineer upon request.

Workers engaged in flagging or traffic control shall wear reflective vests and hard hats. During hours of darkness, white coveralls or white or yellow rain gear shall also be worn. The vests and other apparel shall be in conformance with Section 1-10.3(1)C. During hours of darkness flagger stations shall be illuminated to ensure that flaggers can easily be seen without causing glare to the traveling public. The Contractor shall furnish the MUTCD standard Stop/Slow paddles (18 inches wide, letters 6 inches high, and reflectorized) for the flagging operations.

1-10.3(1)B TRAFFIC CONTROL LABOR (PEACE OFFICERS)

Only an off-duty uniformed peace officer shall be used as a flagger to:

1. Countermand a traffic signal indication at a signalized intersection, and
2. Direct vehicle and pedestrian traffic when a traffic signal indication is turned off or inoperative.

Officers are also required for new traffic signal Work, see Section 8-31.3(1)A. The off-duty uniformed peace officer shall be provided by the Contractor.

The Contractor shall **submit** to the Engineer on the next Working Day, a copy of the daily time card for the off-duty uniformed peace officer showing the hours actually worked countermanding a signal at a signalized intersection and the hours actually worked directing vehicular and pedestrian traffic at a signalized intersection when the traffic signal is inoperative or turned off.

1-10.3(1)C HIGH VISIBILITY APPAREL AND EQUIPMENT

The Contractor shall furnish for the use of flaggers, reflective vests and hard hats for the flagging and control of traffic. This equipment shall be used by the flaggers while actually flagging traffic. The Contractor shall also provide any such equipment used that is necessary or desirable to protect personnel engaged in other activities.

The Contractor shall require all personnel at the Work site under their control (including Subcontractors and lower tier Subcontractors) to comply with the following:

1. To wear reflective vests, except that during daylight hours, orange clothing equivalent to "Ten Mile Cloth" or hunter orange may be worn in lieu of reflective vests,
2. To wear white coveralls at night,
3. Whenever rain gear is worn during hours of darkness, it shall be white or yellow, and
4. The reflective vests shall always be the outermost garment.

Exceptions to the above requirements are:

- a. When personnel are out of view of or not exposed to traffic.
- b. When personnel are inside a vehicle.
- c. Where it is obvious that such apparel is not needed for the employee's safety from traffic.

Reflective vests shall have a minimum of 100 square inches of reflective surface distributed 30 percent on the front and 70 percent on the back. The retro-reflection value at an entrance angle of -4 degrees and an observation angle of 0.2 degrees shall be a minimum 500 candle power for the reflective surface of the vest. Reflective vests, hard hats, white coveralls, rain gear, and other apparel shall be furnished and maintained in a neat, clean, and presentable condition at no additional cost to the Owner.

1-10.3(2) TRAFFIC CONTROL VEHICLES

The traffic control vehicle shall be equipped with a roof or post-mount flashing amber light visible for 360 degrees. Truck and construction equipment that encroach onto the traveled roadway for any reason shall also be equipped with flashing yellow warning lights. Unless one or more flaggers are present to control traffic, supplementary traffic control devices shall be placed to warn, slow down, and if necessary divert traffic around such equipment.

1-10.3(3) CONSTRUCTION SIGNS

1-10.3(3)A GENERAL

The Contractor shall furnish, install and maintain all traffic control signs required by the Contract or a Contractor's approved traffic control plan. These include:

1. Temporary traffic control signs referenced in the Seattle Traffic Control Manual.
2. Any permanent signs located in the construction area that are temporarily relocated, damaged or destroyed by the Contractor or a third party prior to the Physical Completion Date.

When all or some of the necessary signs or traffic control devices are to be furnished by the Engineer, it will be so specified in the Contract.

The Contractor shall:

1. Provide the posts or supports.
2. Erect and maintain the signs in a clean, neat, and presentable condition until the Engineer approves their removal.
3. Take these signs, posts, or supports down when the need for these signs has ceased. All posts and supports shall be removed from the project and shall remain the property of the Contractor.
4. Remove all non-applicable signs, or completely cover with metal or plywood, during periods when they are not needed.
5. Return to the Engineer in good condition any Engineer-furnished signs. All such signs lost, stolen, damaged, or destroyed shall be replaced by the Contractor in kind at the Contractor's expense or their value will be deducted from the Contractor's payments.

All control signs necessary for nighttime traffic control shall be fully reflectorized.

Existing traffic control and street name signs that interfere with construction shall be relocated or removed by the Contractor and temporarily stored in a safe place. All "STOP", "YIELD", and "ONE-WAY" signs shall be removed or relocated only upon approval of the Engineer (See Section 8-21.3(4) Sign Relocation). Existing signs shall not be removed until the Contractor has provided temporary measures sufficient to safeguard and direct traffic after the existing signs have been removed. Except as otherwise provided in the Contract, preservation and maintenance of traffic control and street name signs shall be the sole responsibility of the Contractor.

As Work progresses and as conditions permit, temporarily relocated or removed traffic and street name signs shall be reset in their permanent location by the Contractor (see 500 and 600 series applicable Standard Plans regarding sign and post installation). Signs and other traffic control devices damaged or lost by the Contractor shall be replaced or repaired by the Contractor at no additional cost to the Owner. The option whether a sign can be repaired or shall be replaced shall be the Engineer's, and such decision shall be final and binding on the Contractor.

Traffic control signs, other than parking prohibition signs, which are required to be installed ahead of construction activities, shall be installed immediately before the construction activity begins. The Contractor may elect, as a matter of convenience in advance of the scheduled construction activity, to install and effectively cover the signs until the construction activity begins. See Section 8-21.3(3) Sign Covering.

Construction signs shall be divided into two classes – Class A and Class B. In case of disputes, the Engineer will determine if a construction sign is considered as a Class A or B construction sign.

When Class A or B construction signs are required, the Work to provide these signs shall be:

- 1) Furnishing, removing, and disposing of the posts or supports for the signs.
- 2) Initial acquisition from the Engineer and ultimate return to the Engineer of the required Engineer-furnished signs.
- 3) Initial installation and subsequent removal of both Class A and B construction signs.
- 4) All other incidentals necessary for providing Class A or B construction signs according to the approved traffic control plan(s).

1-10.3(3)B CLASS A SIGNS

Class A construction signs shall be installed where shown in the Contract. 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 substantial supports of a semi-permanent nature. Sign and support installation for Class A signs shall be in accordance with the Contract Drawings or the Standard Plans.

1-10.3(3)C CLASS B SIGNS

Class B construction signs are those signs that are placed and removed daily, or are used for short durations that may extend for one or more Days. They are mounted on portable or temporary mountings. If it is necessary to add weight to the signs for stability, only a bag of sand that will rupture on impact shall be used. The bag of sand shall:

1. Be furnished by the Contractor.
2. Have a maximum weight of 40 pounds.
3. Be suspended no more than 1 foot from the ground.

No separate Bid item will be provided in the Bid Form for Class B construction signs. Signs, posts, or supports that are lost, stolen, damaged, destroyed, or which the Engineer deems to be unacceptable, while their use is required on the project, shall be replaced by the Contractor at no additional cost to the Owner.

For special sign requirements for new traffic signals, see Section 8-31.3(1)A.

Sign materials shall conform with the requirements of Section 9-28.

Signs used during the hours of darkness shall be properly reflectorized (see Section 9-28) except for parking and pedestrian prohibition signs. Paint impregnated with glass beads shall not be used. Where reflectorization is rendered ineffective due to extraneous light sources, the sign shall be illuminated either externally or internally. Where external illumination is used, the source shall be properly shielded to reduce glare. Street or highway lighting shall not be considered adequate for illuminating signs. All reflectorized or illuminated signs should be checked by the Contractor during the hours of darkness to insure that they are functioning properly.

Signs shall be constructed from material that will not deteriorate abnormally under normal weather conditions. Sign blanks shall be weatherproof plywood or non-corrosive metal (see Section 9-28). Roll-up signs fabricated from vinyl-coated nylon or vinyl-coated nylon mesh may also be used. Only reflectorized signs shall be used at night.

1-10.3(4) TEMPORARY TRAFFIC CONTROL DEVICES

1-10.3(4)A GENERAL

Traffic control devices shall be installed so that they are readily visible to approaching traffic. Traffic control devices shall be placed such that they allow the driver to see from one device to the next and are in the same position on successive Days unless changes in construction Work dictate otherwise.

1-10.3(4)B HIGH LEVEL WARNING DEVICE

A "High Level Warning Device" shall be required for each separate Work area in the roadway, except when an arrow panel or board is used with the taper area. Device materials and usage shall conform to the Seattle Traffic Control Manual. A high level warning device shall be installed for all temporary Work, except when an arrow panel or board is used in the roadway and as a supplement to warning signs. Depending on the situation, high level flags may be attached to a service vehicle or placed directly on the roadway in advance of the obstruction. The device shall be placed in the middle of the closed lane and shall always be placed behind appropriate channeling devices. Normally, one unit should be used for each lane closed; however, additional units may be used if appropriate. A high level warning device should always be the first traffic control equipment to be placed as it will provide a degree of protection during the positioning of other devices.

1-10.3(4)C PAINT LINES AND LEGENDS

When paint lines are obliterated due to construction activities or pavement restoration, temporary pressure-sensitive pavement marking tape, traffic buttons, temporary lane markers, or delineators shall be installed where designated by the Engineer. These temporary features shall be removed only upon installation of permanent traffic channelization.

Temporary centerline striping shall consist of placing strips of pressure sensitive pavement marking tape at 10 to 15 foot intervals along the centerline. Temporary marking tape shall be placed in sets of two 12-inch strips of yellow 4-inch wide marking tape set 4 inches apart and parallel to the center line with each set of 1-foot double line spaced 10 to 15 feet along the center line of the roadway, or the equivalent surface area in temporary lane markers (TLMs).

Temporary stop bars shall consist of a 12-inch wide stop bar made up of three parallel 4-inch strips of temporary pavement marking tape placed at locations designated by the Engineer. All other temporary pavement markings utilizing pavement-marking tape shall be designated by the Engineer.

Pressure-sensitive pavement marking tape used on the wearing course prior to installation of permanent lane markers, traffic buttons, or permanent paint striping shall be removed from the pavement current with, or immediately subsequent to, the installation of permanent pavement markings.

Temporary pavement markings shall be maintained in serviceable condition by the Contractor for the duration of time it is in use. Layout and marking in preparation for application and the application and removal of the temporary striping shall be the Contractor's responsibility. The Engineer will do the layout for permanent lane markings as specified in Section 8-22.3(1).

Temporary pavement marking tape shall meet the requirements of Section 9-29.4.

Damage to the pavement resulting from removal of temporary pavement marking, including the use of high heat sources, shall be repaired by the Contractor at no expense to the Owner.

1-10.3(4)D BARRICADES AND CHANNELIZING DEVICES

The Contractor shall place and maintain necessary barricades, vertical barricades, drums, cones or other channeling devices as are needed to warn and alert drivers and pedestrians on or near the Traveled Way or construction area, and to guide and direct them safely past the construction area.

1-10.3(4)E LIGHTING DEVICES

Roadway and pedestrian illumination systems shall be maintained in operation for all traveled ways open to traffic. See Section 8-30.3(1).

Barricades or drums used at night shall be equipped with approved yellow warning lights. The Contractor shall 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 shall be responsible for replacing missing or damaged signs and posts.

1-10.3(4)F SPEED AND PARKING CONTROL

In those areas where construction operations have changed road conditions, such additional hazards as reduced lane width, open trenches, temporary roadway, etc., may be considered as evidence of need for an alteration of the legal (or posted) speed limit. Requests for alteration of the legal speed limits on City streets must be submitted to the Engineer. Costs related to speed limit revisions and parking control shall be borne by the Contractor and at no additional cost to the Owner.

1-10.3(5) CONSTRUCTION AND MAINTENANCE OF DETOURS

Unless otherwise approved, the Contractor shall maintain two-way traffic during construction. The Contractor shall build, maintain in a safe condition, keep open to traffic, and remove when no longer needed:

1. Detours and detour bridges that will accommodate traffic diverted from the roadway or bridge during construction;
2. Detour crossings of intersecting streets; and
3. Temporary approaches.

All on-site or off-site detours required or necessitated by the Work, including side street crossings, temporary bridges over freshly placed concrete, utilization of one or more lanes of the construction area for maintenance of through traffic, and related traffic control shall be the responsibility of the Contractor.

Any detour proposed by the Contractor shall not be built until the Engineer approves. Surfacing and paving shall be consistent with traffic requirements.

1-10.4 MEASUREMENT

Measurement for "Maintenance and Protection of Traffic Control including Flagging, Min. Bid = \$_____" will be by the lump sum.

Measurement for "Traffic Control Labor" 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)B. No measurement will be made for standby time, show-up time, and all other time not in accordance with Section 1-10.3(1)B.

Measurement for "Construction Signs Class A" will be by the square foot on one face of panel area. No measurement will be made for reuse of a Class A construction sign in a new location, relocation of a sign to a new location, or for posts or supports.

Class B construction signs will not be measured.

1-10.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 1-10 will be made at the Bid item prices Bid only for the Bid items listed or referenced below:

1. **"Maintenance and Protection of Traffic Control including Flagging, Min. Bid = \$_____"** per lump sum.

Payment for "Maintenance and Protection of Traffic Control including Flagging, Min. Bid = \$_____" shall include all costs for the Work required to control traffic as specified in Section 1-10 not including traffic control labor and construction sign Class A. To prevent unbalanced Bids, the Bid item lump sum price Bid for "Maintenance and Protection of Traffic Control including Flagging, Min. Bid = \$_____" shall 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 in 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 "Maintenance and Protection of Traffic Control including Flagging, Min. Bid = \$_____" of less than the Bid item lump sum minimum price shown in the Bid Form will be revised to reflect the Bid item lump sum minimum price allowed including the extension and shall govern as becoming a part of the Bid.

2. **"Traffic Control Labor"**, per hour.

Payment for "Traffic Control Labor" shall include all costs for the Work specified in Section 1-10.3(1)B.

3. **"Construction Signs Class A"**, per square foot.

Payment for "Construction Signs Class A" shall include all costs for the Work required to fabricate and to obtain and deliver as applicable, construction signs Class A including installation, relocation, removing, providing supports and posts,

maintaining the signs in a condition acceptable to the Engineer, and refinishing disturbed earth to a condition acceptable to the Engineer.

4. **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 in accordance with Section 1-09.4.

DIVISION 2 EARTHWORK**SECTION 2-01 CLEARING, GRUBBING, AND ROADSIDE CLEANUP****2-01.1 DESCRIPTION****2-01.1(1) GENERAL**

Section 2-01 describes work consisting of clearing, grubbing, and roadside cleanup including protecting from harm all trees, bushes, shrubs, or other objects identified in the Contract to remain.

2-01.1(2) CLASSIFICATION

Clearing: removing and disposing of trees, vegetation or other unwanted materials from the ground surface.
Grubbing: removing and disposing of the same materials from below the ground surface.
Roadside cleanup: cleaning and maintaining the roadside to an attractive appearance.

2-01.2 CLEARING AND GRUBBING DISPOSAL

Disposal of clearing and grubbing waste and debris shall be as specified in Section 1-07.3.

Borrow sites shall be as specified in Section 2-03.13.

Unless otherwise specified in the Contract, the Contractor shall be allowed to sell all usable material such as timber, chips or firewood produced by clearing and grubbing. The Contractor shall not allow the public to fell trees.

2-01.3 CONSTRUCTION REQUIREMENTS**2-01.3(1) CLEARING**

Clearing shall consist of removing and disposing of all unwanted material from the surface including, but not limited to, trees 6 inch and less in diameter measured at a point one foot above the ground, brush, downed timber and rotted wood, rubbish, etc.; removing building sheds, fences, and other obstructions interfering with the Work when removal and disposal of such 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 inch in diameter measured one foot above the ground shall remain unless marked for removal on the Drawings (see Section 2-02.3(3)l).

If branch trimming is required of trees that are to remain, it shall be done in accordance with Section 1-07.16(2).

Trees marked for removal shall be felled within the area to be cleared. Where the tree or tree limb structure interferes with or is in close proximity to overhead wires, or near METRO or Benson Waterfront Street Car overhead wires, the Contractor shall make the advance notifications specified in Section 1-07.28 items 4B and 12.

All buildings, fences, lumber piles, trash, and obstructions, except utility poles, within the area to be cleared shall be removed and disposed of by the Contractor. Burning will not be allowed.

The refuse resulting from the clearing operation shall be disposed of by the Contractor. Refuse material shall not be left on the project Site, shoved onto abutting private properties, or be buried in embankments or Sewer trenches on the Project Site. See Sections 1-04.11, 1-07.3, 1-07.5, 1-07.24, and 8-01 regarding prevention of pollution, cleanup, and erosion control.

2-01.3(2) GRUBBING

The work shall consist of removing and disposing of all unwanted vegetative matter from below the surface including, but not limited to, stumps, roots, buried logs and timber, etc.; and removing and disposing of drains, culverts, wood catch basins, foundations, stairways, steps, and such other obstructions that interfere with the Work but whose removal and disposal are not specifically provided for in Section 2-02.

All stumps, roots, foundations and planking embedded in the ground within the limits described in the Contract shall be removed to a minimum depth of 2 feet below subgrade or 2 feet below existing ground level, whichever is lower. Disposal requirements for grubbing shall be the same as those described for clearing.

Removal of tree stumps in improved areas as part of grubbing operations shall comply with Section 2-02.3(3)l.

2-01.3(3) LIMITS OF CLEARING AND GRUBBING

The limits of clearing and grubbing shall be as indicated in the Contract.

2-01.3(4) ROADSIDE CLEANUP

See Section 1-04.11.

2-01.3(5) PROTECTION OF EXISTING IMPROVEMENTS

See Section 1-07.16.

2-01.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Clearing", for "Grubbing", and for "Clearing and Grubbing" will be by lump sum or by the square foot as indicated in the Bid Form.

2-01.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 2-01 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

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" shall include all costs for the specified work.

4. **Other payment information.**

If the Bid Form does not include a Bid item pertaining to the work of "Clearing", "Grubbing", or "Clearing and Grubbing", then this work shall be considered included in the Bid item prices of the various Bid items and no separate or additional payment will be made.

Payment for "Remove Tree" will be 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 permit(s), related property owner agreements, related grading regulations, or other related Contract requirements, shall be considered included in the Bid item prices for the Work 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 work consisting of removing and disposing of, or salvaging or abandoning, selected items identified in the Contract located within a Right of Way or an area of existing improvement. The work also involves backfilling of trenches, holes or pits resulting from the removal of such existing improvements.

Actual pavement and related restoration may be modified by the extended limits of restoration required to meet the "Street and Sidewalk Pavement Opening and Restoration Rules". This document may be obtained at The Street Use Counter, Room 3700, 37th Floor, Key Tower, 700 Fifth Avenue, Seattle, Washington 98104.

2-02.2 MATERIAL

Materials shall meet the requirements of the following Sections:

Cement Concrete Pavement	5-05
Aggregates	9-03

Concrete for plugging pipe ends and for filling inlets shall be Class 5 (3/4) (see Sections 5-05.3(1) and 5-05.3(2)).

Backfill Material for filling structure voids and Structures (other than inlets) shall be either Mineral Aggregate Type 9 or Type 17 meeting the requirements of Section 9-03; selected Material excavated on the Project Site; or such other Material as designated in the Contract.

2-02.3 CONSTRUCTION REQUIREMENTS

2-02.3(1) GENERAL REQUIREMENTS

With certain exceptions, the Contractor shall raze, remove, and dispose of all buildings and foundations, structures, fences, and other obstructions that lie wholly or partially within the Right of Way. The exceptions are public and private utility-owned equipment, and other items identified in the Contract.

The Contractor shall:

1. Remove foundations to a depth of at least 5 feet below finished ground elevation or 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. The fill shall match the level of surrounding ground. Any such fill within the slopes of the roadbed shall be compacted to meet the requirements of Section 2-03.3(14)D, Method B.
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) and 1-07.28 item 17.

When salvageable material is to remain Owner property, the Standard Specifications, unless otherwise specified in the Contract, will identify the material and removal requirements. Such material shall be either stored on the Project Site or delivered to a location identified in these Standard Specifications unless the Contract specifies otherwise.

Any material not named in these Specifications or in the Contract as Owner property will belong to the Contractor. The Contractor shall store or dispose of such material so that it cannot be seen from any public highway.

The Contractor shall dispose of surplus material or debris per Section 1-07.3. The Contractor shall not under any circumstance dispose of surplus material or debris within a wetland as defined in Section 1-07.5(9). Trench excavation over 4 foot in depth shall comply with the safety requirements of Section 7-17.3(1)A7a.

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 other activities shall comply with the most current edition of the "Street and Sidewalk Pavement Opening and Restoration Rules" found at: http://www.seattle.gov/transportation/stuse_pavementopen.htm

Joints and cracks referenced within this section shall include, but are not limited to, the abutment between differing surface materials (including but not limited to asphalt, concrete, brick, or cobblestones), asphalt or concrete surfaces roadway surface and curb, non-monolithic curb and sidewalk, separately placed cement concrete slabs (including but not limited to sidewalk, driveways, and bus shelter foundations), separately placed rigid pavement slabs without overlay, and separately placed rigid pavement base slabs with overlay that are distinguishable.

2-02.3(2) REMOVAL OF BRIDGES, BOX CULVERTS AND OTHER DRAINAGE STRUCTURES

In salvaging any steel or wooden bridge that will remain Owner property, the Contractor shall prevent unnecessary damage to the material. Steel members shall be match-marked.

Unless otherwise specified in the Contract, the Contractor shall remove foundations of existing Structures to a point 2 feet below the finished ground level, the adjacent ground level, or the natural stream bottom whichever is deepest. If a foundation lies wholly or partially on the site of a new structure, it shall be removed to a level that accommodates building the new structure.

Any blasting shall be subject to the requirements of Section 1-07.22. The Contractor shall complete all blasting before the placement of new work.

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 upon the subgrade, or over a base material composed of treated or non-treated, granular or select soil materials. Non-rigid pavement does not contain cement concrete, brick, or cobblestones.

The thickness of a non-rigid pavement will be considered as the thickness of the bituminous mix, or any combination of bituminous mixes and surface treatments.

Non-rigid pavement shall be precut full depth prior to removal by sawcutting to ensure a neat straight 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 shall be vertical along a neat straight line. Sawcutting is not required.

Required sawcutting on the perimeter of full depth non-rigid pavement openings will be paid as "Saw Asphalt Concrete, Full Depth". All other sawcutting associated with removal of non-rigid pavement shall be considered incidental to the removal bid item. Pavement openings will be as indicated on the Drawings or as determined by the Engineer. Adjacent openings shall be considered one opening regardless of the method of Work.

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 shall not be considered pavements.

2-02.3(3)B REMOVE ASPHALT OVERLAY

When removing an asphalt overlay from a rigid base pavement, the Contractor shall use methods and equipment that do not structurally damage the existing rigid base.

If the asphalt overlay is removed by planing, and edges are vertical along a neat straight line. Sawcutting is not required.

Required sawcutting on the perimeter of an asphalt overlay removal area will be paid as "Saw Asphalt Concrete, Full Depth". All other sawcutting associated with removal of asphalt overlay shall be considered incidental to the removal bid item. Areas of asphalt overlay removal shall be as indicated on the Drawings or as determined by the Engineer. Contiguous asphalt overlay removal areas shall be considered one regardless of the method of work.

No sawcutting is required where pavement removal limits extend to joints or cracks.

Planing bituminous pavement is addressed 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 will be considered the thickness of the cement concrete, brick, cobblestone, or any combination of asphalt, cement concrete, brick, or cobblestone.

In trenching operations, rigid pavement shall be removed at locations as indicated on the Drawings, or if not shown on the Drawing as indicated on Standard Plan no. 404a or 404b.

Rigid pavement shall be sawcut, or with the approval of the Engineer line drilled unless otherwise specified; see section 2-02.3(6).

Required sawcutting on the perimeter of rigid pavement openings will be paid as "Saw Cement Concrete, 2 Inch Minimum Depth" or "Saw Cement Concrete, Full Depth", and sawcutting for neat edge removal of the asphalt overlay 12-inch

step-back as shown on Standard Plan nos. 404a and 404b will be paid as "Saw Asphalt Concrete, Full Depth". All other sawcutting associated with removal of rigid pavement shall be considered incidental to the removal bid item. Pavement openings will be as shown on the Drawings or as determined by the Engineer. Adjacent openings shall be considered one opening regardless of the method of Work.

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 will not be permitted.

Removal of former street car foundation may be required. This foundation may extend 21 to 24 inches below street grade and may include rails and ties.

2-02.3(3)D REMOVE CATCH BASIN, SANDBOX, VALVE CHAMBER, MANHOLE, OR INLET

The Contractor shall excavate and completely remove the structure including casting and outlet trap, concrete encasement, and bricks, as applicable to each removal Bid item.

Connecting pipes shall be plugged in accordance with Section 2-02.3(5)B. Backfill shall be with selected material compacted to meet the requirements of Section 7-17.3(3).

2-02.3(3)E CURB REMOVAL AND CLASSIFICATION, AND REMOVE CURB AND GUTTER

There are four types of curb; doweled curb (includes mountable and other curb attached to underlying pavement structure), full depth curb, curb and gutter, and monolithic curb (cement concrete). Monolithic curb will be considered cement concrete sidewalk removal. Unless the Drawings indicate otherwise, doweled curb, full depth curb, or curb and gutter removal adjacent to full depth pavement removal will be considered to be part of the full depth pavement removal. If doweled curb, full depth, or curb and gutter removal is isolated from full depth pavement removal, removal of doweled curb and full depth curb will be considered curb removal, and removal of curb and gutter will be considered curb and gutter removal.

Curb shall be sawcut perpendicular to the curb line at the neat line limits of removal, or removed to the nearest joint as indicated on the Drawings or as directed by the Engineer. Sawcutting at the limits of removal (end points of removal segments) will be paid as "Saw Cement Concrete, Full Depth". Sawcutting between limits of curb removal, and all other sawcutting associated with removal of curb shall be 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, shall be as indicated on the Drawings. Sawcut shall comply with the requirements of Section 2-02.3(6) and shall leave straight edges and vertical faces. The minimum width of sidewalk removal measured longitudinally shall be two (2) feet, or to the nearest score line as indicated on the Drawings or as directed by the Engineer.

Required sawcutting on the perimeter of sidewalk removal will be paid as "Saw Asphalt Concrete, Full Depth" or "Saw Cement Concrete, Full Depth"; except for sidewalk removal for curb ramp and driveway installations. Saw cutting on the perimeter of new curb ramps, new driveways, and all other sawcutting associated with removal of sidewalk shall be considered incidental to the removal bid item. Sidewalk removal areas will be as shown on the Drawings or as directed by the Engineer. Adjacent sidewalk removal areas shall be considered one area regardless of the method of work.

No sawing is required where sidewalk removal limits extend to joints or cracks.

Unless the Contract specifies otherwise, removal of parking pay stations, D-22 signage ("Pay L", "Pay R", "Pay H", and "Pay LR" signs and posts), and "numbered" base plates, parking meter, bus stop, and street name signs including their posts will be by SDOT. Should the Contractor require removal or relocation prior to scheduled Work, the Contract shall notify SDOT in accordance with Section 1-07.28.

Removal of a bus shelter requires the notification specified in Section 1-07.28.

2-02.3(3)G REMOVE ELECTRICAL AND TRAFFIC CONTROL DEVICES

The Contractor shall submit a written schedule for removing the existing traffic control and electrical systems to the Engineer at least 5 Working Days prior to proceeding with the removal.

The Contractor shall notify the Engineer 3 Working Days prior to any removal of traffic signals in which no traffic signal devices are to be reinstalled. Within 3 Working Days after the removal, the Contractor shall again notify the Engineer, in writing, stating the location, exact date and time of the actual removal.

The Contractor shall remove equipment from the span wire before the span wire is disconnected from the poles. Existing span wire shall not be cut without first releasing the tension in the span.

Removal of any part of a loop detector system, whether or not in conjunction with pavement, curb, or sidewalk removal, requires the Contractor make the notification in Section 1-07.28 item 16.

2-02.3(3)H REMOVE GUARD RAIL

Removal of the various types of guardrail and anchors shall include removal of the rail, cable elements, hardware, posts, concrete bases, and steel tubes. All holes resulting from the removal shall be backfilled with native Material compacted in 6 inch layers with each layer compacted to 95% as determined in Section 2-03.3(14)E. The removed guardrail items, if reusable as determined by the Engineer, shall be delivered either to the Charles Street Facility or to the Haller Lake Facility whichever facility is nearest the guardrail to be removed. Damaged and unusable items shall be disposed of by the Contractor.

2-02.3(3)I REMOVE TREE

Trees which are greater than 6 inch in diameter at one foot above the ground and marked for removal will be indicated on the Drawings. The Contractor shall notify the Engineer at least 2 Working Days in advance of tree removal.

The Contractor shall comply with Section 1-07.16(2) whenever tree trimming or removal is near overhead wires.

In unimproved areas, removal of the tree shall include complete removal of the stump.

In improved areas, stump removal shall be by grinding and removing the stump to an 18 inch depth below finished grade, unless specified otherwise in the Contract.

2-02.3(3)J REMOVE PAVEMENT MARKING

Pavement paint and thermoplastic stripes and markings, traffic buttons, and lane markers to be removed as indicated in the Contract shall be obliterated until blemishes caused by the pavement marking removal conform to the coloration of the adjacent pavement. Traffic button and lane marker removal shall be incidental to pavement marking removal. If the pavement is materially damaged by pavement marking removal, such damage shall be repaired by the Contractor in accordance with Section 1-07.13. Sand or other material deposited on the pavement as a result of removing pavement markings shall 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, removal of parking pay stations, D-22 signage ("Pay L", "Pay R", "Pay H", and "Pay LR" signs and posts), and "numbered" base plates, parking meter, bus stop, and street name signs including their posts will be by SDOT. Should the Contractor require removal or relocation prior to scheduled Work, the Contractor shall notify SDOT in accordance with Section 1-07.28

Removal of the various types of signs, posts, and hardware shall include patching the holes with a suitable material flush with existing surface. Removal of posts in earth shall be backfilled with suitable native Material in 6" layers with each layer thoroughly compacted. Removal of posts and concrete foundations from sidewalk or other improvement shall 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 shall be in accordance with the Bid items in the Bid Form; if Work is not specified in the Bid Form, replacement of improvements shall be in accordance with applicable Specifications or in-kind to the satisfaction of the Engineer, and incidental. Damaged and unusable items shall be disposed of by the Contractor. Salvage of useable Material shall be in accordance with Section 2-02.3(7).

2-02.3(4) ABANDON CATCH BASIN, VALVE CHAMBER, MANHOLE, OR INLET

As applicable to each structure designated on the Drawings to be abandoned, the Contractor shall 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 follows.

The Contractor shall not abandon any existing water service unless the Contract so specifies. When abandonment of an existing water service is required, the Contractor shall first make the notification as specified in Section 1-07.28 item 5.

Valve chambers, catch basins, and manholes shall be filled with Mineral Aggregate Type 9 or Type 17 or crushed concrete compacted to 95% of maximum dry density per Section 2-03.3(14)E. Old Type 164 inlets shall be filled with Class 5 (3/4) concrete (see Section 5-05.3(2)). Inlet grates shall be delivered to the Owner.

The upper portion of abandoned structure shall be replaced with Material matching the existing pavement structure unless indicated otherwise in the Contract.

2-02.3(5) ABANDON AND FILL, AND PLUG PIPE**2-02.3(5)A ABANDON AND FILL PIPE**

Pipes designated on the Drawings to be abandoned and filled shall be 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 shall be completely plugged with Cement Concrete, Class 5 (3/4) (Section 5-05.3(2)) 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, or other cement concrete slabs, with or without asphalt overlay for removal, the minimum depth of sawcut shall be the greater of 2-inches or one-half of the concrete material, and the maximum depth of sawcut shall be three-fourths of the concrete material. For cement concrete sidewalk, when over areas sensitive to the breaking of non-full depth sawcuts, or when specified as "full depth" in the Drawings or Standard Plans, sawcutting shall be full depth of the concrete material.

For removal of pavements consisting of mortared decorative or other type special pavement units, such as brick, cobblestone or paver block, overlying a concrete pavement base (rigid pavement), the depth of sawcut shall be no more than three-fourths the thickness of the concrete base.

Curb removal shall be sawcut full height and width of curb.

Asphalt removal shall be sawcut full depth.

When line drilling, spacing of drilled holes center to center shall be 6 inches maximum and hole diameters shall be 1-1/2 inches minimum. Holes shall be perpendicular to the surface and shall penetrate completely through the pavement.

Sawcutting shall be the required method for removals:

1. Unless otherwise noted in the Contract.
2. Unless otherwise noted in the permit for work in the street Right of Way.
3. Unless otherwise allowed in writing at the discretion of the Engineer.

To thoroughly clean sawcut, the Contractor shall employ non-polluting methods using, or as effective as using, high pressure water (water under at least 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

When sawcutting concrete pavement for contraction joints, as shown on Standard Plan no. 405, the depth of sawcut shall be 1/3 the pavement depth and shall not cut tie bars and dowel bars (see Section 5-05.3(8)B2).

2-02.3(7) SALVAGE

2-02.3(7)A GENERAL

Unless otherwise indicated in the Contract, all materials identified as salvageable by the Engineer to be removed from the project shall be carefully salvaged in its existing condition as amended in the following paragraph. Delivery of salvageable material shall be as specified in subsections 2-02.3(7)B through 2-02.3(7)F. Delivery of salvageable guardrail components shall be in accordance with Section 2-02.3(3)H. Materials deemed not salvageable by the Engineer shall be removed by the Contractor and disposed of.

All castings and other materials removed from the project which are not to be re-used on the project, and which in the opinion of the Engineer are suitable for salvage, shall have excess concrete, debris and dirt removed.

2-02.3(7)B WATER MAINS AND APPURTENANCES

The Contractor shall excavate and completely remove hydrants, valves, and any appurtenance where new Water Main and appurtenance is to be installed. Items designated for salvage will be indicated 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 appurtenance shall be disposed of by the Contractor. Backfill shall be with Mineral Aggregate Type 17 and shall be compacted to meet the requirements of Section 7-17.3(3)B.

2-02.3(7)C ILLUMINATION, SIGNALS, ELECTRICAL, AND SIGNS

Electrical and traffic control items to be salvaged shall include the following:

1. High pressure sodium luminaries, lamps and photo 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.

Items 1 through 4 shall be delivered by the Contractor to City Light South Service Center at 4th Avenue South and South Spokane Street. Call 206-386-1766 prior to delivery of wood poles, or 206-386-1704 prior to delivery of metal poles, high pressure sodium luminaries, lamps, photo cells, and aluminum bracket arms.

Items 5 through 16 shall be returned to SDOT Traffic Shops at 4200 Airport Way South. Call 206-386-1206 a minimum 2 Working Days prior to delivery.

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 shall 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 shall not damage the brick, cobblestone, or granite curb. If necessary, the Contractor shall hand

excavate to ensure these materials are not damaged. The Contractor shall coordinate the loading operations with the SDOT Pavement Supervisor, see Section 1-07.28. The Contractor shall be responsible for loading of the salvaged material.

2-02.3(7)F DRAINAGE AND SEWER MATERIALS

Inlet, catch basin, manhole, and other Sewer and drainage materials, such as castings, grates, hoods, ladders, and related materials, deemed salvageable by the Engineer shall be delivered to the Haller Lake facility, weekdays between the hours of 8:00 AM and 3:00 PM. Contact 206-684-7507 at least 1 Working Day in advance for arrangement of delivery.

2-02.3(8) STREET SADDLES AND 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 meeting the requirements that follow shall be used to temporarily cover the excavation or opening.

2-02.3(8)B STREET SADDLES

Saddle boards and irons shall be used only on those streets which have concrete pavement or other surface which can safely support them.

Saddle board shall be made of 4-inch or thicker roughcut, construction grade timbers with no warp. Saddle iron flanges shall have minimum dimensions of 6 inch width x 8 inch length. They shall be made of minimum thickness 3/4-inch steel and have chamfered edges. The support iron shall be of adequate size so that there is no significant deflection with traffic. At any time the saddle iron flanges do not get full bearing on the pavement surface, shims shall be used. Saddle boards and irons may be bolted together.

Saddle irons and boards shall be firmly wedged on sides and ends. The boards shall be flush with surrounding pavement. All holes shall be cut to provide a good fit and without excessive openings. Saddle boards shall be notched to receive the irons, or scabbing shall be added to the sides of the board so that the board is flush along the pavement opening. There shall be no more than 3 feet of unsupported board between irons.

Shims, where needed, shall comply with the requirements of Section 2-02.3(8)C.

Street saddles shall have a non-skid surface coating capable of providing slip resistance in wet and dry weather for the length of time the saddles are in-place.

2-02.3(8)C STEEL PLATES

In general, where a steel plate covers an excavation or opening, the Contractor shall 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(s) are in-place.

Steel plates shall be capable of withstanding, at the minimum, HS-20 loading.

All bearing ends of steel plates shall overlap existing remaining pavement at least 12 inches. Flanges or angle irons shall be welded to the plate underside conforming basically to the size of the street opening to ensure the plate does not move relative to the opening. The edges of all plates shall be highlighted with a bright 12 inch minimum width paint.

All steel plates shall 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 shall provide a smooth, gradual transition between pavement and the plate at least 12 inch in length to accommodate wheelchair, bicycle, and other traffic. The tapered transition shim shall be highlighted with paint stripes consisting of the color Omaha Orange, approximately 2 inches wide and located 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 shall be provided, such as braced steel beams. The space between the steel beam and the plate shall be covered with a material, such as an old carpet, to prevent rattling and noise.

When directed by the Engineer, the Contractor shall use steel pins welded at the corners of the plate. When pins are used, holes shall be drilled through an opening in the plate full depth into underlying pavement structure. The pins shall be long enough to be driven full depth of pavement and be of cross-section to be snug in the holes. The pin head shall 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 shall have a permanent non-skid surface in both dry and wet conditions. Non-skid coatings are not acceptable.

Any crosswalk containing steel plates or saddles may be closed at the discretion of the Engineer.

2-02.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for sawcutting will be made by the linear foot, measured along the slope of the surface cut. When acceptable full depth precut is performed using an asphalt cutting wheel, it will be measured as sawcutting. No measurement will be taken for line drilling.

Sawcutting of cement concrete will be measured as "Saw Cement Concrete, 2 Inch Minimum Depth" unless specified as "full depth".

Measurement for openings in pavement structure will be based on the removal and replacement limits as indicated on the Drawings, as determined by the Engineer, or if not shown on the Drawing as indicated on Standard Plan no. 404a or 404b as modified by the extended limits of restoration required to meet the "Street and Sidewalk Pavement Opening and Restoration Rules".

Abandon pipe will not be measured.

Measurement for "Abandon and Fill Pipe" will be by the linear feet of pipe abandoned and filled.

Measurement for "Remove Pavement Marking" and "Remove Pavement Marking, Thermoplastic" will be by the actual linear foot. Unpainted skips in pavement marking removal, and removal of traffic buttons and lane markers incidental to pavement marking removal, will not be measured.

Measurement for "Remove Pavement Marking Legend/Symbol" and "Remove Pavement Marking Legend/Symbol, Thermoplastic" will be measured per each.

Removal of monolithic curb and cement concrete sidewalk will be considered cement concrete sidewalk removal by the square yard. No separate measurement for curb removal will be made for removal of monolithic curb.

Unless the Drawings indicate otherwise curb and gutter, doweled curb and full depth curb removal adjacent to full depth pavement removal will be considered to be part of the full depth pavement removal and will be included in the surface area measurement of the applicable full depth pavement removal Bid item.

Doweled curb and full depth curb isolated from full depth pavement removal will be measured by the linear foot along the curb face as "Remove Curb"

Curb and Gutter isolated from full depth pavement removal will be measured by the linear foot along the curb face as "Remove Curb and Gutter".

Measurement for "Abandon Existing Water Service" will be per each service permanently retired and disconnected from the existing Water Main.

Measurement for the removal of the former street car foundation will be per square yard using the Bid item "Remove Pavement, Over 12 Inch Depth, Including Rails and Ties". No separate measurement will be made for the removal of rails and ties.

2-02.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 2-02 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

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)" shall include 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 shall 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 "Common Excavation" in accordance with Section 2-03, 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 shall be considered as incidental to and included in the Bid item price of installing the new underground facility.

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 shall be considered included in the removal Bid item. Payment for removal of rigid base shall include the removal of the overlying asphalt in the removal Bid item.

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 overlying asphalt, will be paid as "Remove Pavement".

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 overlying asphalt is greater than 6 inches in average thickness.

Payment for removal of untreated roadway surfaces will be paid as "Common Excavation".

Removal 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 located within the excavation area between pipe trench neat lines or within the neat line area of a structural excavation shown on the Drawings, shall be considered as incidental to and included in the Bid item price for installation of pipe or for structural excavation. Removal of catch basin and manhole will be paid for at the Bid item price Bid for their removal.

Costs for sidewalk thickened edge removal shall be incidental to and included in the cement concrete sidewalk removal Bid item price.

Payment for removal of traffic sign posts shall include all costs for the removal of the post, traffic sign, mounting hardware and restoration of the surface where sign posts were removed.

The Bid item price for; "Remove Pavement Marking", "Remove Pavement Marking, Thermoplastic", "Remove Pavement Marking Legend/Symbol" and "Remove Pavement Marking Legend/Symbol, Thermoplastic" shall include 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 shall 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" shall include all costs for the work required to remove the existing luminaire, or luminaire and bracket arm and it's ballast, wiring and appurtenances.

The Bid item price for "Remove Pole, Metal" shall include all costs for the work required to remove and salvage the pole.

The Bid item price for "Remove Pole, Wood" shall include 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 Foundation, (Type)" shall include 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.

5. **"Saw Cement Concrete, 2 Inch Minimum Depth"**, per linear foot.
6. **"Saw Cement Concrete, Full Depth"**, per linear foot.
7. **"Saw Asphalt Concrete, Full Depth"**, per linear foot.

The Bid item price for sawcutting shall include all costs for the work required to sawcut cement concrete or asphalt concrete. No payment will be made for sawcutting concrete or asphalt, which is 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 for neat edge removal of the 12-inch asphalt overlay step-back as shown on Standard Plans 404a and 404b, will be paid in accordance with the Bid item "Saw Asphalt Concrete, Full Depth".

No separate payment shall 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)" shall include 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", shall include all costs for the work required to plug the pipe where indicated 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 shall be 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)" shall include all costs for the work required to complete the removal, disposal, and salvage work as specified in 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 shall be paid for as "Remove Pavement, Over 12 Inch Depth, Including Rails and Ties" per square yard. No separate payment shall be made for the removal of rails and ties.

When existing Type 164 Inlet (see Std. Plan 268) is to be removed with the removal of concrete pavement, the removal of the inlet shall be considered incidental to the cost of "Remove Pavement".

Unless the Drawings indicate otherwise, full depth removal of traffic islands shall be considered included in the Bid item prices for "Remove Pavement", "Common Excavation", or "Remove Concrete Sidewalk" applicable to the underlying pavement structure of the traffic island being removed.

Traffic islands consisting of monolithic curb and sidewalk shall be paid as "Remove Cement Concrete Sidewalk".

Traffic islands curb over non-full depth pavement removal shall be considered "Remove Curb", or "Remove Curb and Gutter" when curb removal is not adjacent to or overlying full depth pavement removal.

All costs for coordination and delivery of salvageable material shall be included in the various Bid item prices.

Payment for Mineral Aggregate shall be in accordance with section 4-01.5.

All costs for disposal shall be included in the various Bid item prices for the Work.

SECTION 2-03 ROADWAY EXCAVATION AND EMBANKMENT

2-03.1 DESCRIPTION

2-03.1(1) GENERAL

Section 2-03 describes work consisting of excavating and grading the roadway; excavating below grade; removing and replacing slide material; furnishing, placing, temporarily stockpiling, and compacting selected or other backfill Material; removing and disposing of unsuitable or excess material; and all work necessary for the construction and completion of cuts, embankments, slopes, roadway ditches, side street approaches, alley and alley approaches, driveways and driveway approaches, sidewalks and planting areas, and such subsidiary work not otherwise provided for separately in other Sections of the Standard Specifications.

This work shall be performed in reasonably close conformity with the lines, grades, and cross sections indicated in the Contract or established by the Engineer.

2-03.1(2) CLASSIFICATION

Roadway excavation shall be classified as common excavation, solid rock excavation and unsuitable foundation excavation. Trench excavation shall be as specified elsewhere.

Solid Rock Excavation shall consist of the removal and disposal of solid rock, i.e. ledge rock that requires systematic drilling and blasting for its removal and also boulders exceeding 1/2 cubic yard in volume as determined by the Engineer. Hard pan, hard clay or glacial till shall not be classified as solid rock excavation. Sandstone, siltstone, shale or other sedimentary rocks which are soft, weathered or extensively fissured shall not be 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 shall consist of the removal and disposal of unstable material including, but not limited to, peat, muck, swampy or other unsuitable materials such as buried logs and stumps, but only when the removal is as specified in Section 2-03.3(14)F or Section 2-03.3(14)G and such methods are specified in the Contract and included in the Bid Form or are specifically ordered in writing by the Engineer. Removal of soft or spongy spots in the prepared subgrade shall be considered excavation below grade pursuant to Section 2-03.3(3).

Common Excavation shall consist 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. The widening of roadway cuts and ditches, and excavation below the designated subgrade elevation to an excavation depth of 3 feet or less below subgrade elevation when ordered by the Engineer, shall be considered as common excavation.

2-03.1(3) PROTECTION OF EXISTING IMPROVEMENTS

The Contractor shall insure that stockpiled Mineral Aggregates, that debris from the Work area, and that materials from roadway excavation are prevented from entering existing drainage structures and water courses as required in Sections 1-07.5, 1-07.15, and 8-01, and that these materials shall be removed, recycled, or disposed of as required in Sections 1-07.3 and 1-04.11.

2-03.2 RESERVED

2-03.3 CONSTRUCTION REQUIREMENTS

2-03.3(1) WIDENING OF CUTS

If routine cuts do not supply enough Material to form the embankment, the Contractor shall obtain more fill from cuts inside or outside the Right of Way as the Engineer may direct or from widening one or both sides of existing cuts as staked by the Engineer.

In either case, the Contractor shall dress the sides of the cuts to any slopes the Engineer may require.

2-03.3(2) ROCK CUTS

2-03.3(2)A PRESERVING ROCK BELOW SUBGRADE

The Contractor shall take care not to break down, loosen, or damage the rock under the subgrade line except as provided by Section 2-03.3(3). Normally, cuts shall be made from the top, lift by lift, to protect the rock bench that remains. The Contractor shall be responsible for methods used and for any damage caused to the roadbed, regardless of any previous approvals by the Engineer.

2-03.3(2)B SCALING AND DRESSING

To leave rock cuts in a safe, stable condition, the Contractor shall scale and dress them, removing all loose fragments and rocks not firmly fastened to the rock slope. The Contractor shall also remove any overhanging rock the Engineer sees as a hazard to roadway users.

If the Engineer requires it, the Contractor shall remove loose fragments and rocks lying outside the slope stakes including loading and hauling. Such extra work shall be as provided in Section 1-04.4.

2-03.3(3) EXCAVATION BELOW GRADE

When the Contractor finds rock or other hard Material at the subgrade elevation, it shall be excavated the full width of the roadbed to at least 6 inches below subgrade, then backfilled with rock fragments, gravel, or other free-draining Material of size not more than 4 inches in diameter.

If the Contractor uses a subgrade trimmer, the backfill shall be rock, gravel, or other free-draining Material not more than 2 inches in diameter. The Contractor shall save the finer granular Material from excavations or borrow pits to use in backfilling the top 6 inches of the subgrade. All such Material shall be approved by the Engineer.

Draining rock pockets. If blasting below subgrade leaves a rock pocket that does not drain, the Contractor shall at no additional cost to the Owner, dig a trench from the pocket bottom to the roadside ditch, then backfill both the pocket and the trench with rock fragments, gravel, or other Material approved by the Engineer.

Compaction. If the density of the natural earth under any area of the roadway is less than that required in Section 2-03.3(14)D, Method B, the Engineer may direct the Contractor to:

1. Scarify the earth to a depth of 6 inches.
2. Aerate or water.
3. Compact the scarified area to the required density.
4. Excavate to a specific depth.
5. Backfill the excavated area in layers, using the previously excavated Material or other Material.
6. Compact each layer to meet the compaction requirements for embankments.

2-03.3(4) SLUICING

The Contractor shall not excavate by sluicing unless the Contract specifically calls for it.

2-03.3(5) SLOPE TREATMENT

The tops of all roadway cut slopes, except solid rock cuts, shall be rounded in accordance with Standard Plan no. 140. Unless otherwise noted in the Contract, Class A slope (Class A slope refers to WSDOT Standard H-8 treatment) shall be utilized.

If a layer of earth covers a rock cut, the slope shall 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 shall be backfilled and stabilized to prevent erosion.

2-03.3(6) DEPOSIT OF ROCK FOR OWNER'S USE

At the Engineer's direction, the Contractor shall deposit excavated rock at the roadside or elsewhere. If this requires the Contractor to use Material that would otherwise have gone into an embankment, the Owner will pay for the extra cubic yards of excavation needed to complete the embankment. Any such rock deposit shall be Owner property. The Contractor shall be responsible for safe-keeping the deposit until the Owner has removed it or until the Contract is completed.

2-03.3(7) DISPOSAL OF SURPLUS MATERIAL

Recycle or disposal of surplus and unsuitable material from other than excavation shall be in accordance with Section 1-07.3.

Material obtained from all excavation within the project Site shall not be wasted unless the excavated material is designated by the Engineer as unsuitable for use in embankment construction, trench backfill, or for other purposes. Disposition of surplus excavated material shall be as specified in Section 2-03.3(10).

Reclamation of a Contractor-supplied quarry, pit, and borrow sites shall conform to the requirements of Section 3-03.

2-03.3(8) WASTING MATERIAL

If the Contractor wastes excavated material which is deemed suitable by the Engineer for embankment or other backfill work, and Material is later needed for embankment or backfill work, the Contractor shall, at no cost to the Owner, replace the wasted material with Material meeting the Engineer's approval.

2-03.3(9) ROADWAY DITCHES

At each transition from cut to embankment fill, the Contractor shall divert any roadway ditch away from the embankment in natural ground. Ditches shall never permit water to flow into or upon embankment Material.

All ditches shall be constructed as shown on the Drawings and shall be graded to direct the flow of the water to catch basins, Culverts or channels.

2-03.3(10) SELECTED MATERIAL

Selected Material shall be considered as that Material designated by the Engineer as suitable for selected fill applications which is obtained from the excavation or widening of the roadway prisms, or any other excavation within the Right of Way, including trench excavation. Selected Material shall be used first before new borrow Material is imported for construction of project embankments, finishing the top portion of the subgrade, structure backfill, or such other backfill applications the Contract may designate.

Selected Material shall be used for any of the following purposes as determined by the Engineer:

1. Embankment construction.

2. In lieu of Mineral Aggregate (Type) meeting the requirements of Section 9-03.
3. Trench backfill.
4. Planting soil (see Section 8-02.3(2)).
5. Other selected uses.

Excavated material which is in excess of the needs of the project shall be recycled or disposed of in accordance with Section 1-07.3.

Selected Material shall be placed and compacted in accordance with the requirements for the type of work for which the Material is being used.

Unless the Contract specifies otherwise, the Engineer may identify as "selected" any Material excavated within the Right of Way, including the excavation of local borrow. Where the Contract specifies Material excavated from the project Site to be labeled as top soil Type B, the requirements of Section 8-02.3(2)C shall apply.

If necessary, stockpiling of selected Material shall be at locations approved by the Engineer. Thereafter, such Material shall be removed from stockpile and used when needed. Excavated Material stockpiled for use as selected materials shall be protected from contamination by other materials, be protected from damage by weather, and be prevented from producing sediment by covering with waterproof sheeting or such other means as the Contractor deems necessary. Selected Materials stockpiled and later found unsuitable by the Engineer shall be disposed of and replaced with Material acceptable to the Engineer.

2-03.3(11) SLIDES

The Contractor shall slope the sides of cuts and embankments to comply with lines staked or reestablished by the Engineer. If a slide occurs on a finished slope before final acceptance of the Work, the Contractor shall remove or replace the slide Material. The Contractor shall also refinish the slope to the condition and with the Materials required by the Engineer.

If the Contractor undercuts or destroys a slope, the slope shall be resloped to the original alignment or to a new one established by the Engineer at the sole expense of the Contractor.

2-03.3(12) 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, however, does not include material from slides as described in Section 2-03.3(11).

If the Engineer does not approve use of the overbreak, the Contractor shall remove, haul, and dispose of it, at no expense to the Owner. In this case, the Contractor shall follow the procedure for handling surplus Material described in Section 2-03.3(7).

If the Engineer approves, the Contractor may use overbreak:

1. To complete an embankment when the excavated material unexpectedly falls short of the amount required.
2. To replace borrow excavation originally planned for an embankment.

2-03.3(13) BORROW AND BORROW SITES

2-03.3(13)A BORROW

Borrow is imported Material obtained from sources other than the roadway prism, trench excavation, or other excavation Work on the project. When suitable native excavated Material is insufficient, borrow shall be used to construct embankments, subgrades, shoulders, and other roadway components to the neat lines shown on the Drawings.

Borrow shall be classified as "Unclassified Borrow" or "Borrow (Type)" as follows:

- Unclassified Borrow: an imported soil which meets the suitability requirements set forth in Section 2-03.3(14).
- Borrow (Type): an imported soil which meets the suitability requirements set forth in Section 2-03.3(14) and in addition, meets all gradation and other requirements listed in Section 9-03 for the Mineral Aggregate Type specified (e.g., "Borrow, Mineral Aggregate Type 17", etc.).

2-03.3(13)B BORROW SITES

Sources of borrow Material, the selection of borrow sites and their operation, and the borrow Material shall at all times be subject to the approval of the Engineer. No borrow site shall be utilized by the Contractor until the proper grading permits and property owner agreements have been obtained by the Contractor and copies submitted to the Engineer. Utilization of a site without a legal grading permit, a consent Agreement from the property owner, and approval of the Engineer will be considered unauthorized.

Borrow sites located within the City limits of Seattle are subject to the rules and regulations set forth in Seattle Grading and Drainage Control Ordinance (Ord. No. 108080 as amended by Ord. No. 111043) or as otherwise provided in the Seattle Municipal Code Chapters 22.800 through 22.808 and shall require a grading permit issued to the property owner by the Director of Planning and Development.

Borrow sites located outside the City limits of Seattle but within unincorporated King County, shall be subject to the rules and regulations set forth in the King County Grading Ordinance (Ord. No. 1488). Sites may also be subject to rules and regulations of a local governmental authority if located within its jurisdiction.

2-03.3(14) EMBANKMENT CONSTRUCTION**2-03.3(14)A GENERAL**

The Owner classifies embankment construction as:

1. **Rock embankment** - in which the Material in all or any part of an embankment contains 25 percent or more, by volume, gravel or stone 4 inches or more in diameter. Section 2-03.3(14)B.
2. **Earth Embankment** - made of any Material other than that used in rock embankment. Section 2-03.3(14)C.
3. **Unstable Base** - If the Engineer believes the natural earth base impairs an embankment or makes it unstable, the Contractor shall stabilize or remove and dispose of the base Material in keeping with this Section or Section 2-03.3(14)F.
4. **Hillside Terraces** - Unless the Contract specifies otherwise, the Contractor shall terrace the original ground or embankment on hillsides, on the sides of existing embankments and in transitions from cuts to fills. Each terrace shall penetrate the slope at least 5 feet and shall not be more than 5 feet high. The horizontal face of the terrace shall slope outward at approximately 0.05 foot per foot. The Engineer may order the Contractor to place gravel backfill, pipe drains or both to drain any seepage.
5. **Soft Base** - On wet or swampy ground, the Contractor shall haul and spread embankment Material by methods that cause minimal disturbance to the base. If the Engineer approves, the Contractor may place the lower part of the fill by dumping and spreading successive loads to form a uniform layer just thick enough to support equipment used to place and compact upper layers.

Normally the Contractor shall not increase the planned depth of the embankment over a soft base merely to permit the use of heavier equipment. However, if the Contractor can demonstrate that the planned depth can not support light hauling vehicles, the Engineer may approve a deeper fill. The Contractor shall not claim extra pay if these restrictions require the use of light equipment or different construction methods than originally planned for use on the soft base.

In the order of priority, Material used for embankment shall be:

- 1) Selected Material obtained from Common Excavation and Trench Excavation; and
- 2) Borrow of the type specified.

Selected excavated Material shall be used to construct all required project embankments per Section 2-03.3(10).

Excavated Material will be considered suitable for general fill applications which do not require a Material meeting specific Mineral Aggregate Type Specifications found in Section 9-03 if it:

- (1) Is capable of attaining the degree of compaction specified in Section 2-03.3(14)D;
- (2) Is within ± 3 percent of optimum moisture content as determined in accordance with ASTM D 698;
- (3) Is free from deleterious Material and does not contain more the 5% total by volume of organic Material; clay; frozen lumps; and rocks, concrete, asphalt, or other debris and rubble having a dimension greater than 6 inches.

Embankment Material that contains less moisture than required for proper compaction with the compacting equipment being used shall be watered to obtain the optimum range of moisture. Compaction of embankment Material that contains excessive moisture shall not be started until the moisture content is reduced to the optimum range of moisture.

2-03.3(14)B ROCK EMBANKMENT CONSTRUCTION

The Contractor shall build rock embankments in horizontal layers. No layer shall be deeper than 18 inches unless the rocks in the fill Material average more than 18 inches in diameter. The Contractor shall separate and distribute the larger pieces of rock and fill the spaces between them with smaller rocks and earth. With the Engineer's approval, the Contractor may dispose of rocks larger than the average size instead of placing them in the embankment.

Compacting. The Contractor shall use a 50-ton compression roller or a vibratory roller having a dynamic force of at least 40,000 pounds impact per vibration and at least 1,000 vibrations per minute. In either case, the roller shall make one full coverage for each 6 inch lift depth, or any fraction of 6 inch lift depth.

When the lift depth is 18 inches or less, the Contractor may use a 10-ton compression roller or a vibratory roller having a dynamic force of at least 30,000 pounds impact per vibration and at least 1,000 vibrations per minute. In either case, the roller shall make four full coverages for each 6 inches of lift depth, or any fraction of 6 inch lift depth.

Rollers shall exert reasonably even pressure over the area covered. The Contractor shall limit the speed of compression rollers to no more than 4 miles per hour, and the speed of vibratory rollers to no more than 1.5 miles per hour.

If possible, the Contractor shall compact the Material even further by routing empty and loaded hauling equipment evenly over the entire width of the embankment.

When the Engineer believes rolling to be physically impractical, rolling may be omitted on part or all of a layer.

Should excessive moisture threaten the stability of the embankment, the Engineer may order the Contractor to alter the operation. The Contractor may alternate layers of wet and dry Materials, drying Materials before placing, or halting Work in the problem areas.

Top layer. The Contractor shall build each rock embankment up to 6 inches below subgrade. The top 6-inch layer of embankment shall be of rock, gravel, or other free-draining material that does not exceed 4 inches in any dimension. When the Contract requires use of a subgrade trimmer, these Materials in the top layer may not exceed 2 inches in diameter.

When practical, and as approved by the Engineer, the Contractor shall save the finer granular Material from excavations or borrow pits for use in topping rock fills.

2-03.3(14)C EARTH EMBANKMENT CONSTRUCTION

The Contractor shall place earth embankments in horizontal layers of uniform thickness. These layers shall run full width from the top to the bottom of the embankment. Slopes shall be compacted to the required density as part of embankment compaction.

During grading operations, the Contractor shall shape the surfaces of embankments and excavations to uniform cross-sections and eliminate all ruts and low places that could hold water.

On a tangent, the Contractor shall raise the center of the embankment above the sides. On a sidehill, the high point of any layer shall intersect the original ground and shall slope uniformly toward the lower side. This slope shall not exceed 1 foot in 20 feet.

2-03.3(14)D COMPACTING EARTH EMBANKMENTS

This section describes three methods (A, B, and C) for building earth embankments. The Contractor shall use Method B unless the Contract requires another method.

Method A. Each embankment shall be made of layers no more than 2 feet thick. The Contractor shall compact each layer by routing loaded haul equipment over its entire width. If the Engineer approves, the Contractor may use end dumping to begin placing a sidehill fill too narrow for hauling equipment. When the fill is wide enough, the remaining layers shall be compacted by the loaded hauling equipment.

Method B. The top 2 feet of each embankment shall be compacted to 95 percent of the maximum density as determined by the compaction control tests described in Section 2-03.3(14)E. All Material below the 2-foot level shall be compacted to 90 percent of the same maximum density.

In the top 2 feet, horizontal layers shall not exceed 4 inches in depth before compaction. No layer below the top 2 feet shall exceed 8 inches in depth before compaction.

The Contractor shall use compacting equipment approved by the Engineer.

Method C. Each layer of the entire embankment shall be compacted to 95 percent of the maximum density as determined by the compaction control tests described in Section 2-03.3(14)E.

In the top 2 feet, horizontal layers shall not exceed 4 inches in depth before compaction. No layer below the top 2 feet shall exceed 8 inches in depth before compaction.

The Contractor shall use compacting equipment approved by the Engineer.

Under Methods B or C, the Engineer may permit the Contractor to increase layer thickness up to 18 inches before compaction, provided:

1. The layer is more than 2 feet below the top of the embankment,
2. An approved vibratory roller is used, and
3. The required density is obtained throughout the full depth and width of each layer.

Whatever the method used, any embankment inaccessible to large compacting equipment shall be compacted with small mechanical or vibratory compactors.

Moisture content. Within the limits described in the following, the Contractor shall adjust moisture content during compaction to produce a firm, stable embankment. The Contractor shall not begin compaction until the moisture content is so adjusted.

Under Method B, the moisture content of the Material shall not exceed 3 percent above the optimum determined by the tests described in Section 2-03.3(14)E. If the Material contains too little moisture to compact properly, the Engineer may order the Contractor to water the Material to achieve the range of optimum moisture. See Section 2-07 regarding water.

Under Method C, the moisture content shall not vary more than 3 percent above or more than 3% below optimum determined by the tests described in Section 2-03.3(14)E.

The Engineer may permit the Contractor to place Materials having a higher moisture content than specified in this Section if:

- 1) The Material consists of free-draining rock, gravel, or sand that produces a firm, stable embankment, and
- 2) The excess moisture does not result in impairing the embankment.

However, the Engineer may at any time require the Contractor to return to normal moisture-content Specifications.

The Owner will consider all costs of drying embankment Material to be incidental to other Work and at no additional cost to the Owner. If, however, the Contract includes an aeration Bid item of Work, the Owner will measure for such Bid item of Work as specified in Sections 2-03.4 and pay as specified in Section 2-03.5.

If weather prevents drying excavation or borrow Materials to the required moisture content, the Engineer may order the Contractor to alter normal procedures or equipment to prevent damage to the partial or complete embankment.

The Contractor shall repair any partial or complete embankment that loses stability because of continued hauling across it. Evidence of lost stability shall include pumping or rutting. The Contractor shall also alter 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 shall 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 shall be done at no expense to the Owner.

2-03.3(14)E COMPACTION CONTROL TESTS

In-place density, or field soil density reading, will be determined by one or more of the following methods:

1. ASTM D 1556, Test for Density of Soil In-place by the sand cone method.
2. ASTM D 2167, Test for Density of Soil In-place by the rubber balloon method.
3. ASTM D 2922, Test for Density of Soil In-place by the nuclear method.

The Contractor shall provide the Engineer a minimum 1 Working Day advance notification when field soil or Mineral Aggregate density reading or compaction testing is required.

Laboratory densities may be determined by one of the following methods:

- 1) ASTM D 698, Moisture-Density Relations of Soils and Soil-Aggregate Mixtures.
- 2) ASTM D 4253, Maximum Index Density of Soils using a Vibratory Table.
- 3) ASTM D 1557, Laboratory Compaction Characteristics of Soil Using Modified Effort.

ASTM D 698 will be used for computing the maximum density of all fill soils except for those granular soils yielding, in the opinion of the Engineer, an unsatisfactory moisture-density curve. In that case the maximum density will be determined by the method specified in ASTM D 4253. Compaction to ASTM D 1557 standards will only be used when so specified in the Contract.

The Contractor shall excavate pits for density sampling at locations designated by the Engineer. Density sampling will be performed by Owner forces.

Degree of compaction in trench backfill shall be as specified in Section 7-17.3(3)B. All other fills and earth embankments shall be compacted as specified in Section 2-03.3(14)D.

2-03.3(14)F UNSUITABLE FOUNDATION EXCAVATION

When the Contract or the Engineer requires it, the Contractor shall excavate unstable natural ground before building any embankment over it. This unstable material may include peat, muck, swampland, buried logs and stumps, or other material not fit for an embankment base. The Contractor shall excavate such material to the boundaries set by the Engineer.

The work will not be considered unsuitable foundation excavation if the materials:

1. Came from the roadway cut, ditch, or channel-change prisms as defined by Section 2-03.1(2).
2. Resulted from structure excavation (Section 2-09).
3. Are covered in Section 2-03.3(3).

Materials excavated from the roadway or channel change prisms will not be classified as unsuitable foundation excavation as defined by Section 2-03.1(2) unless the removal is accomplished by dragline operation or by special excavation methods requiring different equipment from that used for roadway excavation, as determined by the Engineer.

2-03.3(14)G DISPLACEMENT OF UNSUITABLE FOUNDATION MATERIALS

If the Contract requires it, the Contractor shall displace or remove any overburden of peat, muck, or other unstable material to permit placing the embankment on underlying firm ground. The Engineer will determine the elevation at which the ground is firm enough to support the embankment.

To displace such material, the Contractor shall use methods the Engineer requires. If this work upheaves overburden material outside the slopes of the new fill, the Contractor shall level the Material to make it presentable or to make final grade.

2-03.3(14)H BACKFILLING

When water fills an area after the removal of soft or unstable materials, the Contractor shall, if possible, drain the site so that backfill can be compacted. If drainage is not possible, the Contractor shall use granular Material for backfilling in water, including areas where blasting has displaced the soft material. The Contract may require other backfilling methods.

2-03.3(14)I PREFABRICATED VERTICAL DRAINS

If the Contract requires it, the Contractor shall install prefabricated vertical drains and a sand drainage blanket to stabilize the soft or unstable Material that overlays firm ground as indicated in the Contract.

The prefabricated drain shall consist of a continuous plastic drainage core wrapped in a non-woven geotextile Material as specified in the Contract.

The drains shall be free of defects, rips, holes, or flaws. During shipment and storage, the drain shall be wrapped in a heavy duty protective covering. The storage area shall protect the drain Material from sunlight, mud, dirt, dust, debris, and detrimental substances. A Manufacturer's Certificate of Compliance shall be provided for all drain Materials delivered to the project Site.

Vertical drains shall be staked by the Contractor and constructed prior to embankment construction.

Prior to installation of vertical drains, a sand drainage blanket shall be placed on the ground surface for use as a working platform. This platform shall have a minimum depth of 2 feet and shall consist of uncompacted Material meeting the requirements of Section 9-03.13(2).

Vertical drains shall be installed with equipment which cause a minimum of subsoil disturbance. A mandrel or sleeve shall be advanced through the subsoil using vibratory, constant load, or constant rate of advance methods. The mandrel shall have a maximum cross-sectional area of 14 square inches, shall protect the prefabricated drain Material from tears, cuts, and abrasions during installation, and shall be provided with an "anchor" plate or rod. The "anchor" plate or rod shall provide sufficient strength to prevent the soil from entering the bottom during installation and shall anchor the bottom of the drain at the required depth when the mandrel is removed. Use of falling weight impact hammers or jetting will not be allowed within the compressible subsoil to be drained.

The prefabricated drains shall be installed vertically from the working surface to the required elevations and in a sequence that do not require equipment to travel over previously installed drains. The Contractor shall provide the Engineer with a suitable means of verifying the equipment is plumb, and determining the depth of the drain at any time. The equipment shall not deviate more than 0.25 inch per foot from plumb.

Splices or connections in the prefabricated drain Material shall be done in a professional manner to ensure continuity of the wick Material. The prefabricated drain shall be cut to leave at least 6 inches protruding above the working platform at each drain location.

Where obstructions are encountered which cannot be penetrated, the Contractor shall abandon the hole. A maximum of two attempts shall be made to install a new drain within 18 inches of the obstructed hole. If the following two attempts also encounter an obstruction, the Contractor shall promptly notify the Engineer. Drains that otherwise deviate from the Drawing location by more than 6 inches, or that are damaged or improperly installed, will be rejected.

Installation of the drains should consider and be coordinated with the geotechnical instrumentation shown on the Drawings. Special care shall be taken when installing drains near instrumentation already in place. Replacement of instrumentation damaged by the Contractor shall be the responsibility of the Contractor.

The Contractor shall demonstrate that the equipment, method, and Materials produce an acceptable installation in accordance with these Specifications. For this purpose, the Contractor will be required to install trial drains at Engineer designated locations within the Work area.

At least 10 Working Days prior to the installation of the drainage wicks, the Contractor shall submit to the Engineer, details of the sequence and method of installation. The submittal shall, at a minimum, contain the dimensions and length of mandrel, a detailed description of the proposed method(s) for overcoming obstructions, and the proposed method(s) for splicing drains.

Submittal review by the Engineer does not relieve the Contractor of the responsibility to install prefabricated vertical drains in accordance with the Contract. If, at any time, the Engineer considers the method of installation does not produce an acceptable drain, the Contractor shall alter the method and equipment as necessary.

2-03.3(14)J EMBANKMENTS AT BRIDGE AND TRESTLE ENDS

This work consists of filling around the ends of trestles and bridges, the area defined in Section 1-01.3 as bridge approach embankment. The Contractor shall begin and complete this work as soon as possible after each bridge is completed or when the Engineer requires.

The Contractor shall select fill Material from the excavation sources elsewhere on the project. Bridge Approach Embankments shall be compacted to at least 95 percent of the maximum density as determined by the tests described in Section 2-03.3(14)E. In any embankment area where piles are to be installed, the Contractor shall remove all solid material, rocks, broken concrete, etc., larger than 3 inches across that would interfere with pile driving.

To prevent the bridge from being distorted or displaced, the Contractor shall place Material evenly around all sides and parts of the Structure. The Contractor shall not backfill any abutment prior to placing the superstructure. After the superstructure is in place, small compactors may be required. Embankments shall be layered and compacted concurrently at either end of the Structure. The difference in embankment height from one end to the other shall not exceed 2 feet.

The Contractor shall build the embankment under the bridge to the dimensions shown in WSDOT Standard Plan no. H-9 unless detailed otherwise in the Contract.

2-03.3(14)K GRAVEL BORROW INCLUDING HAUL

When the Contract requires, the Contractor shall use gravel borrow meeting the requirements of Sections 9-03.12(7) and 9-03.14 to:

1. Build embankments.
2. Backfill excavation of unsuitable foundation material.
3. Backfill below-grade excavation.

2-03.3(15) AERATION

The Contractor shall use methods known to be effective in building embankments with wet Materials. Such methods include open ditching to drain excavation areas or alternating layers of wet and dry Materials.

Aeration Equipment. The Engineer may direct the Contractor to use aeration equipment in roadway excavation, borrow sites, or embankments. The Owner does not guarantee the moisture-reducing effectiveness of any single type of equipment. The Engineer may, however, require the use of any type equipment believed to be the best to aerate a given area.

If the Contractor uses any of the following types of equipment, it shall meet these minimum requirements:

Heavy duty power grader. This machine shall have a moldboard measuring 12 feet long, 24 inches high, and 3/4 inch thick. Each grader shall carry its maximum number of standard scarifier-rippers or discs.

Heavy duty gang plow. It shall have at least five 16-inch bottoms. Its tractor shall be able to move no less than 1-1/2 miles per hour while plowing at least 9 inches deep through fairly wet material.

Heavy duty tandem discs. This machine shall cut a swath at least 8 feet wide with discs no less than 28 inches in diameter. Its tractor shall be able to turn fairly wet material at least 6 inches deep while moving at 2 miles per hour or more.

Heavy duty self-propelled, rotary pulverizer. This machine shall have paddles attached to a transverse shaft. It shall travel 1-1/2 miles per hour or more while aerating a swath at least 6 feet wide to a depth of 6 inches.

The Contractor shall not use any aerating equipment listed above in tandem nor use any of this equipment to carry out other Bid items of Work while aerating.

The Engineer may halt aerating work when weather conditions prevent acceptable results.

2-03.3(16) END SLOPES

The Engineer will determine when and where to build end slopes, whether these occur at the beginning or end of a project, at the borders of excavation or embankments, at bridge ends, or elsewhere. The Contractor shall build end slopes not detailed on the Drawings to the line and grade staked by the Engineer regardless of center line limits shown on the Drawings. All work to complete and maintain these end slopes shall be considered as work to be performed under the Contract.

2-03.3(17) SNOW REMOVAL

If snow is deep enough to interfere with the work that covers a cut or an embankment, the Contractor shall remove snow to outside the slope stakes. Snow removal shall be done at least 100 feet ahead of excavation and embankment work.

2-03.3(18) STEPPED SLOPE CONSTRUCTION

When indicated on the Drawings, the Contractor shall shape slopes cut in soft rock to a stepped pattern conforming closely to the typical cross-section shown on the Drawings. Stepped slopes shall meet these requirements:

1. Each step shall be 1 to 2 feet high.
2. The horizontal depth of each step depends on its relationship to the staked slope ratio. The approximate midpoint of each horizontal tread shall occur on the staked slope line.
3. The treads shall be approximately level in all directions.
4. The ends of the steps shall be blended into the natural ground, with loose Material removed from transitional areas.
5. If the Contractor cannot rip a rock outcropping within a cut, the steps shall be blended into the rock.
6. Large rocks and Material that may fall into the ditch line or onto the roadway shall be removed, but scaling is not required.

The compaction for seeding requirements of Section 8-01.3(5)C shall not apply to stepped slope construction.

2-03.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Excavation of the class specified will be 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 roadway Material which has become unsuitable because of the Contractor's neglect, negligence or method of operation.

Borrow will be measured by the ton at the point of delivery in accordance with Section 1-09.1.

Unsuitable foundation excavation will be measured by the cubic yard in its original position by cross sectioning.

Prefabricated vertical drains will be measured by the vertical foot from the top of the working table to the bottom of the holes.

Sand borrow for drainage blanket will be measured by the cubic yard or by the ton as indicated in the Bid Form, provided that moisture in excess of 8 percent will be deducted in ascertaining the pay quantities when measured by the ton.

Embankment compaction will be measured by the cubic yard of embankment Material compacted pursuant to Section 2-03.3(14)B, or pursuant to Method B or Method C in Section 2-03.3(14)D. Quantities will be computed based upon measurements taken to the neat lines of the staked cross section and no allowance will be made for settlement.

When existing Material in a cut section is stabilized by scarifying, aerating and compacting, measurement for the embankment compaction will be based upon the length and width of cut section compacted and a maximum depth of 6 inches.

Measurement for depth of common excavation will be as specified in Section 2-03.1(2).

Measurement for stepped slope excavation will be by the cubic yard as defined by the staked slope line and the existing slope.

2-03.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 2-03 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

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" shall include all costs for the work described in Section 2-03 and not otherwise provided for hereinafter. If the Engineer orders excavation more than 3 feet below subgrade, that portion more than 3 feet below subgrade will be paid as extra work per Section 1-09.4. Payment for such types and classes of excavation listed above shall be full compensation for excavating, loading, hauling, stockpiling, placing as backfill, or disposing of the Material as specified herein.

Payment for embankment work to bring the subgrade in sidewalk areas to the level of the top of the sidewalk will be per Section 2-03.5. Payment for excavation of the subgrade to the depth of the sidewalk will be paid per Section 8-14.

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 in accordance Section 1-04.1(2).

3. "**Unclassified Borrow**", per ton.

4. "**Borrow (Type)**", per ton.

The Bid item prices for "Unclassified Borrow" and for "Borrow (Type)" shall include all costs for the work required to excavate, haul, stockpile, and place the Material as indicated in the Contract. Compaction of borrow Material will be paid as "Embankment Compaction".

5. "**Embankment Compaction**", per cubic yard.

The Bid item price for "Embankment Compaction" shall include all costs for the work required to compact embankments.

Compaction of approved on-site excavated native Material and selected Material used for compaction of embankment will be paid as "Embankment Compaction" per cubic yard, as indicated above.

As indicated in Section 2-03.3(14)D, when the Engineer directs a change in embankment 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 in accordance with Section 1-04.6.

6. "**Unsuitable Foundation Excavation**", per cubic yard.

The Bid item price for "Unsuitable Foundation Excavation" shall include all costs for the work required to excavate or displace unsuitable foundation Material only by the methods set forth in Section 2-03.3(14)F and 2-03.3(14)G. These costs shall include disposal of the unsuitable Material, and leveling the upheaved Material outside of the embankment slopes when the unsuitable Material is displaced. Replacement Material will be paid 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.

7. "**Drain, Vertical Sand**", per vertical foot.

The Bid item price for "Drain, Vertical Sand" shall include all costs for the work required to excavate the drain holes and for selecting, loading, hauling and placing the Material.

8. "**Drainage Blanket, Sand**", per ton or per cubic yard.

The Bid item price for "Drainage Blanket, Sand" shall include all costs for the work required for processing, hauling, and placing the Material.

9. "**Stepped Slope Construction**", per cubic yard.

The Bid item price for "Stepped Slope Construction" shall include all costs for the work required to build stepped slopes including disposal of excess material.

10. **Other payment information**

All costs for excavation, backfill, and recompaction of sampling pits shall be considered included in the Bid item prices for the various Bid items and no separate or additional payment will be made.

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 shall take place after recompaction. Engineer expenses related to retesting will be charged to the Contractor as specified in Section 1-05.7.

Payment for overbreak Material used in lieu of borrow will be made at the Bid item price for the type of borrow specified.

If the Contractor has dressed a cut per Section 2-03.3(1) 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 shall be at the Contractor's sole expense and at no additional cost to the Owner.

All work required to complete slope treatment, including excavation, haul, and slope rounding, shall be included in the Bid item price for roadway excavation.

All costs for building terraces as specified in Section 2-03.3(14)A shall be included in the Bid item prices for other applicable Bid items.

All costs and expenses involved in drying embankment Materials with whatever method is appropriate shall be considered incidental to the various Bid item prices and at no additional cost to the Owner.

If the Bid Form does not include Mineral Aggregate (Type) for rock embankment construction, payment will be as provided in Section 1-04.1(2).

The costs of pumping or digging temporary drainage ditches as required per Section 2-03.3(14)H shall be incidental to and included in other Bid items of Work that apply and shall be at no additional cost to the Owner.

Costs related to all bridge embankment and trestle work described in Section 2-03.3(14)J shall be incidental to the Work and shall be included in the Bid item prices for applicable Bid items.

All costs to remove, haul, and dispose of overbreak material which is deemed unsuitable for use by the Engineer shall be at the sole expense of the Contractor.

Payment for aeration shall be incidental to and included in the excavation and embankment Bid items.

When excavated Material unexpectedly falls short of the amount 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 amount of excavated Material deemed suitable by the Engineer is wasted by the Contractor, the Contractor shall provide replacement material of the type acceptable to the Engineer at the Contractor's sole expense.

Any partially or fully completed embankment or stepped slope that loses stability and slides due to Contractor operations, such as continued hauling across the embankment or undercutting the slope, shall be fully restored by the Contractor at the Contractor's sole expense.

Should the Contractor fail to protect an aerated area prior to onset of inclement weather, all costs for additional aeration required to restore the area to its previous aerated condition shall be at the Contractor's sole expense.

Snow removal outside of roadways shall be at the sole expense of the Contractor. Payment for snow removal within roadways shall be in accordance with Section 1-07.23.

The cost of any permits and approvals required in this Section shall 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 embankment compaction, shall be included in the Bid item prices of the various applicable Bid items.

SECTION 2-04 HAUL

2-04.1 DESCRIPTION

Section 2-04 describes work consisting of transporting excavated Material from its original site or borrow site to its final resting place on the project Site or to a waste or recycle site.

2-04.2 RESERVED

2-04.3 CONSTRUCTION REQUIREMENTS

Off-highway earthmoving equipment shall not haul on or across any street not being improved in the Contract.

2-04.4 MEASUREMENT

Haul work will not be measured.

2-04.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 2-04 will be considered incidental to the various Bid items comprising the Work and no separate or additional payment will be made.

SECTION 2-05 STRUCTURAL DEMOLITION

2-05.1 DESCRIPTION

This section describes work related to demolition of an existing structure as indicated on the Drawings. It is the Contractor's responsibility to determine the actual demolition quantities and limits of work.

2-05.2 RESERVED

2-05.3 CONSTRUCTION REQUIREMENTS

Demolition shall be done safely and in a manner such that portions of the structure that are to remain will not be damaged. Federal, local and state codes, including WAC 296-155 "Safety Standards for Construction Work" Part S "Demolition", shall be observed at all times. Explosives shall not be used. The Contractor shall review all Drawings of the existing structure that are noted in the Contract.

Drawings for the existing structure are named **fill-in and are available at:

Records Vault

Seattle Public Utilities – Seattle Municipal Tower

700 – 5th Avenue, 47th Floor

PO Box 34018

Seattle, Washington 98124-4018

FAX (206) 684-7396

For the purposes of this section "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 them.

Prior to beginning demolition, the Contractor shall perform an engineering survey, by a Competent Person, 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 shall also be similarly checked. The Contractor shall have in writing, evidence that such a survey has been performed.

Hazardous materials, including but not limited to, asbestos, lead or other heavy metals, flammable or explosive materials shall be removed or safely contained prior to beginning demolition.

Any material to be removed that will cause dust to be formed shall be sprinkled with water to keep dust controlled.

Demolition shall not proceed until electric, gas, water, steam and other utilities are relocated, shut-off, capped or otherwise controlled.

The Contractor shall demonstrate to the satisfaction of the Engineer that the methods and equipment for demolition are safe, adequate for the intended purpose and shall provide satisfactory results. Contractor shall submit to the Engineer for approval a demolition plan with Shop Drawings showing:

- (1) Each stage in the demolition required by the Contract.
- (2) Methods and equipment to be 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 injuries due to the demolition activities.
- (4) Methods and equipment to be 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) Identify any adjoining structures that could be compromised by demolition activities and supply support system plan. The support system plan shall be prepared by a registered Professional Engineer per section 1-05.3(2)F and submitted to the Engineer for review and approval.
- (7) Communications protocol between all personnel working within the area of influence of the demolition.
- (8) A copy of the Competent Person's engineering survey of the demolition and the demolition plan shall be maintained on the project Site.

Demolition shall not begin without the Engineer's written approval of the demolition plan and support system plan. Prior to beginning demolition, a meeting to review the demolition plan shall be held. Workers performing the demolition, others working within the sphere of influence of the demolition, Contractor's Competent Person and the Engineer shall be in attendance.

During demolition, the Contractor's Competent Person shall 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 shall stop until such hazards are corrected.

If hazardous materials not previously identified are found during demolition, then demolition shall stop until the newly identified hazards are safely contained or removed and are addressed in a revised demolition plan.

2-05.4 MEASUREMENT

Measurement for "Demolition (Structure Name)" will be by lump sum.

2-05.5 PAYMENT

The Bid Item price for "Demolition (Structure Name)" shall be full compensation for all labor, material, and equipment required to complete the removal, hauling, disposal, and salvage work as specified and as indicated on the Drawings.

All costs associated with the preparation and implementation of the demolition plan and the support system plan shall be included in the Bid item price of "Demolition (Structure Name)".

No adjustments other than for approved changes shall be made in Bid item price for "Demolition (Structure Name)", even though items not listed above may be indicated in the Drawings or elsewhere in these specifications, or encountered in field.

SECTION 2-06 SUBGRADE PREPARATION

2-06.1 DESCRIPTION

Section 2-06 describes work consisting of the preparation of subgrade for new and proposed streets, alleys, driveways, sidewalks, pavements, and other public places upon which surfacing is to be placed. All subgrade preparation work shall be in accordance with the Contract and in close conformity with the lines, grades, and typical cross sections indicated on the Drawings, in the Standard Plans., or as established and staked by the Engineer.

Subgrade preparation for sidewalk shall be in accordance with Section 8-14.3(2).

2-06.2 MATERIALS

Materials shall meet the requirements of the following section:

Geotextile	9-37
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The geotextile used for subgrade stabilization shall be as specified in Section 9-37, Geotextile – Soil Stabilization.

2-06.3 CONSTRUCTION REQUIREMENTS

2-06.3(1) SUBGRADE FOR SURFACING

In preparing the roadbed for surfacing, the Contractor shall:

1. Remove from the roadbed, immediately before placing surfacing Materials, all brush, weeds, vegetation, grass and other debris.
2. Dispose of all debris.
3. Drain water from all low spots or ruts.
4. Shape the entire subgrade to a uniform surface running reasonably true to the line, grade, and cross-section staked by the Engineer.
5. If necessary, the Contractor shall process the subgrade in cut areas to remove materials too coarse for mechanical trimming and recompaction.
6. Compact the subgrade to a depth of 6 inches. Compaction shall achieve 95 percent of maximum density determined by tests described in Section 2-03.3(14)E. All portions of the surface on the subgrade which are inaccessible to large compactor units shall 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 shall dispose of this excess by placing it where the subgrade lacks Material or by wasting it.
8. Add Materials where the subgrade needs more to bring it up to grade. The Contractor shall water and compact these added Materials as needed to produce a true finished subgrade.
9. Underground work in the area of the subgrade shall be completed and properly backfilled and compacted before subgrade work is started. This shall include the Work and work performed by the Owner or others.
10. If the underlying subgrade is soft, spongy, or yielding and does not permit proper compaction, the Contractor shall stabilize the subgrade per Section 2-06.3(3).
11. Where normal crown sections are being constructed, stakes will 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. It shall be the responsibility of the Contractor to set centerline grades which may be needed except in cases where the street grades are warped or otherwise do not conform with the typical section, in which case the Engineer will set the stakes.
12. The full width of the roadway shall be kept well sprinkled with water before and during process of rolling the subgrade.
13. Grade and line, throughout the stages of constructing the subgrade, shall be secured from the reference stakes. The subgrade shall be maintained in the finished condition until the first course of surfacing is placed upon it.

If the Contract requires trimming equipment, the equipment shall:

1. Maintain the grade and transverse slopes automatically through sensors that respond to reference lines on both edges of each roadway.
2. Create a smooth, uniform surface free from chatter and ripples.
3. Be subject to the Engineer's approval.

2-06.3(2) SUBGRADE FOR PAVEMENT

When Drawings call for concrete pavement to be placed directly on the subgrade, the Contractor shall prepare the subgrade as outlined in Section 2-06.3(1). This work shall include:

1. Removal of 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. When the pavement is to be constructed over an old subgrade composed of gravel and macadam, the old gravel or macadam shall be scarified and the Material shall be uniformly spread and thoroughly compacted.
3. Compaction of subgrade shall 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.
4. 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.
5. The subgrade shall be compacted both before and after the forms are set.

2-06.3(3) SUBGRADE STABILIZATION

When the density of the native earth in a roadway section is determined by the Engineer to be less than that required for the method of compaction specified for the earth embankment, or where the nature or condition of the earth below the designated subgrade is such that it may impair the stability of the subgrade, the Contractor shall stabilize the subgrade by the method selected by the Engineer from among the following:

Method 1: Thoroughly loosen the earth to a depth of 6 inches by scarifying, aerating or watering as applicable, and compact to the required density, or;

Method 2: Excavate below grade to the limits and depth designated by the Engineer and by whose direction the excavated Material shall be temporarily stockpiled for use as backfill, placed in adjacent embankments, or, if unsuitable, wasted and replaced with selected Material or other designated backfill Material. If deemed necessary by the Engineer, the earth at the bottom of the excavation shall be loosened to a depth of 6 inches by scarifying, aerating or watering, as applicable, and compacted to the required density. The excavated area shall then be backfilled with the previously excavated and stockpiled, or selected, Material or with such other Mineral Aggregate backfill as may be ordered by the Engineer. Backfill shall be placed and compacted in successive layers in accordance with the compaction method required for embankments under the provisions of the Contract. Excavation below finish grade as set forth above shall be classified the same as the excavation above final grade.

Method 3: Bring the exposed soil surface to the required line, grade and cross section. All protruding objects (rocks, sticks, debris) shall be removed and all holes and depressions filled. The Engineer may require additional depth of excavation and shaping the soil to the required line, grade and cross section. The geotextile, specified in the Contract (see Section 9-37), shall be placed as shown on the Drawings and shall extend a minimum of 2 feet beyond the placement of the fill Material. The geotextile sheets shall overlap a minimum of 2 feet and shall be placed in a manner such that the preceding roll overlaps the following roll in the direction of fill Material placement. If a geotextile is torn or damaged during construction, the damaged area shall be repaired by placing a large enough piece of geotextile to cover the damaged area and meet the overlap requirement in a manner acceptable to the Engineer. Fill Material shall be placed first on the top layer of geotextile to prevent Material from entering between and separating the overlapping geotextile layers. See Section 2-12 for geotextile construction requirements. Construction vehicles shall be limited in size and weight such that the rutting depth in the initial lift of fill above the geotextile is not greater than 2 inches. Compaction of the overlying fill shall be done in the static or non-vibratory mode. Wrinkles, folds or creases shall be kept to a minimum. The Engineer will approve the geotextile installation before it is covered with fill.

NOTE: There are other alternate methods of sub-grade stabilization which include the addition of lime or Portland cement mixed into subgrade material. The Contractor may propose an alternate method by submitting the alternate method to the Engineer at least 3 Working Days in advance. Should a Bid item not exist for the alternate method, payment shall be in accordance with Section 1-04.1(2).

2-06.3(4) MAINTENANCE AND PROTECTION OF SUBGRADE

Once prepared, the subgrade for surfacing shall be maintained in a finished condition until the first course of crushed rock base or the finish pavement surface is ready to be placed. The Contractor shall maintain the subgrade by blading and compacting as frequently as may be necessary. All cuts, ruts, and breaks in the surface of the subgrade shall be repaired in a manner acceptable to the Engineer prior to placing surfacing, treated base, or paving Materials.

The Contractor shall take steps necessary to protect the prepared subgrade from inclement weather, the Contractor's operations, and public traffic prior to the placement of crushed surfacing, gravel base, pavement, etc. These steps shall include, but are not limited to, the use of plastic sheeting to protect the subgrade from inclement weather, planking to protect the subgrade from the Contractor's equipment, and the placing of paving Materials or base Materials from an adjacent lane in lieu of operating equipment over the prepared subgrade. Traffic detours shall comply with Sections 1-07.23 and 1-10.

Hauling over the finished subgrade shall be limited to that which is essential for construction purposes. Equipment used for transporting Materials over the prepared subgrade shall 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 shall be removed from the Work upon request of the Engineer. If approved by the Engineer, the Contractor may plank the subgrade before hauling Materials or operating equipment over it.

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 in order to construct a crushed surfacing base course, treated base, or finished pavement, the Engineer may order the use of a ballast Material to stabilize and protect the subgrade prior to paving. Stabilization shall be by Method 2 of Section 2-06.3(3) except the roadway ballast shall be either Mineral Aggregate Type 2 or Type 14, whichever is designated by the Engineer. Roadway ballast shall be used for subgrade stabilization only when designated by the Engineer.

2-06.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Subgrade stabilization by Method 1 in Section 2-06.3(3) will be measured by the cubic yard of embankment compaction in accordance with Section 2-03.4.

Subgrade stabilization by Method 2 in Section 2-06.3(3) will be measured by the cubic yard of the same class of excavation as that above grade, in accordance with Section 2-03.4.

Subgrade stabilization by Method 3 with geotextile in Section 2-06.3(3) will be measured by the square yard installed. Measurement will not be made for extra fabric required to meet overlap requirements. Additional excavation, if required in Method C, will be measured by the cubic yard in accordance with Section 2-03.4.

2-06.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 2-06 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

Unless otherwise specified in the Contract, all costs for the subgrade preparation shall be included in the Bid item prices Bid for the various Bid items included in the Contract.

Subgrade stabilization by Method 1 in Section 2-06.3(3) will be paid as embankment compaction per Section 2-03.5.

Subgrade stabilization by Method 2 in Section 2-06.3(3) will be paid as excavation of the same class as the excavation above grade, in accordance with Section 2-03.5.

Payment for the geotextile for stabilization will be made in accordance with Section 2-12.5.

Mineral Aggregate backfill of the Type ordered by the Engineer used in lieu of selected native material will be paid as "Mineral Aggregate, (Type)" in accordance with Section 1-04.1(2)..

SECTION 2-07 WATERING

2-07.1 DESCRIPTION

Section 2-07 describes work consisting of furnishing, hauling, and applying water for compacting embankments, constructing subgrade, placing of crushed surfacing, dust control, flushing, testing, and as the Contract requires.

2-07.2 RESERVED

2-07.3 CONSTRUCTION REQUIREMENTS

2-07.3(1) GENERAL

The Contractor shall apply water upon streets by means of tank trucks equipped with spray bars. Spray controls shall ensure that the water is applied uniformly and at a rate of coverage for the intended purpose. When the source of water is hydrants within the Work area, the Contractor may, with approval of the Engineer, apply water by means of a hose and reduced pressure principle backflow assembly (see Section 9-30.16(5)) approved by the Washington State Department of Social and Health Services ("WSDSHS certification") directly connected to the hydrant. The Contractor shall have a copy of the "WSDSHS certification" on board the vehicle drawing water from the hydrant. Before drawing water, the Contractor shall first obtain approval of the assembly and hook-up by making the advance notification specified in Section 1-07.28 item 7D. Contractor shall furnish hose, equipment, or tank truck necessary to do the required watering, and strictly comply with the provisions of the permit.

2-07.3(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 to be used on a project is subject to approval by the Engineer. When the source of water is to be a hydrant, a hydrant use permit shall be obtained from, and use fees paid, when applicable, to the Water Service Section SPU Water Operations.

The Contractor shall use only those water sources or hydrants approved by the Engineer, and shall 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 206-684-5800, option 2, or by visiting the 31st floor, Seattle Municipal Tower, 700 Fifth Avenue, Seattle, Washington.

2-07.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Water used in conjunction with work involving the water distribution system will not be measured.

Water used in conjunction with work other than the water distribution system will be measured.

2-07.5 PAYMENT

All costs associated with obtaining a hydrant use permit and providing and applying water to Work not involving the water distribution system shall be 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 shall be 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 will be based on the prevailing rates as listed in Seattle Public Utilities' current standard charges.

SECTION 2-08 ROCK FACING

2-08.1 DESCRIPTION

Section 2-08 describes work consisting of constructing, rebuilding, and relocating rock facings used for erosion control or the containment of cuts and embankments. Work shall be performed in accordance with Standard Plan no. 141, and as designated in the Contract. Rock facing used for fire hydrant wall requirements as indicated on Standard Plan no. 313 shall comply with the requirements of Section 2-08.3(5).

2-08.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Rock Facing Material	9-03.17
2" to 4" Quarry Spall	9-13.7

Crushed gravel with at least 90% of the total required quantity having two or more fractured surfaces each piece and also meeting the grading requirements of quarry spalls may be used in lieu of ledge rock.

2-08.3 CONSTRUCTION REQUIREMENTS

2-08.3(1) ROCK FACING

2-08.3(1)A GENERAL

Rock facings for other than fire hydrant wall requirements per Standard Plan no. 313 shall be constructed, rebuilt, or relocated at the locations and to the limits indicated on the Drawings and shall be limited to 8 feet in height. The subgrade elevation and location of the rock facing shall be staked by the Engineer or, in the absence of such staking, shall be as described in the Contract.

Rock facing up to a 5-foot high wall will require rock from an approved source. Rock facing over 5 feet high will require rocks to be tested for quality as specified in Section 9-03.17 and submitted to the Engineer.

Rock facing shall be used only against a slope which is verified stable without the addition of rock facing. This verification submittal shall meet the requirements of Section 1-05.3(12).

2-08.3(1)B ROCK FACING KEYWAY

The first step in rock facing construction, after clearing and general site preparation, is to excavate a keyway for the base course of rock facing. The keyway shall be 3 to 12 inches deep (as shown on Standard Plan no. 141) extending over the entire length of the rock facing, and shall 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 shall be at least 40% of the height of the proposed rock facing.

2-08.3(1)C ROCK SELECTION

The Contractor shall have sufficient working space so individual rock selection from a number of stockpiled rocks can satisfy the needs of the project. The stockpile area shall not be placed on traffic lanes or driveways. Rocks shall be of a generally cubical, tabular or rectangular shape, as opposed to rounded or tetrahedral forms, and shall be placed to match as closely as possible the spaces afforded by the next lower course of rocks. One-man rocks shall not be used on rock facings more than 3 feet high.

2-08.3(1)D ROCK PLACEMENT

The thickness of the rock facing, including the filter layer behind it, shall be approximately 40% of its height. Where required in the Contract, a 6-inch drain pipe shall be installed in a keyway behind the rock facing, with sufficient gradient to initiate flow, and be piped to the curb, catch basin, or outfall as shown on the Drawings.

The Contractor shall 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 no. 141. There shall 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 shall place and compact filter Material behind and to the top of the rocks previously placed.

The Contractor shall use rock sizes as specified in Section 9-03.17, using the largest rocks at the bottom and progressively smaller rocks toward the top. The rocks shall be placed so that there are no continuous joint planes in either the vertical or lateral direction. Each rock shall bear on at least two rocks below it, shall have at least 3 contact surfaces, and shall be set stable with no rocking.

Rocks shall be placed in a manner that there is some bearing between flat rock faces rather than on joints. Horizontal joints between rock courses shall slope downward towards the embankment being protected.

The batter of the rock facing shall be 1:4 (horizontal to vertical) and shall 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 four inches in dimension, exist in the face of the rock facing, they shall 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. But if there is no rock contact within the rock facing thickness, some resetting is required. If there is a void measuring six inches or more near the inside face of the rock facing, the void shall be "chinked" with a smaller piece of rock. This filler rock shall be placed with the longest dimension perpendicular to the face.

If stability of an unprotected cut slope is of concern, the rock facing shall be constructed in short lengths. The final course shall be an even appearance and shall be placed so as to minimize erosion of the protected embankment.

2-08.3(1)E FILTER MATERIAL

The Contractor shall 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 shall be a minimum 6 inches in thickness.

2-08.3(1)F SLOPE ABOVE ROCK FACING

The slope of the terrain above the rock facing shall be no steeper than 3:1 (horizontal to 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, shall require a rock facing design by a licensed civil engineer in accordance with Section 1-05.3(12) be submitted to the Engineer. The unimproved area above the rock facing shall be hydroseeded for erosion control.

2-08.3(2) REBUILD ROCK FACING

This work shall consist of dismantling an existing rock facing and reconstructing the facing in the same location. Reconstruction work shall be in accordance with the requirements of Section 2-08.3(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 9-03.17. Additional rock ordered by the Engineer to complete the facing shall be furnished by the Contractor meeting the requirements of Section 2-08.2. Existing drainage rock behind the existing rock facing shall be replaced with 2 inch to 4 inch quarry spall for the rebuilt rock facing.

The Contractor shall sequence the removal and rebuild in such a manner as 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 shall proceed in a manner providing the shortest length of unfinished rock facing full height. The removal and rebuild shall be coordinated as to limit the exposure of unrocked embankment.

2-08.3(3) RELOCATE ROCK FACING

This work shall consist 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 shall be in accordance with the requirements of Sections 2-08.3(1) and 2-08.3(2). Additional rock ordered by the Engineer to complete the facing shall be furnished by the Contractor meeting the requirements of Section 2-08.2. Existing drainage rock behind the existing rock facing shall be replaced with 2 inch to 4 inch quarry spall for the relocated rock facing.

2-08.3(4) CONTRACTOR QUALIFICATIONS

The rock facing Contractor or Subcontractor shall furnish written evidence of at least 5 rock facing constructions within the 2 years preceding the date of Advertisement for Bids and shall invite inspection of at least two of these rock facings which are similar to the proposed rock facing(s) in the Contract as determined by the Engineer.

2-08.3(5) ROCK FACING FOR HYDRANTS

Where rock facings are required as wall requirements for fire hydrants as indicated on Standard Plan no. 313, the rock facing construction shall be as specified in Sections 2-08.3(1) with the following exceptions:

1. The depth of the keyway shall be 1' - 0" minimum;
2. The filter Material behind the rock facing shall be Mineral Aggregate Type 2 with a minimum thickness of 6 inches.
3. The maximum height of rock facing shall not exceed 5 feet as measured from finished grade to top of rock facing.
4. The sizes of rock facing shall meet the requirements of the Table listed on Standard Plan no. 141 with "h" measured from finished grade to top of rock facing.
5. The maximum slope behind the rock facing shall be no steeper than 2 horizontal to 1 vertical.
6. Finished grade in front of the rock facing shall be with 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 shall bear on at least 3 points without rocking. Voids greater than 4 inch on either the outside face or inside face shall be chinked with a smaller rock ensuring stability of the rock facing.

2-08.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Rock Facing" and for "Relocate Rock Facing" will be by the square foot of rock face for the new rock facing or for the relocated rock facing.

Measurement for "Rebuild Rock Facing" will be 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.

Quarry spall drainage Material will be measured by the ton.

Filter Material other than quarry spall will be measured by the cubic yard in accordance with Section 4-01.4.

2-08.5 PAYMENT

Compensation for the costs necessary to complete the work described in Section 2-08 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "Rock Facing", per square foot.

The Bid item price for "Rock Facing" shall include all costs for the work required to furnish and place the rock, including excavation of keyway and of embankment.

Payment for drainpipe, when called for in the Contract, will be paid as "Subsurface Drain" per 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” shall 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, such excavation as may be necessary to rebuild or relocate the rock facing, disposal of existing rock or drainage aggregate, and furnishing additional drainage aggregate as necessary.

Costs required to import and place additional rock, or replace existing rock in order to rebuild or relocate rock facing shall be addressed per Section 1-09.4.

4. Other payment information

Payment for quarry spall or other filter Material specified for drainage filter Material will be in accordance with Section 4-01.5.

SECTION 2-09 STRUCTURE EXCAVATION

2-09.1 DESCRIPTION

Section 2-09 describes work consisting of excavating, removing, and disposing of all formations, debris, and materials, natural or man-made, irrespective of nature or condition, encountered within the neat line limits defined in Section 2-09.4, such work being necessary for the construction of foundation Structures required to support pump stations, water tanks, transmission towers, bridges, retaining walls, sign support Structures, and other Structures called for in the Contract. All excavation work shall be done in reasonable conformity with the lines, grades, and dimensions indicated on the Drawings or staked by the Engineer. This work also includes stockpiling, hauling, and placing suitable excavated Material in fill areas, and disposing of excess or unsuitable material.

This work shall also include the construction and subsequent removal of shoring or cofferdams, along with necessary pumping, sealing, and dewatering of the excavated area, the furnishing, stockpiling, placing and compacting of selected excavated or imported Material over and around the completed Structure.

Excavation for roadways, sanitary Sewers, Water Mains and their appurtenances, manholes, inlets, catch basins, conduits, utility Structures, and such other related miscellaneous work are covered elsewhere in the Standard Specifications and shall not be considered as Structure excavation.

2-09.2 MATERIALS

Materials shall meet the requirements of the following sections:

Portland Cement	9-01
Aggregate for Portland Cement Concrete	9-03.1
Fly Ash and Admixture for Concrete	9-01.6 and 9-23
Water	9-25

2-09.3 CONSTRUCTION REQUIREMENTS

2-09.3(1) GENERAL REQUIREMENTS

All structure excavation, trenching, and shoring shall be performed in compliance with Chapter 296-155 WAC as well as all other applicable local, State, and Federal laws and regulations.

2-09.3(1)A STAKING, CROSS-SECTIONING, AND INSPECTING

The Contractor shall not begin excavating until after the Engineer has set stakes to locate and/or outline the structure and taken cross-sections to determine how much Material to remove. The Engineer will occasionally inspect material taken from and material remaining in the excavation.

When any foundation excavation is completed, the Contractor shall notify the Engineer, and no concrete or other permanent structural Material shall be placed therein until permission to proceed is given by the Engineer.

2-09.3(1)B DEPTH OF EXCAVATION

Foundation pits shall be excavated to the Contract specified depth unless otherwise directed by the Engineer.

2-09.3(1)C REMOVAL OF UNSTABLE BASE MATERIAL

When the material at the bottom of an excavation is not stable enough to support the Structure as determined by the Engineer, the Contractor shall excavate below grade and replace the unstable material with gravel backfill.

Gravel backfill shall meet the requirements of Section 9-03.12, and shall be placed and compacted in layers not more than 6 inches thick compacted to 95 percent of the maximum density determined by the specified test in Section 2-03.3(14)E.

2-09.3(1)D DISPOSAL OF EXCAVATED MATERIAL

The Material obtained from structure excavation shall be used for backfilling over and around the Structures after they are complete. Material not required for this purpose shall be used in the construction of embankments, stockpiled per Section 2-03.3(10), or if deemed unsuitable by the Engineer per Section 2-03.3(14)F and wasted per Section 1-07.3. Material which meets the requirements for Mineral Aggregates Type 17 or Type 27 shall be selectively stockpiled for use as wall or abutment backfill.

2-09.3(1)E BACKFILLING

Openings made for Structures shall be backfilled with selected Material from the structure excavation or from other excavations. In general, selected backfill Material from the excavation shall be as defined in Section 2-03.3(10).

Alternative Source. When Material from structure excavation is unsuitable for use as backfill, the Engineer may:

1. require the Contractor to obtain Material elsewhere; or
2. require the Contractor to substitute selected Material in accordance with Section 2-03.3(10); or
3. require the Contractor to use other Material covered by the Contract.

If such substitution, as listed above and required by the Engineer, involves work that does not differ greatly from what would otherwise have been required by the Contract, then this work shall be at Bid item prices. If selected materials are not available or Bid item Materials are not in the Contract, work shall be in accordance with Section 1-04.4.

Stockpiling. The Engineer may require the Contractor to selectively remove and stockpile any usable Material excavated for a structure and may replace a specified Mineral Aggregate Type as wall or abutment backfill.

If the Contractor stockpiles excavated Material for use as backfill, it shall be protected with a durable cover from weather damage and from being tainted by intermingling with other materials. If the Material in the stockpile becomes too wet or intermixed with inferior Material, the Contractor shall dispose of it and replace it with an equal amount of suitable Material.

Compaction. Backfill from structure excavation shall be placed and compacted in keeping with these requirements:

- 1) Backfill supporting roadbed, roadway embankments, or any Structure shall be placed in horizontal layers no more than 6 inches thick with each layer compacted to 95 percent of the maximum density determined by the Compaction Control Test, Section 2-03.3(14)E.
- 2) Gravel backfill for drains shall be placed in horizontal layers no more than 12 inches thick, with each layer compacted by at least 3 passes of a vibratory compactor approved by the Engineer.
- 3) All other structure excavation backfill shall be placed in layers no more than 2 feet thick (loose), with each layer compacted and graded so that final settling leaves the backfill flush with surrounding ground.

Timing. Backfill shall not be placed against any 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.

The Engineer may order the Contractor to use structural backfill controlled density fill; or require the Contractor to obtain Material from an alternative source. Material obtained from an alternative source will be paid for in accordance with Section 1-09.4.

Structural backfill controlled density fill (CDF) shall meet the following requirements:

Structural Backfill Controlled Density Fill (CDF)	
Ingredients	Amount per cubic yard
Portland Cement	50lb.
Fine Aggregate Class 1 or 2	3,300 lb. (3,500 lb. when Fly Ash Class C is used)
Air Entrainment Admixture	Per manufacturer's recommendation
Fly Ash	
Class F	300 lb.
Class C	150 lb.
Water	300 lb. (maximum)

The CDF consistency shall be flowable (approximate slump 3 to 10 inches). If requested by the Contractor, the proportions may be adjusted with the approval of the Engineer.

The producer shall provide a Manufacturer's Certificate of Compliance for each truckload of controlled density fill. The Manufacturer's Certificate of Compliance shall verify that the delivered Material is in compliance with the mix design and shall include:

- (1) Project Contract number,
- (2) Date,
- (3) Truck number,
- (4) Batched weights of each ingredient, and
- (5) Signature of the Supplier affirming the accuracy of the information provided.

Compaction of controlled density fill will not be required.

If water is present and prevents the Contractor from properly placing and compacting backfill as determined by the Engineer, it shall be removed by pumping or other means.

Special precautions shall be taken to prevent any wedging action against abutments and wing walls. If the excavation has sloping sides, the slopes shall be broken up by stepping or serrating to prevent wedge action before the backfill is placed. Fill placed around Culverts, piers or underground utilities shall be deposited on both sides to approximately the same elevation at the same time.

Backfill Material for walls shall conform to the requirements for Mineral Aggregate Type 17. It shall be placed in layers not to exceed 12 inches thick, and shall be compacted to 95% of maximum dry density. Compaction control tests shall be performed per Section 2-03.3(14)E.

Foundation backfill conforming to the requirements for Mineral Aggregate Type 2 or Type 14 shall be placed in layers not to exceed 6 inches, with each layer being thoroughly compacted in accordance with Method C as described in Section 2-03.3(14)D before the next succeeding layer is placed.

If the Material used in making the backfill is too dry to permit proper compaction, sufficient water shall be added to allow acceptable compaction results.

2-09.3(2) CLASSIFICATION OF STRUCTURE EXCAVATION

Structure excavation will not be further classified into solid excavation.

2-09.3(3) STRUCTURE EXCAVATION

2-09.3(3)A PRESERVATION OF CHANNEL

When foundations or substructures are to be built in or next to running streams, the Contractor shall:

1. Excavate inside cofferdams, caissons, or sheet piling unless dredging or open pit excavation is permitted.
2. Never disturb the natural stream bed next to the Structure.
3. Backfill after foundations are placed inside cofferdams and any open pit or dredged area behind sheet piling. This backfill shall be level with the original stream bed and shall prevent scouring.
4. Remove any excavation material that may have been deposited in or near the stream so that the stream bed is free from obstruction.
5. Maintain water depth and horizontal clearances required for traffic to pass on navigable streams, furnishing any channel signals or lights required during construction.
6. Place riprap around the outside of cofferdams to repair local scour.

2-09.3(3)B EXCAVATION IN OPEN PITS - EXTRA EXCAVATION

The Contractor may dig open pits or perform extra excavation without shoring or cofferdams if:

1. Footings can be placed in dry material away from running water.
2. The integrity of the completed Structure and its surroundings is not reduced.
3. Worker safety is ensured as required by law.
4. The excavation does not disturb the existing pavement or any other adjacent facilities.

If a slide occurs in an open pit, the Contractor shall remove the slide material. If the slide disturbs an area over which a roadway is to be built, the Contractor shall backfill and compact the site to the original ground line.

The Contractor shall drain or pump any water from the pit, taking care not to soften or adversely impact the pit bottom. If equipment in the pit or inadequate water removal makes the foundation Material unstable, the Contractor shall, at no expense to the Owner, remove and replace it with Material the Engineer approves.

When the Engineer believes ground water flow may impair a concrete footing, the Contractor shall place under it a layer of gravel at least 6 inches thick. Before placing the gravel, the Contractor shall excavate to whatever grade the Engineer requires. This provision shall not apply to the building of concrete seals.

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 shall bear the entire cost of all extra Material and work.

2-09.3(3)C PREPARATION FOR PLACING FOUNDATIONS

When a foundation is to rest on rock, excavation shall penetrate the rock at least 1 foot, or more if the Drawings require, to form a key for the footing. The Contractor shall cut the bottom of the excavation to a firm surface, level, stepped, or serrated as indicated in the Contract, and remove all loose Material.

For an arch abutment, the back face shall be trimmed to true lines so that concrete can be poured against undisturbed material.

If concrete is to rest on any excavated surface other than solid rock, the Contractor shall not disturb the bottom of the excavation. The Contractor shall also remove all loose or soft Material just before pouring the concrete.

Upon completing any foundation excavation, the Contractor shall notify the Engineer. No concrete or other permanent part of the Structure may be placed until the Engineer has accepted the prepared foundation.

2-09.3(3)D SHORING AND COFFERDAMS

All excavations within 15 feet of the Traveled Way and 4 feet or more in depth shall be shored, or protected by cofferdams. All other excavation 4 feet or more in depth shall be shored, or protected by cofferdams or shall meet the open-pit requirements of Section 2-09.3(3)B.

The Contractor shall use cofferdams in all excavation that is under water or affected by ground water.

In using cofferdams or shoring, the Contractor shall:

1. Extend them well below the bottom of the excavation.

2. Provide enough clearance for building forms, inspecting concrete exteriors, and pumping water that collects outside the forms. If cofferdams or shoring tilt or move laterally during placement, the Contractor, at no expense to the Owner, shall straighten or enlarge them to provide the required clearance.
3. Secure the shoring or cofferdam in place to prevent tipping or movement.
4. Place shoring and cofferdams so that they do not interfere with any pile driving required.
5. Vent cofferdams at the elevation commensurate with seal weight design, or as required in the Contract.
6. Remove any bracing that would extend into the concrete being placed.

When work requiring shoring or cofferdam is completed, the Contractor shall:

- 1) Remove all shoring to at least 2 feet below finished ground line.
- 2) Remove all cofferdams to the natural bed of the waterway.

Cofferdams shall be classified as any watertight enclosure that surrounds the excavated area of the Structure and which is 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, the enclosure is dewatered and the Structure is constructed.

If the Contract requires cofferdam and should water conditions at the time of construction be such that in the opinion of the Engineer, seals are not required, the Engineer may specify that seals be omitted.

Excavation outside the cofferdam shall 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 shall anchor or otherwise hold the shoring or cofferdam in place and secure it against tipping or displacement.

Cofferdams shall be constructed so as 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. No timber or bracing shall be left in the cofferdams in such a way as to extend into the substructure.

The Contractor shall submit Shop Drawings prepared by a professional engineer in accordance with Section 1-05.3(12) showing proposed methods and construction details of shoring or cofferdams. The Contractor shall not begin construction until the submittal has been returned by the Engineer. The Contractor shall be responsible for acceptable results. Calculations supporting the shoring or cofferdam design shall be submitted with the Shop Drawings. The Shop Drawings shall contain details such as member sizes, plate thickness, weld details, bolted connections, etc. and shall be based on AASHTO specifications.

2-09.3(3)E BEARING TESTS

The Engineer may stop the excavation to make bearing tests at any time. The Contractor shall assist with these tests in any way the Engineer requires.

During any test period, the Contractor shall, 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.

2-09.3(3)F DEWATERING

When conditions are encountered which, in the opinion of the Engineer, make it impracticable to dewater the foundation pit before placing concrete, the Engineer may require the construction of a concrete foundation seal in accordance with Section 6-02.3(5)D "Placing Concrete in Foundation Seals", and dewatering in accordance with Section 6-02.3(5)E, "Dewatering Concrete Seals and Foundation".

2-09.3(4) CONSTRUCTION REQUIREMENT FOR TRENCH (OR OTHER EXCAVATIONS) 4 FEET OR MORE IN DEPTH

The requirements of Section 2-09 shall apply to all types of excavation in so far as they do not conflict with the excavation requirements found in other Sections of the Contract for a specific kind of Work.

If workers enter any trench or other excavation 4 feet or more in depth that does not meet the open pit requirements of Section 2-09.3(3)B, the trench or excavation shall have a protective system. For safety systems required for trench excavation, refer to Section 7-17.3(1)A7a.

2-09.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

The materials excavated will be measured in their original position by volume in cubic yards. The quantity measured will include only the Material excavated from within the neat line shown on the Drawings, regardless of whether the excavation is made within a cofferdam enclosure or in an open pit.

The vertical neat line limits for measuring the 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 (1) outside of vertical neat lines of a pile cap, footing, or seal, (2) more than 3 feet beyond the roadway side of a wing wall, and (3) more than 1 foot beyond the other sides and end of a wing wall.

The bottom limits for measuring the excavation for pile caps, footings, or seals will be the bottom elevation as shown on the Drawings or as otherwise established by the Engineer. In pile foundations, the material resulting from the swell due to driving piles will not be included in the measured quantity. The bottom limit for a wing wall will follow a line 1 foot below and parallel to the bottom.

The upper limit for measuring excavation will be the top surface of the ground, or the bed of the stream, as it exists at the time the excavation is started. When the Contract designates removal of the materials through a graded section above the structure excavation, and when there is a designated Bid item in the Contract for the graded excavation above, the upper limit for structure excavation will be the lower neat lines of the designated grading section, as shown on the Drawings.

Measurement for imported Mineral Aggregate, when ordered for backfill in lieu of native Material by the Engineer, will be by the cubic yard placed based on the excavation neatlines in the Standard Plans, or as shown on the Drawings, or as otherwise designated by the Engineer.

Backfill for foundations, drains, and walls will be measured by the cubic yard per Section 1-09.1.

Measurement for concrete seal will be as "Concrete (Class) (Designation)" as specified in Section 6-02.4.

Controlled density fill will be measured by the cubic yard for the quantity of Material placed.

Measurement for "Trench Safety Systems in Structural Excavation" will be per lump sum. Where forms or other structures are installed or constructed in an excavation so as to reduce the dimension measured from the forms or other structures to the side of excavation including the installation of pipe within this area, this will be included in the lump sum measurement for "Trench Safety Systems in Structural Excavation". Measurement for "Safety Systems in Trench Excavation, Minimum Bid = \$0.40 per Square Foot" in accordance with Section 7-17.4 will be for trench excavation associated with pipe installation as described in Division 7 and shall not be part of the structural excavation.

2-09.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 2-09 will be made at the Bid item prices Bid only for the Bid items listed and referenced as follows:

1. "Structure Excavation", per cubic yard.

The Bid item price for "Structure Excavation" shall include all costs for the work required in Section 2-09 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, shall be 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 excavation which is not used for backfill shall be incidental to and included in the Bid item price for "Structure Excavation".

All costs for storing, protecting, rehandling, and placing stockpiled Material as specified in Section 2-09 shall be included in the Bid item price for "Structure Excavation".

2. "Shoring", per lump sum.

The Bid item price for "Shoring" shall include all costs for the work required to construct, maintain and remove all shoring, or perform extra excavation including hauling, temporary stockpiling, and disposing.

No change will be made to the Bid item price for "Shoring" for increased depth, to and including a depth of 3 feet below the elevations shown in the Contract. If depths greater than 3 feet below the elevations shown are required by the Engineer, payment for extra costs will be made in accordance with Section 1-09.4.

If selected backfill Material is required for backfilling within the limits of structure excavation, it shall also be required as backfill Material for excavation greater than 3 feet below the elevations shown. Shoring for other classes of excavation shall be incidental to and included in the Bid item price for Bid Items requiring the excavation and shall include removal of the shoring.

3. "Cofferdam", per lump sum.

The Bid item price for "Cofferdam" shall include all costs for the work required to furnish, install, maintain, and remove the cofferdam including dewatering.

4. "Trench Safety Systems in Structural Excavation", per lump sum.

The Bid item price for "Trench Safety Systems in Structural Excavation" shall include all costs for the work necessary to furnish, install, maintain, and remove trench safety systems in structural excavations.

5. Other payment information.

Payment for safety systems required in trench excavation for pipe installation as described in Division 7 and for other than in structural excavation will be made in accordance with Section 7-17.5.

Payment for imported Mineral Aggregate backfill will be per Section 4-01.5.

Payment for Mineral Aggregate, when ordered for backfill in lieu of native Material by the Engineer, will be in accordance with Section 1-04.1(2).

Concrete seal will be paid as "Concrete (Class) (Designation)" per Section 6-02.5.

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.

Stockpiled excavated Material for use as backfill that is intermingled with unsuitable Material and/or weather damaged shall be disposed of and replaced with sound, untainted fill Material at the Contractor's sole expense.

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, shall be at the sole expense of the Contractor. Replacement shall be made with concrete or other Material acceptable to the Engineer.

When ordered by the Engineer to use controlled density fill in backfilling around piers and in front of abutments and walls, the Owner will pay in accordance with Section 1-04.1(2).

If a slide occurs in an open pit as described in Section 2-09.3(3)B, all costs related to removing slide Material and restoring a slide area shall be at the Contractor's sole expense.

All labor and materials the Contractor provides for the bearing tests as specified in Section 2-09.3(3)E will be paid in accordance with Section 1-04.1(2).

All costs not defined in Section 2-09.3(1)E that relate to providing, placing, and compacting backfill shall be included in the Bid item prices of the applicable Bid items.

SECTION 2-10 DITCH AND CHANNEL EXCAVATION

2-10.1 DESCRIPTION

Section 2-10 describes work consisting of constructing and reshaping ditches and channels. This work may also include the installation of geotextile, filter blanket, riprap, streambed aggregate, weir, in-stream log, scour protection, and other construction. This work shall also include disposal of excess and unsuitable material.

2-10.1A CLASSIFICATIONS

Ditch excavation: Includes all excavation for the flow of surface water less than 8 feet wide at the bottom, but excludes those that are part of the roadway.

Channel excavation: Includes all excavation for the flow of surface water 8 or more feet wide at the bottom.

2-10.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Streambed Aggregate	9-03.3
Filter Material	9-03.12(4)
Matting	9-14.5
In-stream Log	9-14.15
Geotextile	9-37

Erosion control, scour control, and ditch lining geotextile shall be as specified in the Contract.

The filter blanket shall meet the gradation requirements for the ballast as called out in the Contract.

2-10.3 CONSTRUCTION REQUIREMENTS

2-10.3(1) GENERAL

Work in ditches and channels over 4 feet deep are subject to the safety provisions of Section 7-17.3(1)A7a.

Prior to any ditch or channel construction, the Contractor shall have ESCBMPs in place and shall 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 TESC plan.

Ditch and channel excavation, shaping, and construction shall produce a finished product complying with the lines, grades, and shapes as shown on the Drawings, and shall accommodate in-stream installations as indicated in the Contract.

2-10.3(2) IN-STREAM LOG

In-stream logs of the size and shape indicated in the Contract shall be placed at the locations indicated on the Drawings, and may require additional excavation and shaping of the ditch or channel. Existing tree identified for re-use as in-stream log shall be cut, pruned and limbed to the size and shape indicated. The Contractor shall provide the Engineer at least one Working Day advance notice before removing a tree identified in the Contract for re-use as in-stream log, and before the placing of in-stream log.

2-10.3(3) STREAMBED AGGREGATE

Streambed aggregate of the type indicated in the Contract shall be placed at the locations and to the dimensions and thicknesses indicated on the Drawings. Additional excavation and shaping may be required to accommodate stream bed aggregate.

2-10.3(4) GEOTEXTILE – DITCH LINING AND SCOUR CONTROL

See Section 2-12.

2-10.3(5) SCOUR CONTROL MATTING

Scour control matting shall be in accordance with Section 8-01.3(7).

2-10.3(6) IN-STREAM WEIR

In-stream weir shall be constructed at the location and to the dimensions indicated in the Contract. Unless the Contract specifies otherwise, both wings of the weir shall slope gently toward the center section of the weir to allow fish passage over the weir during low flow. The Contract may require weir rock, ecology block, or other Material be placed to specified elevations and contours, and may require excavation for the base and use of a geotextile for scour control.

Placement of weir components shall provide non-rocking contact. As necessary, spacer rock or other suitable material shall be used to ensure interlocking of weir components and shall be sized and placed to resist the forces and scour of the design maximum stream flow. Openings within the weir Structure shall be plugged securely with shaped rock or other suitable material as necessary to minimize any flow through the weir below the top surface.

2-10.3(7) STREAM BYPASS

To accommodate in-stream construction, the Contractor shall be prepared to install a stream bypass as indicated in the Contract. Such stream bypass shall be coordinated with fish bypass.

In general, the excavation of a trench and installation of a temporary bypass culvert may be required to divert the stream around the area of in-stream work. The culvert shall be sized to accommodate the maximum in-stream flow indicated 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 other than 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 shall have controls in-place for leakage, seepage, scour, and other site specific needs. An impermeable barrier material may need to be installed and 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 shall remove all bypass material, backfill with native material including compaction of backfill, and restore the areas to the finish grades indicated in the Contract.

Where a cofferdam or bypass channel is required, such will be addressed in the Contract.

2-10.3(8) FISH BYPASS

Channels, ditches, streams, and other surface flow channels containing fish where construction is required will be identified in the Contract. Such fish bypass shall be coordinated with stream bypass.

The Contractor shall 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, the Contractor shall submit to the Engineer at least 5 Working Days in advance, the means of preventing silt and other material and debris from going beyond the construction area.

The Contractor shall frequently monitor for fish and other creatures (conduct "critter patrol") to retrieve and relocate fish and other water creatures that may enter the work area.

2-10.3(9) FISH SCREEN

Fish screens shall be as specified in the Contract.

2-10.3(10) MAINTENANCE REQUIRED DURING CONSTRUCTION

In streams with fish, and where stream bypass, fish bypass, screen, or other measures are required, the Contractor shall perform the maintenance as specified in the Contract.

2-10.3(11) SCOUR PROTECTION

The streambank, stream bedding and invert, and other stream containing features shall be protected from erosion by measures that may be permanent or temporary and that may include groins, buried groins, barbs, engineered log jams, drop structures, and porous weirs.

When the Work includes such scour protection, the Contract will so specify.

2-10.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for ditch and channel excavation will be 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 shall be included in their respective Bid items.

Measurement for in-stream log and for in-stream weir will be per each.

Measurement for streambed aggregate and for filter Material will be by the ton.

Measurement for geotextile and for ditch lining will be in accordance with Section 2-12.4.

Measurement for in-stream bypass and for fish bypass will be by lump sum.

Measurement for scour control will be by component Bid items in the Standard Specifications.

Measurement for scour control matting not part of a TESC plan, and used specifically for in-stream scour control will be measured as geotextile for ditch lining as specified in Section 2-12.4.

Measurement for safety systems in ditches and channels over 4 foot depth, not including Division 7 pipe installation, will be by lump sum.

2-10.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 2-10 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "Ditch Excavation", per cubic yard.
2. "Channel Excavation", per cubic yard.

The Bid item prices for "Ditch Excavation" and for "Channel Excavation" shall include all costs for the work required for excavation, shaping, loading, placing, stockpiling, disposing, and as necessary 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" shall include all costs for the work required to provide safety systems for ditch and channel excavation over 4 foot 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)" shall include 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)" shall include all costs for work required to furnish and install the type streambed aggregate indicated 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" shall include all costs for work required to furnish and install the weir including, but not limited to, excavating, shaping, placing filler rock, disposal, and as necessary.

7. "In-Stream Bypass", per lump sum.

The Bid item price for "In-Stream Bypass" shall include the cost for all work needed to install, maintain, and remove a complete bypass including backfill, compaction, and as necessary to finish grade.

8. "Fish Bypass", per lump sum.

The Bid item price for "Fish Bypass" shall include all costs for the work required to divert and relocate all fish around the work area including as necessary "critter patrol".

9. Other payment information

Filter Material will be paid as "Mineral Aggregate, (Type)" in accordance with Section 4-01.5.

Unless the Contract specifies otherwise, payment for restorations beyond temporary constructions to accommodate in-stream work shall be incidental to the various Bid items and no separate or additional payment will be made therefore.

Payment for geotextile of the type specified will be in accordance with Section 2-12.5.

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, stream bypass, and fish bypass.

SECTION 2-11 TRIMMING AND CLEANUP

2-11.1 DESCRIPTION

Section 2-11 describes work consisting of dressing and trimming the roadway(s) indicated in the Contract, including frontage roads, connecting ramps, auxiliary lanes, and approach roads. This work extends to shoulders and ditches.

2-11.2 RESERVED

2-11.3 CONSTRUCTION REQUIREMENTS

The Contractor shall:

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 lie on the roadbed, shoulders, ditches, and slopes.
5. Remove from paved shoulders all loose rocks and gravel.
6. Distribute evenly along the embankment any Material not needed to bring the shoulders to the required cross-section.

The Contractor shall not:

- 1) Use heavy equipment (tractors, graders, etc.) to trim the shoulders of an existing or new bituminous surface.

2) Drag, push, or scrape shoulder Material across completed surfacing or pavement.

When the Contract requires the Contractor to rebuild part of a roadway, only the rebuilt areas shall be trimmed and cleaned up.

Trimming and cleanup in ditch and channel over 4 feet deep shall require safety systems as specified in Section 2-10.3.

2-11.4 MEASUREMENT

Work described in Section 2-11 will not be measured.

Measurement for safety systems related to cleanup of ditch and channel over 4 foot depth will be as specified in Section 2-10.4.

2-11.5 PAYMENT

All costs for the work required for trimming and cleanup shall be incidental to the various Bid items comprising the Work and no separate or additional payment will be made.

Payment for safety systems related to ditch and channel cleanup will be as specified in Section 2-10.5.

SECTION 2-12 CONSTRUCTION GEOTEXTILE

2-12.1 DESCRIPTION

Section 2-12 describes work consisting of furnishing and placing construction geotextile as indicated in the Contract.

2-12.2 MATERIALS

Materials shall meet the requirements of the following Section:

Construction Geotextile	9-37
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Geotextile roll identification, storage, and handling shall comply with ASTM D 4873. During periods of shipment and storage, the geotextile shall be stored off the ground. The geotextile shall be covered at all times during shipment and storage such that it is fully protected from ultraviolet radiation including sunlight, site construction damage, precipitation, chemicals that are 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 property values of the geotextile.

Geotextile required for underground drainage shall be "Moderate Survivability" and "Drainage Class C" and geotextile for permanent erosion control shall be "High Survivability" and "Drainage Class C".

2-12.3 CONSTRUCTION REQUIREMENTS

2-12.3(1) GENERAL

The area to be covered by the geotextile shall be graded to a smooth, uniform condition free from ruts, potholes, and protruding objects such as rocks or sticks. The geotextile shall be spread immediately ahead of the covering operation. The geotextile shall not be left exposed to sunlight during installation for a total of more than 14 calendar days. The geotextile shall be laid smooth without excessive wrinkles. Under no circumstances shall the geotextile be dragged through mud or over sharp objects which could damage the geotextile. The cover material shall be placed on the geotextile such that the minimum initial lift thickness required remains between the equipment tires or tracks and the geotextile at all times. Construction vehicles on the first lift above the geotextile will not be permitted.

Soil piles or the manufacturer's recommended method, shall 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 shall be removed and the damaged area repaired or replaced by the Contractor at no expense to the Owner. The repair shall 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 are to be sewn in the field or at the factory, the seams shall consist of one row of stitching unless the geotextile where the seam is to be sewn does not have a selvage edge. If a selvage edge is not present, the seams shall consist of two parallel rows of stitching, or shall consist of a J-seam, Type SSn-1, using a single row of stitching. The two rows of stitching shall be 1.0 inch apart with a tolerance of plus or minus 0.5 inch and shall not cross except for restitching. The stitching shall be a lock-type stitch. The minimum seam allowance, i.e., the minimum distance from the geotextile edge to the stitch line nearest to that edge, shall 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 shall be 1.0 inch. The seam, stitch type, and the equipment used to perform the stitching shall be as recommended by the manufacturer of the geotextile and as approved by the Engineer.

The seams shall be sewn in such a manner that the seam can be inspected readily by the Engineer or a representative. The seam strength will be tested and shall meet the requirements stated herein.

2-12.3(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 shall be smooth and stable. The geotextile shall be placed in a manner which ensures intimate contact between the soil and the geotextile (i.e., no voids, folds, or wrinkles).

The geotextile shall either be overlapped a minimum of 12 inches at all longitudinal and transverse joints, or the geotextile joints shall be sewn for medium survivability drainage applications. In those cases where the trench width is less than 12 inches, the minimum overlap shall be the trench width.

In moderate survivability geotextile underdrain applications, the minimum overlap shall be 12 inches, or the geotextile joints shall 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 shall be overlapped a minimum of 2 feet at all longitudinal and transverse joints, or the geotextile joints shall be sewn together. The minimum initial lift thickness over the geotextile in the area drain shall be 12 inches.

In all cases, the upstream geotextile sheet shall overlap the next downstream sheet.

2-12.3(3) SEPARATION

The geotextile shall either be overlapped a minimum of 2 feet at all longitudinal and transverse joints, or the geotextile joints shall be sewn together. The initial lift thickness shall be 6 inches or more.

2-12.3(4) SOIL STABILIZATION

The geotextile shall either be overlapped a minimum of 2 feet at all longitudinal and transverse joints, or the geotextile shall be sewn together. The initial lift thickness shall be 12 inches or more. Compaction of the first lift above the geotextile shall be by Method A (Section 2-03.3(14)D). No vibratory compaction will be allowed on the first lift.

2-12.3(5) PERMANENT EROSION CONTROL AND DITCH LINING

Unless otherwise specified in the Contract, the geotextile shall either be overlapped a minimum of 2 feet at all longitudinal and transverse joints, or the geotextile joints shall be sewn together. If overlapped, the geotextile shall be placed so that the upstream strip of geotextile overlaps the next downstream strip. When placed on slopes, each strip shall overlap the next downhill strip.

Placement of aggregate and riprap or other cover material on the geotextile shall start at the toe of the slope and proceed upwards. The geotextile shall be keyed at the top and the toe of the slope as shown on the Drawings. The geotextile shall be secured to the slope, but shall be secured loosely enough so that the geotextile does not tear when the riprap or other cover material is placed on the geotextile. The geotextile shall 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 that allow the geotextile to be visible shall be backfilled with quarry spalls or filter material as designated in the Contract, so that the geotextile is completely covered. When an aggregate cushion between the geotextile and the riprap or other cover material is required, it shall have a minimum thickness of 12 inches.

An aggregate cushion shall 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 will not be allowed if grading results in stone movement directly on the geotextile. Under no circumstances shall stones with a weight of more than 100 pounds be allowed to roll downslope. Stones shall 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 the stones is evident, as determined by the Engineer. If the geotextile is placed on slopes steeper than 2H:1V, the stones shall be placed on the slope without free-fall for moderate survivability, high survivability, and ditch lining geotextiles.

2-12.3(6) TEMPORARY SILT FENCES

See Section 8-01.3(10).

2-12.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Construction geotextile, with the exception of temporary silt fence geotextile and underground drainage geotextile used in trench drains, will be measured by the square yard for the ground surface area actually covered. No additional measurement will be made for overlap.

Underground drainage geotextile used in trench drains will be measured by the square yard for the perimeter of drain actually covered. No additional measurement will be made for overlap.

2-12.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 2-12 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

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)" shall include all costs for the work required to furnish, install, maintain, and remove the geotextile for the use as specified.

6. **Other payment information.**

Additional geotextile ordered by the Engineer will be addressed in accordance with Section 1-04.4.

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 shall 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 shall be approved in advance of use in the Work in accordance with the requirements of Section 1-06.

3-01.2(1)B STRIPPING QUARRIES AND PITS

Stripping of quarries and pits shall consist 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. Materials from stripping, to be used later as provided on the site reclamation plan specified in Section 3-03, shall 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 shall be cleared and grubbed, and the area from which Materials are to be taken shall be stripped of overburden as provided in Section 301.2(1)B. All combustible debris resulting from these operations shall be disposed of by the Contractor in a manner acceptable to the Engineer.

3-01.2(1)D PRODUCTION REQUIREMENTS

All oversize stones, rock fragments, or boulders occurring in the source, up to and including those measuring 18 inches in the greatest dimension, shall be utilized 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 utilizing the natural Material, fine portions of the raw Material shall 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 shall 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. Scalping shall be performed 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 shall be of such size and capacity that enough of the fine Material will be removed to produce Material as specified.

Washing and reclaiming of the reject Material and subsequent addition of this Material to any finished products will not be 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 shall be thoroughly washed in order to remove clay, loam, alkali, bark, sticks, organic castings, or other deleterious matter. Washing will be required in the production of other Materials if necessary to produce products meeting all the quality requirements of these Specifications.

When producing screened gravel or sand Materials, the Contractor shall remove all oversize Material by screening at the pit site. The Contractor's operations in the pit shall be conducted so that the grading of individual loads will be reasonably uniform. In general, the Contractor shall utilize the most suitable Materials available and shall make as many moves of the loading equipment as may be necessary to fulfill these requirements.

Where pit-run Materials meet the requirements of the Specifications, screening or processing will not be required.

3-01.2(1)E FINAL CLEANUP

Upon completion of the Contractor's operation, the quarry or pit shall be cleared of all rubbish, temporary structures, and equipment, and shall be left in a neat and presentable condition. The pit or quarry shall be reclaimed in accordance with 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 shall, at no expense to the Owner, make all necessary arrangements for obtaining the Material and shall provide evidence that the needed quantity of suitable Material satisfying the requirements of Section 1-06 is available. Use of Materials from such sources will not be permitted until representative samples taken by the Engineer have been tested, the source approved, and authority granted for the use thereof. Before the samples are taken by the Engineer, the Contractor shall, 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 offered in lieu of Owner pre-approved sources will be contingent upon the Material therein 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.

The Contractor shall notify the State Departments of Ecology, Fish and Wildlife and Natural Resources, in writing, of the intent to furnish the source, and shall, at no expense to the Owner, make all necessary arrangements with these agencies for the determinations of regulations which might be imposed upon 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 shall submit a reclamation plan at least 10 Working Days in advance. No work shall begin in the pit or quarry before the reclamation plan is approved by the Engineer.

The source shall be selected so that, after the Materials have been removed, the pit shall drain to a natural drainage course and no ponding can result. Should the source selected by the Contractor be one which would not drain as outlined herein, permission shall be obtained by the Contractor from the governing body of the city or county for the removal of Materials from the pit or quarry, and provide a copy to the Engineer.

The Contractor shall 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, the Contractor shall correct such unsightly conditions as hereinafter provided.

Following removal of Materials from the pit, the entire site shall be cleared of all rubbish, temporary structures, and equipment which have resulted from the Contractor's occupancy and operations. The Contractor shall obliterate or screen to the satisfaction of the Engineer any unsightly conditions that remain. The Contractor shall secure 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 shall be at the Contractor's sole expense. The requirements of this paragraph shall not apply to pits being operated commercially.

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 aforesaid State agencies, for preparing the site as provided in Sections 3-01.2(1)C and 3-03, for cleaning up the site, and for correcting unsightly conditions, shall be included in the Bid item prices for the various Bid items of Work involved.

The grading and quality of Material shall meet the requirements of Section 9-03 unless the Contract specifies otherwise.

3-01.3 RESERVED

3-01.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

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 shall be 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.

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) RESERVED****3-03.2(2) SITES****3-03.2(2)A CONTRACTOR-PROVIDED SITES**

All borrow, quarry, and pit sites larger than three acres in size of disturbed land, or resulting in pit walls more than thirty feet high and steeper than a one to one slope which are owned or furnished by the Contractor, shall be reclaimed in accordance with 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, evidence of such approval shall be furnished to the Engineer at least 3 Working Days prior to 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 shall 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 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 site always require compliance with SEPA. Reclamation plans shall be prepared and submitted as hereinafter specified.

Under no circumstance will the Contractor be allowed to waste Material within a wetland as defined in Section 1-07.5(9).

3-03.2(2)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 shall be reclaimed in accordance with an approved reclamation plan that is in compliance with local area restrictions.

3-03.2(3) RECLAMATION PLANS**3-03.2(3)A RESERVED****3-03.2(3)B PLANS FOR CONTRACTOR-PROVIDED SITES**

A plan will not be 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 shall apply:

1. The Contractor shall prepare its own plan.
2. Reclamation plans shall 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. The Contractor shall meet or exceed these minimum requirements for the various types of sites described in the Contract. The Owner reserves the right to accept or reject reclamation plans.
4. All Drawings required by the plan shall be on reproducible sheets 22 or 24 inches wide by 36 inches long in overall dimensions.
5. The Contractor shall furnish to the Engineer for approval 6 copies of the reclamation plan which shall include but not be limited to the following details:
 - a. Site boundaries and pertinent topographic features.
 - b. Location of the site. The plan shall provide sufficient information to permit the 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 site which will be affected within 2 years after depletion or abandonment of the site.

- 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 subsequent to restoration measures.
6. The Contractor shall furnish, together with the 6 copies of the reclamation plan, completed forms No. SM-2 and SM-6 issued by the Department of Natural Resources.
 7. The Contractor shall submit the original tracing of the plan or a reproducible of the plan for all borrow, quarry and pit sites. These approved plans shall be submitted to the Engineer within 10 Days after receiving approval of the plan. If the plan is approved as noted, it shall 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 one to one 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. Form No. SM-3 shall be completed by the Contractor and forwarded to the Department of Natural Resources through the Engineer upon completion of all seeding and planting.
Form No. SM-7 shall be completed by the Contractor and forwarded to the Department of Natural Resources through the Engineer immediately upon completion of mining operations and site reclamation.
Forms No. 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 one to one or flatter slope.
 10. The Engineer will notify the Contractor if environmental requirements must be satisfied. To meet the requirements, the Contractor shall 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 shall, if specified on a reclamation plan approved by the Engineer, require erosion control in accordance with Section 8-01 or landscaping in accordance with Section 8-02.

3-03.3(2) DEVIATIONS FROM APPROVED RECLAMATION PLANS

Reclamation of any site which deviates from the approved reclamation plan will not be permitted without first revising the approved reclamation plan and obtaining the approval of the Engineer. The Contractor shall 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 shall be included in the costs of other Bid items of work involved in the Work.

DIVISION 4 BASES**SECTION 4-01 MINERAL AGGREGATES****4-01.1 DESCRIPTION**

Section 4-01 addresses all Mineral Aggregate Types not addressed elsewhere in the Standard Specifications and Standard Plans.

4-01.2 MATERIALS – SUBSTITUTION WITH RECYCLED AGGREGATES

Mineral Aggregate Types shall meet the requirements of Section 9-03. At the option of the Contractor, recycled concrete crushed to the requirements of Section 9-03 will be permitted as a substitute for Mineral Aggregate (Type) with the following exceptions):

1. In exposed areas.
2. Where free drainage is required.
3. For pavement base and Subbase when wet conditions exist.

Recycled aggregates include recycled Portland cement concrete and recycled asphalt concrete. At least 10 Working Days in advance of ordering, the Contractor shall submit to the Engineer, the following:

A 75 pound sample of adequately broken recycled Portland cement concrete shall be submitted to the Engineer (**NOTE** - testing for Determination of Degradation Value and Abrasion of Coarse Aggregates by Use of the Los Angeles Machine will be done in accordance with Section 9-03.15). In addition, the source of any native material that may be blended with the recycled Portland cement concrete rubble shall also meet these same requirements for the Mineral Aggregate Type being used.

A 75 pound sample of recycled asphalt concrete shall be submitted to the Engineer. A maximum of 15 percent by weight of recycled asphalt concrete pavement may be used in the blended product. The asphalt concrete content is calculated as the amount of asphalt particles retained on all screens ¼ inch and above for the Mineral Aggregate being used.

The recycled aggregates shall be stockpiled in such a manner that each certified test report can be identified with a single stockpile of not more than 10,000 tons.

The Contractor shall submit a Manufacturer's Certificate of Compliance including certified laboratory test reports certifying that the recycled material is neither hazardous nor toxic. This certification shall address the toxicity characteristics, and sampling and testing in accordance with Chapter 173-303 WAC. Sampling and testing shall be one sample per 10,000 or less tons from any single source, and not less than one sample from any single source.

Gradation, sand equivalent, L. A. Abrasion, fracture, and other requirements, as applicable, for each Mineral Aggregate shall be per Section 9-03.

Substitution of Mineral Aggregates Type 1G and Type 2G for Mineral Aggregates Type 1 and Type 2 respectively will be permitted where other Specification Sections allow (see Section 4-04.2). The Contractor shall submit written notification of these substitutions ("or equal", etc. per Section 1-06.1) as required in Section 1-05.3(5).

4-01.3 RESERVED**4-01.4 MEASUREMENT**

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for minor and local quantities of backfill for drains surrounding weep holes for new concrete Structure per Section 6-02.5 and paid in accordance with Section 4-01.5 will not be made.

See Section 7-17.4 for measurement for "Mineral Aggregate (Type)" used for bedding and trench backfill.

4-01.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 4-01 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "Mineral Aggregate, (Type)", per ton.
2. "Mineral Aggregate, (Type)", per cubic yard.

The Bid item price for "Mineral Aggregate, (Type)" shall include 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.**

The Bid item price for roadway ballast shall also include all costs for the work required of removal and disposal of unsuitable Material.

The Bid item price for backfill for walls shall include all costs for the work required by the cubic yard in place as determined by the neat lines indicated on the Drawings where indicated, or by the neat lines indicated on the Standard Plans where indicated with the following exception:

the volume of pipes and Structures will be deducted; however, volumes of pipes 6 inch inside diameter or less, and other minor structural features each less than one cubic yard will not be deducted.

Payment for backfill for foundations, and for drains other than behind a wall, shall include all costs for the work required by the cubic yard in place as determined by the neat lines indicated on the Drawings or by the neat lines indicated on the Standard Plans. Payment for minor and local quantities of backfill for drains surrounding weep holes of 1 cubic yard or less shall 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.

Payment for drainage filter layer behind rock facings will be by the Bid item "Mineral Aggregate, (Type)" by the ton (see Section 2-08.5).

When Mineral Aggregate Type 1G or Type 2G are permitted as substitute Mineral Aggregates for Mineral Aggregate Type 1 or Type 2 respectively, no separate or additional payment and no change in the Bid item price for the applicable Bid item will be made for substituted Material.

When recycled material is approved by the Engineer as substitute Mineral Aggregate Type, no separate or additional payment, and no change in Bid item price, will be made for recycled material.

Payment for Engineer directed changes in the Type of Mineral Aggregate from that specified will be in accordance with Section 1-04.1(2). Contractor requested changes in Mineral Aggregate Type which are approved by the Engineer shall be at no additional cost to the Owner.

SECTION 4-02 RESERVED

SECTION 4-03 RESERVED

SECTION 4-04 BALLASTING AND CRUSHED SURFACING

4-04.1 DESCRIPTION

Section 4-04 describes work consisting of constructing one or more courses of crushed aggregate Material upon an existing roadway surface, or upon a subgrade properly prepared in accordance with the provisions of Section 2-06.

This work shall also consist of constructing one or more layers of gravel base upon a prepared subgrade in conformity with the lines, grades, depth, and typical cross-section indicated on the Standard Plans and otherwise indicated in the Contract.

4-04.2 MATERIALS

Materials shall meet the requirements in the following Sections:

Dust Palliative	Dust Palliative Oil CMS-2	9-02
Roadway Ballast	Mineral Aggregate Types 2 and 14	9-03
Shoulder Ballast	Mineral Aggregate Type 13	9-03
Base Course	Mineral Aggregate Type 2	9-03
Crushed Surfacing	Mineral Aggregate Type 1	9-03
Maintenance Rock	Mineral Aggregate Type 3	9-03
Sand Filler	Mineral Aggregate Type 11	9-03
Dust Palliative Sand	Mineral Aggregate Type 6	9-03
Gravel Base	Mineral Aggregate Type 17	9-03

The application of dust palliative with or without crushed surfacing shall be considered an oil mat treatment (Section 4-04). See Section 5-02 for bituminous surface treatment.

Crushed Gravel, Mineral Aggregates Type 1G and Type 2G shall not be used as a substitute for Mineral Aggregates Type 1 and Type 2 except as follows. Crushed gravel may be used in lieu 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.

Crushed gravel Mineral Aggregates Type 1G and Type 2G shall not be used as a base course Material under asphalt concrete pavement, unless the pavement structure is a composite pavement structure consisting of asphalt concrete over Portland cement concrete base (or rigid base). Crushed gravel may be used as a substitute for base course under Portland cement concrete pavement.

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 shall meet the requirements of Section 4-01.

4-04.3 CONSTRUCTION REQUIREMENTS

4-04.3(1) EQUIPMENT

All equipment necessary for acceptable performance of this construction shall be on the Project Site and approved by the Engineer prior to beginning this work. If central mix plant methods are used, the central mixing plant shall comply with the following requirements:

1. The cold aggregate feeder shall be mechanically operated and adjustable to the extent necessary to provide a uniform and continuous flow of Materials. These Materials shall 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 shall be weighed or metered, and dispensed through a device providing uniform dispersion across the mixer.
2. The mixing plant shall 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 permit the sampling of the Materials before and after mixing. The mixer shall be kept in good condition, and mixing blades or paddles shall be of proper size, adjustment, and clearance to provide positive and uniform mixing of the mixture at all times.
3. The capacity of the plant and equipment furnished for the Work shall be adequate at all times to provide for efficient and continuous operations insofar as practical.

The minimum amount and type of heavy equipment considered necessary for the proper execution of the Work described herein shall meet or exceed the following:

- 1) 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.
- 2) One 10-ton self-propelled three-wheel roller, one vibratory roller, or one pneumatic-tired roller. Roller wheels may be weighted if necessary to secure specified weight per linear inch of tire width. Vibratory rollers shall meet 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 shall 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 shall be subject to the Engineer's approval.

4-04.3(2) SUBGRADE

The subgrade shall be prepared as specified in Section 2-06 and shall be approved by the Engineer before placing ballast or surfacing Materials.

Gravel base shall be uniformly spread upon the prepared subgrade to the depth, width, and cross-section indicated 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 shall be mixed in an approved mixing plant as described in Section 4-04.3(1). The completed mixture shall 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 shall be mixed until uniform throughout by motor graders or other equipment approved by the Engineer. Water to facilitate mixing and compacting shall be added in amounts acceptable to the Engineer.

4-04.3(4) PLACING AND SPREADING

On street areas to be paved with asphalt concrete pavement, crushed surfacing shall be placed to a compacted depth of 6 inches.

Spreading of the first course of surfacing or ballasting shall begin at points nearest to the point of loading and successive courses shall begin at points farthest from the point of loading. Each course shall be constructed continuously from the beginning point of the course. The first course of surfacing or ballasting Material shall be placed on the entire available subgrade before placing the succeeding course. If the Engineer deems it necessary, a succeeding course shall be placed over a section of a previously placed course before the final completion (Physical Completion Date) of that course.

Crushed surfacing, base course and top course shall be constructed in layers not to exceed 4 inches in depth. Ballast shall be constructed in layers with each layer not to exceed 6 inches in depth.

Each layer of surfacing and ballasting Material shall be placed and spread by equipment approved for use by the Engineer. The surfacing and ballasting shall be spread by any method that results in an even distribution of these Materials upon the roadway without perceptible separation in gradation. The Material shall be spread and screeded 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 shall immediately, upon request of the Engineer, make such changes in the method of handling the Material which prevents separation.

There shall be a distance of not less than 1 block nor more than 1/2 mile between the construction of any two courses of surfacing or ballast. Uniform gradations of Mineral Aggregates shall be used for surfacing on roadways.

Before placing any layer, the preceding layer shall be properly bound, and all floating or loose stone shall be removed from the surface.

4-04.3(5) SHAPING AND COMPACTION

Following spreading and shaping of each layer, the layer shall be compacted to a minimum 95 percent of the maximum density determined in accordance with Section 2-03.3(14)E before the next succeeding layer of surfacing or pavement is placed.

When necessary, a mist or spray of water shall be applied to replace moisture lost by evaporation should the Engineer determine inadequate moisture is indicated. Each completed layer shall have a smooth, bound, uniform surface true to the line, grade, and cross-section indicated on the Drawings, or as staked by the Engineer.

When the thickness of a layer is less than 2 inches, density testing will not be required and the Engineer will determine the number of equipment applications required for the particular compaction equipment available. Each course of surfacing shall be compacted until the Material does not creep or yield under the compaction equipment before a succeeding course of surfacing Material is applied. All compaction shall begin at the outer edges of the surfacing and continue towards the center.

4-04.3(6) RESERVED**4-04.3(7) MISCELLANEOUS REQUIREMENTS**

The surface of each layer of surfacing Material shall 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 shall be placed on all available subgrade before placing the next overlay course. There shall be a distance of not less than one hundred feet between the construction of any two courses of surfacing or ballast.

Should irregularities develop in any layer surface during or after compaction, they shall be remedied by loosening the surface and correcting the defects after which the entire area including the surrounding surface shall be thoroughly re-compacted. The completed surface shall be true to line, grade, and crown before proceeding with the surfacing or final paving.

4-04.3(8) WEATHER LIMITATIONS

When, in the opinion of the Engineer, the weather is such that acceptable results cannot be obtained, the Contractor shall suspend operations until the weather is favorable. No surfacing materials shall be placed in snow or on a soft, muddy, or frozen subgrade.

4-04.3(9) HAULING

Hauling equipment shall be routed over the roadway in a manner to be most effective in the compacting of the surfacing. Hauling over any of the surfacing in the process of construction will not be permitted when, in the opinion of the Engineer, hauling adversely impacts the roadway.

4-04.3(10) HOURS OF WORK

See Section 1-08.1(4).

4-04.3(11) SHOULDER BALLAST

Shoulder ballast shall not be placed until the abutting pavement has been completed. Shoulder ballast shall be placed through a spreader box in one lift. Processing of the shoulder ballast course on the roadway will not be permitted. Compaction shall be accomplished by making a minimum of three passes over the aggregate with a vibratory compactor of a type acceptable to the Engineer. The density requirements of Section 4-04.3(5) shall not apply.

4-04.3(12) APPLICATION OF DUST PALLIATIVE

Completed crushed rock surfacing courses shall be given two or more applications of dust palliative oil. Dust palliative oil shall be CMS-2 and shall 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. Before succeeding applications of dust palliative oil are applied, the preceding application shall have thoroughly dried.

Dust palliative oil shall not be applied upon a wet surface nor when the temperature is below 60°F.

The Contractor shall furnish and place Mineral Aggregate Type 6 sand on newly oiled streets to prevent tracking of oil onto adjacent surfaces. The Contractor shall be prepared to apply additional sand to areas where oil remains on the surface due to poor surface penetration.

4-04.3(13) RESURFACING OF OIL MAT AND GRAVEL STREETS

The surface of existing oil mat and graveled streets shall 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. No attempt shall be made 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 shall 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 shall be removed. All wood, peat, organic matter, or other deleterious matter shall also be removed prior to the application of the crushed surfacing. In shaping the existing surfacing, all Material that may have been displaced by traffic, or by other means, shall be bladed into the newly formed surfacing section.

Crushed Surfacing, Mineral Aggregate Type 1, shall be applied only after the newly prepared street surface has been approved by the Engineer. Crushed surfacing shall then be spread to a minimum depth of 2 inches by any method that results

in an even distribution of the Material upon the roadway without perceptible separation in gradation. Where separation does occur, correction shall be made according to Section 404.3(4). During or after spreading operations, the newly spread crushed surfacing shall be shaped by blading to conform to the depth, line, grade, and cross section indicated on the Drawings. The Contractor shall 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, dust palliative oil shall be applied as specified in Section 4-04.3(12). Prior to opening the newly oiled streets to traffic, warning signs shall be placed at locations on all routes leading to the freshly oiled roadways. These signs shall say "Caution - Fresh Oil", be of a size and Material with adequately sized lettering and bordering meeting the requirements for "Warning Signs" of the City of Seattle Traffic Control Manual for In-Street Work, and shall remain at the locations until the oiled roadway is accepted by the Engineer. "No Parking" signs, if used, shall be removed at the end of day where areas have been covered with rock. See Sections 1-07.23 and 1-10.

4-04.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

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.

4-04.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 4-04 will be made at the Bid item price Bid only for the Bid item listed or referenced as follows:

1. "Dust Palliative", per gallon.

The Bid item price for "Dust Palliative" shall include all costs for the work required to furnish and place dust palliative.

2. **Other payment information.**

Payment for Mineral Aggregate of the Type specified shall be in accordance with Section 1-04.1(2).

If the Engineer directs the Contractor to change the Type of Mineral Aggregate from that specified, then any change in compensation resulting from the change will be in accordance with 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 per Section 5-04 shall follow.

4-05.1A SUBMITTAL

At least 10 Working Days prior to intended use, the Contractor shall submit a mix design to the Engineer in accordance with Section 1-05.3. This mix design shall 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 of, and the locations of, sample borings in the area to be treated will be provided in the Contract.

4-05.2 MATERIALS

Materials shall meet the requirements of the following sections:

Portland Cement	9-01
Asphalt Emulsion	9-02
Mineral Aggregate	9-03
Water	9-25

Lime shall 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 to be used shall have the Capability of introducing liquid additives uniformly and accurately.

The mixing equipment shall 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 shall include a totalizer so that the amount of asphalt emulsion used during any given period can be read directly and shall 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 shall 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 begins, existing utility castings within the pavement area to be reclaimed shall 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 shall require the notification specified in Section 1-07.28 item 5. The depth of removal shall 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 shall have sufficient strength and shall 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 removed and then covered shall be "tied in" so that after reclamation, the covered utility can be located and reinstalled to finished grade.

All other obstacles identified on the Drawings shall be removed as necessary.

See Sections 1-07.16(1) and 1-07.28 item 17 regarding the survey monumentation, witness monument, remonumentation, and notifications required.

4-05.3(2)B PULVERIZATION

The existing pavement and base Material shall be pulverized and blended to the depth indicated on the Drawings so the entire mass of Material shall be uniformly graded. The pulverized Material shall have a minimum 95% passing the 1-1/2 inch sieve size. Material gradation may vary due to local aggregates and conditions; however, acceptance of the pulverized Material will be based on visual inspection by the Engineer. The Contractor shall remove all rock larger than 3 inches and all deleterious material as defined in Section 9-03.1. The pulverizing operation shall be completed prior to the mixing operation. If any pulverized section is to be temporarily opened to traffic, it shall first be shaped and compacted as approved by the Engineer.

4-05.3(2)C ADDITIVES, MIXING AND COMPACTING

Portland cement or lime, if required as an additive to the emulsion treated base, shall be lightly dusted onto the pulverized surface at a uniform rate of application. The application of Portland cement or lime shall be prior to the application of asphalt emulsion and the mixing operation.

The emulsified asphalt shall 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, a positive displacement variable speed pump and control system Capable of metering the emulsion application rate to a tenth of a gallon per square yard shall be used.

The application rate of the emulsified asphalt shall be expressed in gallons per square yard. This rate shall 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.

The mixing operation shall be completed in continuous segments. Each segment shall 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% of the previous density reading at that same location then the compaction of the Material at that location will be considered acceptable.

4-05.3(2)D FINAL SURFACE PREPARATION

The emulsion treated base shall be allowed to cure for a minimum of 10 Days prior to 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

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1.09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

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

Compensation for the cost necessary to complete the work described in Section 4-05 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **"Reset Casting for Pavement Recycling"**, per each.

The Bid item price for "Reset Casting for Pavement Recycling" shall include 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" shall include 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 on 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" shall include 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" shall include 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" shall include 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 one or more courses of asphalt treated base placed on the subgrade in accordance with these Specifications and in conformity with the lines, grades, thickness, and typical cross-sections indicated 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 shall meet the requirements of the following Sections:

Asphalt	9-02
Anti-Stripping Additive	9-02
Aggregates	9-03

The grade of paving asphalt shall 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 shall meet the following requirements:

1. **Heating:** The plant shall be Capable of heating the aggregates to the required temperature.
2. **Proportioning:** The mixing plant shall be Capable of proportioning the aggregates to meet the specified requirements, and of producing asphalt at the rate specified by the Engineer. If the aggregates are supplied in two or more sizes, means shall 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 shall 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 shall be heated to a temperature between the limits of 350°F and 375°F, unless the Contract specifies otherwise.

4-06.3(2)A MIX DESIGN

The mix design requirements for asphalt treated base shall be as specified in the Contract.

4-06.3(3) HEATING OF ASPHALT MATERIAL

Heating of asphalt Material at the mixing plant shall comply with Section 5-04.3(2).

Heating of asphalt binder shall comply with Section 5-04.3(5).

4-06.3(4) MIXING

Asphalt treated base shall be mixed as specified in the Contract.

4-06.3(5) HAULING EQUIPMENT

Hauling equipment for asphalt treated base shall conform to the requirements of Section 5-04.3(3)A.

4-06.3(6) SPREADING AND FINISHING**4-06.3(6)A GENERAL**

Asphalt treated base shall be spread with a spreading machine 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 at the time compaction is achieved shall be a minimum of 185°F.

When the total depth of ATB exceeds 3 inches, the ATB Material shall be placed in two or more equal courses with each not to exceed 3 inches in thickness.

4-06.3(6)B SUBGRADE PROTECTION COURSE

The Contractor shall 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 shall conform to grade and smoothness requirements that apply to the subgrade upon which it is placed.

4-06.3(6)C FINISH COURSE

The final surface course of the asphalt treated base, excluding shoulders, shall not deviate at any point more than 3/8-inch from the bottom edge of a 10-foot straightedge laid on the surface in any direction on either side of the roadway crown. Failure to meet this requirement shall necessitate corrective measures acceptable to the Engineer to achieve the required tolerance, at no expense to the Owner.

When Portland cement concrete pavement is placed on asphalt-treated base, the surface tolerance of the asphalt-treated base shall be such that no elevation lies above the plan grade minus the specified plan depth of Portland cement concrete pavement. Prior to placing the Portland cement concrete pavement, any such irregularities shall be brought to the required tolerance by grinding or other means approved by the Engineer, at no expense to the Owner.

4-06.3(7) COMPACTION AND DENSITY

The method of compaction shall be as specified in Section 5-04.3(9).

The density of the asphalt treated base shall be not less than 80 percent of the maximum theoretical density established for the mix by WSDOT Test Method 705. The frequency of these tests shall be at the discretion of the Engineer, but in no case shall it be less than one control lot for each normal Day's production. The use of equipment which results in damage to the Materials or produces defective work will not be permitted.

4-06.3(8) ANTI-STRIPPING ADDITIVE

An anti-stripping additive (Section 9-02.4) shall be added to the asphalt Material when directed by the Engineer.

4-06.3(9) RESERVED**4-06.4 MEASUREMENT**

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Asphalt treated base will be measured by the ton.

4-06.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 4-06 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "Pavement Base, Asphalt Treated (ATB)", per ton.

The Bid item price for "Pavement Base, Asphalt Treated (ATB)" shall include 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 in accordance with Section 1-09.4.

3. Other payment information.

Payment for roadway excavation and subgrade preparation including excavation and disposal of unsuitable Material shall be in accordance with applicable Specification 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 in conformance with the slopes and grades indicated on the Drawings; and compacting the mixed stabilized base as specified. A portion of the bottom section of pulverized base Material shall not be mixed with Portland cement.

4-07.1(1) SUBMITTAL

At least 10 Working Days prior to intended use, the Contractor shall submit a mix design to the Engineer in accordance with Section 1-05.3. This mix design shall 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 shall meet the requirements of the following sections:

Portland Cement	9-01
Aggregate	9-03
Joint Filler and Sealants	9-04
Curing Materials and Admixtures	9-23
Water	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. The Contractor shall submit information describing the equipment to be used for this Work shall be submitted to the Engineer at least 5 Working Days in advance.

The compaction equipment shall be a vibratory roller compactor weighing a minimum 15 tons.

4-07.3(2) CONSTRUCTION METHOD**4-07.3(2)A PULVERIZING**

The Contractor shall pulverize existing pavement and underlying base course Materials to the width and depth indicated on the Drawings. The Contractor shall make as many passes as necessary to blend all pulverized Materials to the width and depth indicated on the Drawings. The blended Material shall conform to the following gradation:

Sieve Size	Percent Passing (by weight)
1-1/2 Inch Square Opening	100 - 96%

Acceptance of the gradation will be based on visual inspection of the Engineer. The blended Material shall be shaped and rolled to allow for temporary use of traffic, as necessary. Shaping shall be continued until a uniform roadway section is developed. The surface shall be within 0.10± feet of the finished grade and the Materials shall have a uniform and consistent gradation. All rocks larger than 3 inches and all other deleterious Material shall be removed and disposed of.

4-07.3(2)B DISTRIBUTING ADDITIVES

After the pulverizing and initial shaping and rolling operations are completed, additives shall be placed on the roadway surface for mixing with underlying roadway Materials to the depth indicated on the Drawings. The Portland cement shall be distributed onto the prepared roadway surface at a rate to obtain the approved mix design proportions after mixing and blending water shall be applied to the roadway surface at a rate such that the moisture content of the mixed Material does not exceed the optimum moisture content for the mixed Material by more than 2%.

Portland cement and water shall 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 shall not be permitted on the treated surface for a minimum of 3 Days to allow for curing.

See Section 2-07 regarding watering except payment for water shall be in accordance with Section 4-07.5.

4-07.3(2)C MIXING

The mixing operation shall consist of thoroughly mixing the distributed additives with the pulverized Materials to the total combined depth indicated on the Drawings. The mixing equipment shall be the same equipment used for the pulverizing. The Contractor shall be prepared to provide additional additives or cross mixing or both, as determined by the Engineer, to localized areas to achieve a property mixed base. All rocks and Material larger than 3 inches which are exposed by the mixing

operation shall be removed by the Contractor. Traffic shall not be 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 shall be final graded and compacted within 90 minutes after the addition of Portland cement and water. The finished grade shall be as indicated on the Drawings.

Density of the compacted soil-cement acceptable to the Engineer will be 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% of the previous density reading at that same location, then the compaction of the Material at that location will be considered acceptable.

The completed base course shall be allowed to cure for a minimum of 3 Days before allowing traffic access. The compacted soil cement shall not be allowed to dry. The Contractor may use the water truck or may use any other method of supplying water to keep the finished surface moist and prevent lost of moisture from the treated Material. The Contractor shall apply a tack coat of as soon as practical after final compaction in accordance with Section 5-04.3(4)B4. The HMA Class asphalt wearing course shall be applied 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 shall be removed and reprocessed, or replaced at the Engineer's direction.

4-07.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

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

Compensation for the cost necessary to compete the work described in Section 4-07 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **"Full Depth Pavement Reclamation"**, per square yard.

The Bid item price for "Full Depth Pavement Reclamation" shall include 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 shall be considered incidental to the Bid item "Full Depth Pavement Reclamation" and no separate or additional payment will be made therefore.

2. **"Portland Cement for Pavement Reclamation"**, per ton.

The Bid item price for "Portland Cement for Pavement Reclamation" shall include 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" shall include all costs for the work required to furnish and apply the water as required in Section 4-07.

4. **Other payment information.**

All costs associated with obtaining a hydrant use permit shall be considered incidental to the various Bid items comprising the Work and no separate or additional payment will be made. See Section 2-07.5.

DIVISION 5 SURFACE TREATMENTS AND PAVEMENTS**SECTION 5-01 SUBSEALING****5-01.1 DESCRIPTION**

Section 5-01 describes work consisting of 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 shall meet the requirements of the following Sections:

Portland Cement and Pozzolan	9-01
Pozzolans	9-01.6(1) and 9-23.9
Water	9-25

5-01.3 CONSTRUCTION REQUIREMENTS**5-01.3(1) PROPORTIONING MATERIALS**

The standard mix design for subsealing is as follows:

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 shall be approved by the Engineer. The water content may be varied by the Contractor as required for local conditions.

5-01.3(2) EQUIPMENT

All equipment used in performance of subsealing shall be subject to the approval of the Engineer and shall be maintained in satisfactory working condition at all times.

Air compressors to be used for operating air hammers, and for blowing air into the cavities beneath the pavement, shall be of sufficient size and capacity for acceptable performance.

Air hammers shall be equipped with drills that are Capable of cutting 1-1/2 inch diameter holes through the pavement. The equipment shall be in good working condition and operated in such a manner that out-of-round holes shall not be produced.

The grout plant shall consist of a cement injection pump and a high speed colloidal mixing machine. The colloidal mixing machine shall operate at a minimum speed of 1,200 rpm and shall 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 shall be accurately measured, and the water shall be batched through a meter or scale with a totalizer for the day's consumption.

Wooden cylindrical plugs or other devices approved by the Engineer shall be provided to temporarily plug the application holes until the Material has set. The plugs shall be slightly tapered on one end for ease in driving.

5-01.3(3) CONSTRUCTION

Subsealing shall not be done when the pavement is wet, or when water is present under the pavement. Application holes shall be drilled through the cement concrete pavement in the approximate pattern as indicated on the Drawings.

Application holes shall be approximately 1-1/2 inches in diameter and shall be perpendicular to the pavement surface. The Contractor shall 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, compressed air shall be blown 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, the subsealing mix shall be pumped into the application hole until all cavities are filled, or until any one 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. Immediately upon removal of the nozzle, the plug shall be inserted and firmly driven into the application holes.

Following the application and after the mix has set, the wooden plugs shall be removed and the application holes immediately filled with subsealing mix.

Subsealing shall be continued progressively through the pavement requiring subsealing.

Traffic shall not be allowed upon 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 shall cease operations and move to a new location.

5-01.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Pavement Subseal" will be by the 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

Compensation for the cost necessary to complete the work described in Section 5-01 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **"Drill Hole for Subsealing"**, per each.
The Bid item price for "Drill Hole for Subsealing" shall include all costs for the work required to drill the holes.
2. **"Pavement Subseal"**, per cubic foot.
The Bid item price for "Pavement Subseal" shall include 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 work consisting of 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 shall be classified as treated or untreated roadway surfaces as defined in Section 5-04.3(4)A.

Bituminous surface treatment method shall be Class B unless specified otherwise in the Contract.

Bituminous surface treatment shall not be considered "oil mat surface" (see Section 4-04).

5-02.1(2) BITUMINOUS SURFACE TREATMENT CLASS A

This method of treatment requires two applications of asphalt and three applications of aggregate. The second application (tack coat) shall 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 the placing of one application of asphalt and one or more sizes of aggregate as specified to 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 shall meet the requirements of the following Sections:

Asphalt	9-02
Anti-Stripping Additive	9-02.4
Mineral Aggregates	9-03

The grade of asphalt shall 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 shall be Mineral Aggregate Type 24, Chip Rock, meeting the requirements set forth in Section 9-03.

When cutback asphalts are specified for Bituminous Surface Treatment Class A, construction shall not begin until the need for anti-stripping additive has been determined. The Contractor shall allow a minimum of seven Working Days after the SPU Materials Laboratory has received samples of the Mineral Aggregate, asphalt, and anti-stripping additive, for testing. Additional time will be required by the Engineer to verify acceptable performance and compatibility, if the Contractor has requested more than one source of asphalt or anti-stripping additive be approved. The Contractor shall take this into consideration in preparing for and meeting Contract Time.

5-02.3 CONSTRUCTION REQUIREMENTS

5-02.3(1) EQUIPMENT

The equipment used by the Contractor shall include scarifying, mixing, spreading, finishing and compacting equipment, an asphalt distributor, and equipment for heating asphalt Material, and shall be subject to approval by the Engineer before its use on the Work.

The distributor shall have a capacity of not less than 1,000 gallons, and shall be so designed, equipped, maintained, and operated that asphalt Material of an even heat shall be uniformly applied at the required rate. It shall be equipped with a 10-foot spray bar with extensions, pressure pump and gauge, volume gauge so located as to be observed easily by the Engineer from the ground, a tachometer to control accurately the speed and spread of asphalt, and two thermometers, one installed permanently in the tank to indicate temperatures of the asphalt at all times. The power for operating the pressure

pump shall be supplied by a power unit which provides a uniform spray from each of the nozzles across the spray bar and extensions.

Rollers shall be self-propelled pneumatic-tired or smooth-wheeled rollers, each weighing not less than 10 tons.

Spreading equipment shall be self-propelled, supported on at least four pneumatic tires, with an approved device for accurately metering and distributing the Mineral Aggregate uniformly over the roadway surface.

Brooms shall be motorized with a positive means of controlling vertical pressure.

Other equipment necessary to acceptably perform the work as specified herein shall be subject to approval by the Engineer before its use on the Work.

Additional units shall be placed on the Work when, in the opinion of the Engineer, it is considered necessary in order 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 shall be calibrated prior to their use to ensure applications within the specified coverage limits. Adjustment of the asphalt distributor spray bar height shall 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.

The Contractor shall frequently check and adjust, if necessary, the height of the spray bar during asphalt application to insure the height above the pavement surface does not vary 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 will be 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 will not allowed.

5-02.3(3) APPLICATION OF ASPHALT

Upon the properly prepared roadway surface, Cationic Emulsified Asphalt (CRS-2) shall be applied in non-shaded areas at the rate of 0.35 to 0.40 gallon per square yard, and in shaded areas at 0.38 to 0.45 gallon per square yard. The asphalt spraying application temperature at the distributor shall be between 140°F and 185°F. The Engineer may vary the rate of asphalt application that will give the best results.

To ensure uniform distribution of asphalt prior to beginning the asphalt application, the distributor bar shall be operated over a pit or vat. To avoid gaps and ridges at transverse junctions of separate applications of asphalt, the Contractor shall spread sufficient building paper over the treated surface to make sure that the spray jets function normally when the untreated surface is reached.

The pattern of application of shots, and width and length of application of shots of asphalt Material shall be such as to provide proper coverage of crushed Material within the times specified, provide proper widths to such dimensions as to facilitate an acceptable coverage of crushed cover stone, and provide lapping of subsequent adjacent applications.

Asphalt shall be applied to spandrels of intersections and driveways immediately ahead of, or immediately behind the adjacent longitudinal street application.

Omissions (skips) by the distributor shall immediately be covered by hand application with the same grade of hot asphalt.

Any one spread of asphalt shall cover no more area than can be covered with Mineral Aggregate within 3 minutes from the time of application, upon any part of the spread.

Asphalt shall be spread toward the source of Mineral Aggregate to avoid injury to the freshly treated surface. No asphalt shall be spread until adequate supplies of Mineral Aggregate are on hand at the Project Site.

Where earth curbs or no curbs exist, the application of asphalt shall extend 4 inches beyond the gutter line. Where concrete curb and gutter exist, the application shall lap onto the gutter section, but shall not exceed 2 inches. Where concrete curb exists, the application shall be placed as closely as possible to the vertical surface without excessive splash onto the curb. Where concrete curb or curb and gutter exist, the distributor shall be equipped with a splash board designed to prevent spraying thereon.

All castings shall be protected by securely covering with heavy building paper and weighing down with sand or crushed Material.

Hand sprayers shall be used to apply asphalt around castings, and to areas where coverage is insufficient.

5-02.3(4) CHANGE IN GRADES OF ASPHALT

At any time during the progress of the asphalt construction, the Engineer may order the use of other grades of asphalt Materials in substitution of the grades specified in the Contract if the intent of the Specifications will be better attained.

5-02.3(5) APPLICATION METHOD OF AGGREGATES

Any method of handling the Mineral Aggregate which causes segregation of the various sizes of aggregate particles shall be corrected by the Contractor upon the request of the Engineer so that a uniform product is incorporated in the Work.

After applying the asphalt uniformly over the roadway surface, Mineral Aggregate of the Type specified shall be uniformly applied to the roadway surface at a rate of 25 to 33 pounds per square yard by spreader equipment. The quantity of Mineral Aggregate to be applied shall be such that the asphalt shall be uniformly covered and shall not pick up under traffic. The Mineral Aggregate shall be uniformly applied over the freshly spread asphalt by trailer-type or self-propelled spreader boxes. The Mineral Aggregate shall be applied so that trucks and spreader boxes do not travel on the fresh asphalt and the Mineral Aggregate layer shall be spread in one operation for each application of asphalt. Spandrels of intersections, driveways, and bare spots shall be covered by hand spreading from trucks immediately behind the box application. Mineral Aggregate shall be spread in such a manner as to provide an 8-inch strip of asphalt exposed to provide a lap with the next application of asphalt.

The Mineral Aggregate shall be damp and shall be free of dust and impurities, when applied to the roadway. If the Mineral Aggregate is dry or dusty or both dry and dusty, the Contractor shall spray the aggregate with water to obtain a damp and dust free condition. Dusty or dry Mineral Aggregate which compromises adhesion of the Mineral Aggregate to the substrate will not be allowed.

As soon as the aggregate has been applied to the surface, the aggregate shall be well rolled with a self-propelled pneumatic-tired roller. Places inaccessible to the pneumatic-tired roller, such as spandrels of intersections and private driveways, shall be rolled with a self-propelled smooth-wheel roller.

Where excess Mineral Aggregate has been applied, it shall either be removed or be drifted uniformly over the adjacent roadway by using a motor patrol grader equipped with a wire broom mold board, subject to approval of the Engineer. This type of brooming shall be held to a minimum, and where necessary it shall be very carefully performed so as not to disturb the mat in any way. Thin or bare spots in the spread of Mineral Aggregate shall be corrected by hand spreading or by use of a grader as described above.

Rolling and brooming shall continue until the roadway is uniformly covered and the Mineral Aggregate is well compacted and "set" into the asphalt. This operation shall continue 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 shall 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 order the use of a different Mineral Aggregate grading in lieu of the Mineral Aggregate specified if in the Engineer's judgment the results contemplated by the Specifications will thereby be better attained.

5-02.3(6) 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 one or both Materials in accordance with these Specifications.

5-02.3(7) PATCHING AND CORRECTION OF DEFECTS

Omissions by the distributor or damage to the treated surface of any coat shall be immediately covered by hand application with asphalt in adequate quantities. Holes which develop in the surface shall be patched 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 shall be corrected and new work shall not be started until such defects have been remedied.

All improper workmanship and defective Materials resulting from overheating, improper handling or application, shall be removed from the roadway by the Contractor and shall 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 shall 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. The emulsified asphalt shall be diluted with water at a rate of one part water to one part emulsified asphalt.

5-02.3(8) PROGRESS OF WORK

The Contractor shall organize the entire operation ensuring progression in an orderly and expeditious manner.

The sequence of operation for placing Bituminous Surface Treatments shall be as follows:

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. This work shall be accomplished 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, etc.

Ten (10) Calendar Days after the final application, the Contractor shall make a final sweep with a mechanical broom, using the pick up broom only, to clear off any remaining loose aggregates. Gutter brooms shall not be used. The Contractor shall dispose of the excess Mineral Aggregates.

5-02.3(9) PROTECTION OF STRUCTURES

All handrails, guardrails, curbs, road signs, and other facilities shall be protected from splashing and overspray.

5-02.3(10) UNFAVORABLE WEATHER

Asphalt shall not be applied to excessively wet Material. Asphalt shall not be applied during rainfall, sand or dust storms, or before any imminent storms that might adversely impact the construction. The Engineer will determine whether the surface and Materials are acceptable for the construction in inclement weather.

The application of any asphalt to the roadway shall be restricted to the following conditions:

1. The roadway surface temperature shall be at least 60°F and the air temperature at least 60°F and either holding or rising, or
2. The air temperature shall be not less than 70°F when falling and the wind shall be less than 10 miles per hour as estimated by the Engineer.

No asphalt shall be applied which cannot be covered one hour before darkness. The Engineer may require the Contractor to delay application of asphalt until the atmospheric and roadway conditions are within the conditions listed above.

Construction of bituminous surface treatments on any Traveled Way shall not be carried out before May 15 or after September 1 of any year except upon written notice from the Engineer.

5-02.3(11) ANTI-STRIPPING ADDITIVE

When directed by the Engineer, an anti-stripping additive shall be added to the asphalt Material (see Section 9-02.4).

5-02.3(12) UNTREATED ROADWAY SURFACES

Existing crushed rock, gravel, and oil mat streets shall be restored with Mineral Aggregate Type 1, to a compacted depth of 4 inches. Final surfacing shall be constructed as specified in Section 5-04.3(4)C2.

5-02.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

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

Compensation for the cost necessary to complete the work described in Section 5-02 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **"Asphalt, (Grade)"**, per gallon or ton.

The Bid item price for "Asphalt, (Grade)" shall include 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 in accordance with 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 in accordance with Section 1-04.1(2).

All costs for the work required to coat omissions or to patch defects shall be included in the Bid item price for the applicable Bid item.

All costs for splashing and overspray protection shall be included in the Bid item price for the applicable Bid item.

All costs for roadway preparation will be paid in accordance with Section 5-04.5.

All costs for water will be paid in accordance with Section 2-07.5.

SECTION 5-03 RESERVED**SECTION 5-04 HOT MIX ASPHALT (HMA) PAVEMENT****5-04.1 DESCRIPTION**

This work shall consist of providing and placing one or more layers of plant-mixed hot mix asphalt (HMA) on a prepared foundation or base in accordance with these Specifications and the lines, grades, thicknesses, and typical cross-sections shown on the Drawings.

HMA shall be composed of asphalt binder and Mineral Aggregate as may be required, and then mixed in the proportions specified to provide a homogeneous, stable, workable, and compactable mixture.

5-04.2 MATERIALS

Materials shall meet the requirements of the following sections:

Bituminous Materials	9-02
Mineral Aggregates	9-03

Temporary Pavement Marking 9-29.4

The grade of asphalt binder will be specified in the Contract (also see Section 5-04.2(1)).

5-04.2(1) USE OF SUBSTITUTE MATERIALS

The proposed use of substitute or alternate materials by the Contractor in the production of HMA from those specified in the Contract shall be part of the submittal as specified in Section 5-04.3(6) and shall require approval of the Engineer.

Recycled asphalt pavement (RAP): Unless the Contract specifies otherwise, the Contractor may propose the use of RAP (see Section 9-03.8(3)B). RAP shall not exceed 20% of the total weight of aggregate in the HMA mix. RAP will not be allowed for asphalt binders with grades of PG-70 or higher.

Grade of asphalt binder: Unless the Contract specifies otherwise, the Contractor may propose the use of a substitute grade of asphalt binder. The substitute grade of asphalt binder shall:

1. meet the requirements of Section 9-02.1(4),
2. have a maximum pavement design temperature that is equal to or greater than that of the specified binder, and
3. have a minimum pavement design temperature that is equal to or lower than that of the specified binder.

The Engineer approved substituted grade of asphalt binder shall 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, will not be permitted.

5-04.3 CONSTRUCTION REQUIREMENTS**5-04.3(1) TERMS RELATED TO HMA**

In Sections 5-04, 9-02, 9-03.6, and 9-03.8, terms and phrases used (such as "design aggregate structure", "nominal maximum aggregate size", "air voids", "maximum aggregate size", "binder content", etc.) and abbreviations (such as "JMF" for "job mix formula", "V_a", "N_{design}", "G_{sb}", etc.) are consistent with and can be found in WSDOT Standard Operating Procedure (SOP) 732 "Volumetric Design for Hot-Mix Asphalt (HMA)" and such other documents that are incorporated by reference within WSDOT SOP 732. WSDOT SOP 732, and other incorporated by reference documents, are available in the current edition of the Washington State Department of Transportation's Materials Manual M 46-01.

5-04.3(2) MIXING PLANT

In addition to the requirements of Section 1-06, the Contractor shall allow the Engineer safe access to stockpiles for sampling. An adequate and convenient space for the Engineer to temporarily store and test samples shall be allowed.

Plants used for the preparation of HMA shall conform to the following requirements:

Equipment for Preparation of Asphalt Binder: Tanks for the storage of asphalt binder shall be equipped to heat and hold the binder at the required temperatures. The heating shall be accomplished by steam coils, electricity, or other approved means so that no flame shall be in contact with the storage tank. The circulating system for the asphalt binder shall be designed to ensure proper and continuous circulation during the operating period. A valve for the purpose of sampling the binder shall be placed in either the storage tank or in the supply line to the mixer. Also see Section 5-04.3(5) for heating asphalt binder additional requirements.

Thermometric Equipment: An armored thermometer, Capable of detecting temperature ranges expected in the HMA mix, shall be fixed in the asphalt feed line at a location near the charging valve at the mixer unit. The thermometer location shall be convenient and safe for observation by the Engineer.

The plant shall also 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 drier to automatically register or indicate the temperature of the heated aggregates. This device shall be in full view of the plant operator and shall be convenient to observation by the Engineer.

Sampling and Testing of Mineral Aggregates: The HMA plant shall be equipped with a mechanical sampler for the sampling of the Mineral Aggregates by the Engineer (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 shall have tight, clean, smooth metal beds. A cover fabricated of canvas or other suitable material and of sufficient size to completely protect the mixture from adverse weather shall be securely attached to the truck. Whenever the weather conditions during the workshift include, or are forecast to include, precipitation or an air temperature less than 45° F, the cover shall be securely attached to protect the HMA.

In order to prevent the HMA mixture from adhering to the hauling equipment, truck beds shall be sprayed with an environmentally benign release agent. Excess release agent shall be drained prior to filling with HMA. For hopper trucks, the conveyer shall 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 shall replace equipment producing defective work.

When requested by the Engineer, the Contractor shall be prepared to timely provide HMA and related equipment manufacturer's written operating instructions and maintenance manual.

5-04.3(3)B2 HMA PAVERS

HMA pavers shall be self-contained, power-propelled units, provided with an internally-heated vibratory screed or strike-off assembly and shall 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 shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, segregating, or gouging the HMA. Extensions will be allowed provided they produce the same results, including ride, density, and surface texture as obtained by the primary screed or strike off assembly. Extensions without augers, vibration, and heated screeds, shall not be used in the traveled way.

The paver shall be equipped with automatic screed controls with sensors for either or both sides of the paver. The controls shall 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(s) shall be constructed so it operates from a reference line or a mat referencing device.

The Contractor shall furnish and install all pins, brackets, tensioning devices, wire, and accessories necessary for satisfactory operation of the automatic control equipment. The Contractor shall be prepared to provide samples of the above items prior to installation when requested by the Engineer.

The transverse slope controller shall be Capable of maintaining the screed at the desired slope within plus or minus 0.1 percent. The paver shall be equipped with automatic feeder controls, properly adjusted to maintain a uniform depth of material ahead of the screed.

Pavers operating with an MTV shall have additional capacity as specified in Section 5-04.3(3)B3.

5-04.3(3)B3 MATERIAL TRANSFER VEHICLES (MTV)

An MTV shall be an independent, self-powered device configured for transferring HMA from hauling equipment to the paver. An MTV shall also have the following characteristics:

Delivery System: The MTV shall have a high capacity truck unloading system that receives HMA from the hauling equipment. The truck unloading systems shall be Capable of unloading a truck at a rate greater than the rate of placement by the paver.

Surge Capacity: The MTV shall be equipped with an integral storage bin Capable of holding 25 tons of HMA. In addition, the HMA paver operating with an MTV shall be equipped with a hopper insert that shall be able to contain 15 additional tons of HMA.

Remixing Equipment: The MTV shall be designed to provide HMA remixing prior to discharging to the paver.

Discharge Conveyor: The MTV shall be equipped with a discharge conveyor that shall have the ability to swivel so the MTV may be operated from an adjacent lane while delivering HMA to the paver.

5-04.3(3)C ROLLERS

Rollers shall be of the steel wheel, vibratory or pneumatic tire type, in good condition and Capable of reversing without backlash. Operation of the roller shall be in accordance with the manufacturer's recommendations. The number and weight of rollers shall be sufficient to compact the mixture in compliance with the requirements of Section 5-04.3(9). The use of equipment that results in crushing of the aggregate will not be permitted. Rollers producing pickup, washboard, uneven compaction of the surface, displacement of the mixture, or other defective work (see Section 1-05.7) will be rejected by the Engineer in accordance with Section 1-05.9.

5-04.3(3)D PLANING BITUMINOUS PAVEMENT AND REQUIRED PRE-PANING METAL DETECTION

5-04.3(3)D1 GENERAL

Prior to planing, the Contractor shall meet with the Engineer to discuss the planing operations as specified in Section 5-04.3(17).

5-04.3(3)D2 PLANING BITUMINOUS PAVEMENT

Planing bituminous pavement shall be by the cold planing method only. Equipment shall be of a type that has operated successfully on work comparable to that in the Contract and shall be subject to the Engineer's approval prior to use. Equipment shall be maintained in good working condition while in use.

Cold planers shall be milling type equipment Capable of cutting at least a 5 foot chord to a depth of up to four (4) inches in one pass. For Contract or Engineer required planing depths in excess of four inches and as the total depth requires, the first pass and all succeeding passes shall each be to a maximum four inch depth, with the final pass depth being four or fewer inches to achieve the total depth. 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 shall employ 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 so as not to damage Contractor equipment. On areas where irregularities or unavoidable obstacles make the use of mechanical planing equipment impractical, the planing shall be done with other equipment or by other means.

For mainline cold planing operations, the equipment shall 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 shall also be

Capable of maintaining the desired transverse slope. The sensor shall be so constructed that it operates from a reference line or multi-footed ski-like arrangement. The transverse slope controller shall be Capable of maintaining the desired slope within plus or minus 0.1 percent.

5-04.3(3)D3 REQUIRED PRE-PLANING METAL DETECTION

The Contractor shall be aware that metal may be buried beneath the existing asphalt surface. Such metal may be rail track associated with Seattle's former street car system, or may be castings buried under asphalt overlay, or other similar metallic items.

Before planing, the Contractor shall adequately sweep the entire area of asphalt to be planed to detect buried metal.

If such metal is detected and is not indicated in the Contract, the Contractor shall surface mark such detected metal and shall notify the Engineer of such condition before planing as required by Section 1-04.7.

Where the Drawings indicate the existence of metal not visible on the existing pavement surface, the Contractor shall 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, the Contractor shall note such and shall avoid planing contact with such metal. If the depth to metal is within the depth range of required planing, then one of two outcomes is required, as follows:

1. If a metal casting, then the casting shall be treated as specified in Section 7-20.
2. If a metal object other than a casting, then the Engineer may require removal. If removal is not addressed in the Contract, then this portion of work will be addressed as extra work.

Metal detection equipment shall 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 four inches, the Contractor shall be prepared to make multiple planing passes with each pass not exceeding the four inch depth. Before each planing pass of four inch or less, the Contractor shall resweep the same area of asphalt to detect metal.

Where the Engineer directs additional depth planing beyond that required in the Contract, the Contractor shall again sweep for metal before such additional depth planning, as described in this Specification.

Contractor planing equipment damaged by metal buried within asphalt shall be the sole responsibility of the Contractor.

5-04.3(4) PREPARATION OF STREET SURFACES

5-04.3(4)A PREPARATION CLASSIFICATION DESCRIPTIONS

In preparing surfaces, the following surface classifications apply:

Treated surfaces: cement concrete, asphalt concrete, brick, seal coat or other bituminous surface treatments.

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 4-04.

The work of preparing existing surfaces for asphalt concrete or other bituminous Material overlay shall be 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 to be used as a base for one or more courses of new asphalt concrete, or other surfacing (see Sections 4-04 and 5-02), the treated surface shall first be swept, cleaned, and patched as follows:

1. Treated surfaces shall be swept with a power broom until free from dirt and other foreign matter. Hand brooms shall be used to clean omissions of the power broom. Fatty asphalt patches, grease drippings and other objectionable Material shall be removed from the existing pavement.
2. Excess asphalt joint filler shall be completely removed and premolded joint filler shall be removed to at least 1/2-inch below the surface of the existing pavement.
3. In order to obtain a sound base having uniform grade and cross section, irregularities in the existing treated surface shall be corrected prior to placement of the new asphalt concrete or other bituminous surface treatment. Corrections shall be made by planing, preleveling, grinding, patching or by placing new base pavement.

5-04.3(4)B2 PRELEVELING

When a surface of the existing pavement or old base is irregular, it shall be brought to a uniform grade and cross section by 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, then the Engineer will direct preleveling before HMA wearing course placement in accordance with Section 5-04.3(8). As soon as the existing surface has been thoroughly cleaned, holes and discontinuities in the surface and edges and edge breaks shall be repaired as specified in the Contract. Patching shall be accomplished prior to preleveling or installation of the first asphalt course, whichever is applicable.

Preleveling Materials shall be the same HMA class of asphalt concrete as the wearing course or an acceptable alternate approved by the Engineer. If the Contract does not require a finish HMA wearing course, then the preleveling of uneven or broken surfaces shall be accomplished by placing asphalt concrete of the class specified with a motor patrol grader, by hand-raking, by Miller box, or by such other method acceptable to the Engineer.

After placement, the preleveling Material shall be thoroughly compacted 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 shall be prepared to spot grind occasional high areas caused by rutting, etc., to a depth 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 beginning planing of pavements, and before any additional depth planing when directed by the Engineer, the Contractor shall conduct a physical survey of existing pavement to be planed with equipment that can identify hidden metal objects.

Should such metal be identified, the Contractor shall promptly bring this to the attention of the Engineer.

See Section 1-07.16(1) regarding the protection of survey monumentation that may be hidden in pavement.

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 bring to the attention of the Engineer any hidden metal that is detected, shall be the Contractor's sole responsibility.

Also see Section 5-04.3(17) regarding a planing plan and pre-planing briefing prior to beginning planing.

5-04.3(4)B3b PLANING

See Section 5-04.3(17) regarding a planing plan, and pre-planing briefing prior to beginning planing.

Locations of existing surfacing to be planed will be indicated in the Contract.

Where planing an existing pavement is specified in the Contract, the Contractor shall be prepared to both remove existing surfacing material, and to reshape a surface to remove irregularities. The finished product shall be a prepared surface acceptable for receiving an HMA overlay.

Planing shall be by the cold milling method unless otherwise specified in the Contract. The planer shall not be used on the final wearing course of new HMA.

Planing operations shall be conducted in a manner that does not tear, break, burn, or otherwise damage the surface which is to remain. The finished planed surface shall be slightly grooved or roughened and shall be free from gouges, deep grooves, ridges, or other imperfections. Repair of the surface to remain that is damaged by the Contractor's planing shall be by a method acceptable to the Engineer.

Metal castings and other surface improvements damaged by planing shall be repaired or replaced as determined by the Engineer.

A tapered wedge cut shall 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 shall be as shown on the Drawings or as specified by the Engineer.

A tapered wedge cut shall also be made at transitions to adjoining pavement surfaces (meet lines) where butt joints are indicated on the Drawings. Butt joints shall be cut in a straight line with vertical faces 2 inches or more in height and shall produce a smooth transition to the existing adjoining pavement.

After planing is complete, the planed surfaces shall be swept, cleaned, and if required by the Contract, patched and preleveled.

The Engineer may direct additional depth planing. Prior to performing this additional depth planing, the Contractor shall first conduct a hidden metal in pavement detection survey as required in Section 5-04.3(4)B3a.

5-04.3(4)B4 TACK COAT AND DISTRIBUTOR EQUIPMENT REQUIREMENTS

5-04.3(4)B4a TACK COAT REQUIREMENT

Tack coat shall 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 one part water to one part emulsified asphalt. The emulsified asphalt shall not exceed the maximum temperature recommended by the emulsified asphalt manufacturer.

A tack coat of asphalt, applied at the rate of 0.02 to 0.08 gallons per square yard of retained asphalt, shall be applied to all paved surfaces on which any course of HMA is to be placed or abutted. The tack coat shall cover the existing pavement uniformly with a residual asphalt film free of streaks and bare spots. Tack coat shall only be applied to surfaces that are dry and free from moisture. Tack coat shall not be applied under the imminent threat of rain as determined by the Engineer.

The Contractor shall make arrangements with the Engineer demonstrating tack coat application at the beginning of such application. Once the Engineer approves the tack coat application method and rate of application, the Contractor shall 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, tack coat of asphalt shall be applied on the vertical face of the abutting surface. The application on the contact surfaces shall be uniform in order to avoid an accumulation of excess asphalt. Excess tack coat shall be immediately removed. The

Contractor shall not apply the tack coat on vertical contact surfaces above the finished height of the asphalt concrete being placed.

Tack coat shall be applied only to surfaces to receive tack coat treatment, and shall not be applied to any other surface. Tack coat applied to surfaces not to be coated shall require immediate removal of the tack coat, including thorough cleaning of the surface area as may be reasonably necessary for leaving no residue.

Equipment shall not operate on tacked surfaces until the tack has broken and cured. If the Contractor's operation damages the tack coat it shall be repaired prior to placement of the HMA. For surfaces open to traffic, the application of tack coat shall be limited to surfaces that will be paved during the same working shift.

5-04.3(4)B4b DISTRIBUTOR EQUIPMENT REQUIREMENT

The distributor equipment shall be Capable of distributing a uniform tack coat in controlled amounts.

The distributor shall have a capacity of not less than 1,000 gallons, and shall be so designed, equipped, maintained, and operated that asphalt Material of an even heat shall be uniformly applied at the required rate.

The power for operating the pressure pump shall be supplied by a power unit which provides a uniform spray from each of the nozzles across the spray bar and extensions.

In addition, the distributor shall be equipped with the following:

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 so located as to be observed easily by the Engineer from the ground, and
6. a tachometer to control accurately 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

Untreated roadway surfaces, including intersections and side roadway approaches which are to receive asphalt concrete pavement, or other surfacing (see Sections 4-04 and 5-02), shall be shaped to a uniform grade and cross-section, conforming as nearly as possible to that which exists except:

Where new lines and grades are indicated in the Contract or staked by the Engineer.

The basis for establishing final line and grade in such cases shall be curbs, curbs and gutters, existing pavement, or pavement edges or other existing street improvements. Existing driveways shall be graded as necessary to provide a smooth transition to the final grade of the new pavement surface including such grading as may be necessary to permit driveway adjustment.

Where no curbs or curbs and gutters exist and where none are required by Contract, subgrade preparation shall extend one foot on each side of the roadway beyond the final asphalt paving width indicated on the Drawings. The Contractor shall be prepared to extend this subgrade preparation to such greater width as the Engineer may require to accommodate local conditions such as intersections.

The grade shall be shaped so that all frame castings for manholes, monument boxes, gate valve boxes, catch basins, etc. within the roadway section to be treated, extend above the prepared surface, and such that all castings are flush with the final wearing course. Where existing asphalt or Portland cement concrete pavement is being met with new asphalt surfacing, sufficient existing untreated surfacing shall be removed to permit the forming of a butt joint. The completed finish surface, including castings and transitions with existing treated surfaces, shall be smooth as specified in Section 5-04.3(12).

Those areas and surfaces which are to be prepared for the placement of asphalt concrete pavement or other surfacing shall be considered Subgrade for the new construction. See Section 2-06 for subgrade preparation requirements. Excess native material deemed suitable by the Engineer shall be considered selected Material per Section 2-03.3(10) and shall be stockpiled by the Contractor or bladed to the roadway edge and used as needed for fill or shoulder restoration following completion of the paving. The selected Material shall be used to the fullest extent possible as sub-base Material prior to the placement of new crushed rock.

Water shall be available on site and shall be applied as necessary to meet compaction requirements and to alleviate dust.

Excess material shall be disposed of.

5-04.3(4)C2 PRIME COAT TREATMENT

Where required in the Contract, 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 shall be applied prior to paving with asphalt concrete. The prime coat shall be applied over the entire area of proposed asphalt pavement construction. Following the application of the prime coat, HMA shall not be placed until the prime coat has cured.

In the event the surface receiving the prime coat is of such gradation and relative density as to resist penetration of the prime coat, the Contractor shall immediately before application of the prime coat, loosen no more than the upper 1/2 inch of surface and regrade it without compaction.

The Contractor shall maintain the completed prime coat by blading or brooming until the asphalt concrete is placed. Should any holes, breaks, or irregularities develop in the roadway surface after the prime coat has been applied, such defects shall be patched or repaired in accordance with Section 5-04.3(4)C1 immediately in advance of placing the asphalt concrete pavement.

Immediately prior to placing the HMA, the surface of the prime coat shall be swept clean of all dirt, dust, and other foreign matter.

5-04.3(4)D CRACK SEALING

Where the Contract requires "Crack Sealing", all cracks and joints shall be cleaned with a stiff-bristled broom and compressed air. Loose pieces shall be removed and disposed of.

After cleaning, all cracks less than 1/4 inch in width shall be filled with straight CSS-1 emulsified asphalt and topped with sand.

After cleaning, all cracks and joints at least 1/4 inch or greater in width, shall be filled with sand slurry.

Rubberized asphalt shall be used 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. Rubberized asphalt shall not be used to seal cracks greater than 1-1/2 inches in width.

Application of the sand slurry or rubberized asphalt shall be as follows:

1. Sand Slurry: The sand slurry shall consist of 20 percent CSS-1 emulsified asphalt, 2 percent Portland cement, sufficient water for workability, and the remainder clean U.S. No. 40 paving sand. The components shall be thoroughly mixed and poured into the cracks and joints until full. The following day, any cracks or joints that are not completely filled shall be topped off with additional sand slurry. After the sand slurry is placed, the filler shall be struck off flush with the existing pavement surface and allowed to cure. The HMA overlay shall not be placed until the slurry has fully cured.

2. Rubberized Asphalt: The sealant Material shall meet the requirements of Section 9-04.10 and shall be applied in accordance with the sealant manufacturer's recommendations. These recommendations shall be submitted to the Engineer by the Contractor prior to the start of this type construction and shall include recommended heating time and temperature, allowable storage time and temperatures after initial heating, allowable reheating criteria, and application temperature range. The cracks shall be completely dry before being filled with the rubberized asphalt. Filling shall be controlled to confine the Material within the crack or joint. Where the sealed cracks are to be overlaid with asphalt, the sealant shall be recessed 3/8 inch below the surface. The Contractor's method of sealant application shall confine the sealant to the crack or joint and shall not result in any spillage on the pavement surface.

Should spillage occur, the Contractor shall have readily available, Supplies and as necessary to timely and effectively remove sealant over-application.

5-04.3(5) HEATING OF ASPHALT BINDER

The temperature of the asphalt binder shall not exceed the asphalt binder manufacturer's recommended maximum temperature at any time, and shall not fall below the minimum temperature recommended by the asphalt binder manufacturer. The asphalt binder shall be heated in a manner that prevents local variations in heating. The heating method shall provide a continuous supply of asphalt binder to the mixer at a uniform average temperature with no individual variations exceeding 25°F. Also see Section 5-04.3(2) regarding HMA mixing plant requirements.

5-04.3(6) HMA MIX DESIGN AND SUBMITTAL REQUIREMENTS

5-04.3(6)A PREPARATION OF AGGREGATES

Sufficient storage space shall be provided for each size of aggregate. The aggregates shall be removed from stockpile(s) in a manner to ensure a minimum of segregation when being moved to the HMA plant for processing into the final mixture. Different aggregate sizes shall be kept 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 to be used in the production of HMA, the Contractor shall determine a design aggregate structure and asphalt binder content in accordance with WSDOT Standard Operating Procedure 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 grade of asphalt binder shall be as specified in the Contract (also see Section 5-04.2(1) where binder substitution is allowed). The nominal maximum aggregate size and design ESALs shall be as required by the Contract. The amount of anti-stripping additive to be added to the mix will be determined by the Engineer based on the Contractor's proposed design and submittal (see the following and Section 9-02.4).

Once the Contractor has determined the aggregate structure and binder content, the Contractor's submittal shall provide data demonstrating that the proposed HMA design meets the requirements of Sections 9-03.8(2) and 9-03.8(6). In no case shall the HMA paving begin before the determination of anti-stripping agent requirement by the Engineer has been made.

5-04.3(6)B2 APPLICATION DEFINITIONS

Unless the Contract specifies otherwise, the following definitions shall be used regarding HMA CI mix designs and apply to all HMA submittals:

<u>Structural application – major quantity:</u>	an HMA CI mix used for vehicular traffic where the project specifies not less than 400 tons of HMA. See Section 504.3(6)C for submittal requirements.
<u>Structural application - minor quantity:</u>	an HMA CI 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.
<u>Non-structural application:</u>	an HMA CI 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 shall include roadways of any kind for vehicular traffic, alleys, driveways, and other surfaces as may be 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 Engineer approved HMA CI mix design major quantity structural application, an Engineer approved HMA CI major quantity structural application mix design shall remain “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 CI mix. The SPU Materials Laboratory will specify the “approval date” on the returned submittal, and will maintain records on such. On future Contracts, the Contractor shall contact the SPU Materials Laboratory (206-386-1236) to find out if and when a specific major quantity structural application mix design has been Engineer approved.

5-04.3(6)C2 MIX DESIGN AND SAMPLE SUBMITTAL REQUIREMENTS

For HMA CI mix designs not pre-approved by the Engineer as specified in Section 5-04.3(6)C1, the Contractor's HMA CI submittal shall require 20 Working Days and requires both the Contractor mix design and samples.

The following Contractor mix design information shall be submitted for each HMA class:

1. Project name and Public Works (PW) number.
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 (also see Sections 1-06.1 and 1-08.3(2) item 6).
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.
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 (P_b).
18. Effective Binder Content (P_{be}).
19. HMA compaction temperature for the gyratory compactor.
20. Relative density of the final mix at N_{design} gyrations.
21. Number of design (N_{design}) gyrations used (N_{ini} ; N_{des} ; N_{max}).
22. Voids in Mineral Aggregate (VMA).
23. Voids filled with asphalt (VFA).
24. Air voids in the compacted mixture (V_a).
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 (G_{mm}).
29. Percent of G_{mm} for extruded specimens at N_{ini} , N_{des} and N_{max} .
30. Bulk specific gravity of the extruded specimen at N_{design} gyrations (G_{mb}).
31. Bulk specific gravity of the combined aggregates in the mix (G_{sb}).
32. Effective specific gravity of the combined aggregates in the mix (G_{se}).
34. Bulk specific gravity of the aggregate fraction passing the 3/8" sieve.

35. Bulk specific gravity of the aggregate fraction retained on the 3/8" sieve.

36. Specific gravity of the binder (G_b).

Samples: The mix design submittal shall be accompanied with the following minimum sized samples:

- | | | |
|----|---|------------|
| 1) | The HMA class mix (if RAP is proposed, the mix shall contain the RAP) | 75 pounds, |
| 2) | Asphalt binder(s) | 1 quart |
| 3) | Recycled asphalt pavement component (RAP), if used | 25 pounds |
| 4) | Anti-stripping agent | 1 quart |

Any adjustment to an Engineer approved HMA class JMF will require a submittal (Section 1-05.3(5)) and the approval of the Engineer per Section 9-03.8(7).

Submittal of items "2." through "4." (not "2)" through "4)") above may be waived by the Engineer if the Contractor submits a valid and current WSDOT mix design of the same class of HMA utilizing 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 shall make this known in the submittal (see items 10, 11, 12, 13, 16, 17, 18, and 36).

Based on the submittal proposed by the Contractor, the Engineer will determine the anti-stripping additive requirement, and will 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 as may apply.

The Contractor shall not commence production of any HMA class until that HMA JMF mix design has been established and approved by the Engineer.

Any change in source of supply for any of the constituents of an approved HMA class JMF will require a new mix design be submitted and approved prior to use as specified in this Section.

If the results of the verification testing by the Engineer of the submitted sample Materials and proposed mix design meet the requirements of Sections 9-02.1(4) and 9-03.8, then the submittal will be considered approved. The approved mix design will be the "initial" job mix formula (JMF) 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.

5-04.3(6)C3 ACCELERATED SUBMITTAL

When an Engineer approved HMA CI 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 shall submit to the Engineer at least 5 Working Days in advance, a Manufacturer's Certificate of Compliance stating the following:

1. For each HMA class specified in the Contract, the name and location of each Supplier providing the Engineer approved HMA class mix and component parts.
2. Supplier's HMA CI mix design number, or other designating identification (designation) consistent with the Engineer 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 CI to the Project Site shall be accompanied with a certification stating the following:

- 1) The HMA mix being delivered is an Engineer approved HMA mix,
- 2) Name and location of HMA CI Supplier,
- 3) Supplier's HMA CI 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 CI minor quantity structural application mixes, the Contractor shall 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 request of the Engineer, the Contractor shall submit the pre-approved mix design data (previously submitted and approved in Section 5-04.3(6)C2).

The Engineer reserves the right to obtain samples of a previously approved HMA CI mix and/or its individual constituents for verification of the mix design.

In addition, every delivery of the HMA CI mix to the Project Site shall be accompanied with a certificate stating the following:

- (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 PG 64-22,
- (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 CI non-structural application mixes, the Contractor shall 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 request of the Engineer, the Contractor shall submit the pre-approved mix design data specified in Section 5-04.3(6)C3.

The Engineer reserves the right to obtain samples of a previously approved HMA CI mix and/or its individual constituents for verification of the mix design.

In addition, every delivery of the HMA CI mix to the Project Site shall be accompanied with a certificate stating the following:

- (1) HMA Class ½ Inch,
- (2) Binder grade of PG 64-22 (binder grade may be substituted as described in Section 5-04.2(1)),
- (3) Supplier designed at any ESAL level, and
- (4) Tonnage in hauling vehicle.

5-04.3(7) HMA MIXING PROCESS

5-04.3(7)A GENERAL

After the required amounts of Mineral Aggregate and asphalt binder have been introduced into the mixer, the HMA shall be mixed until a complete and uniform coating of the particles and a thorough distribution of the asphalt binder throughout the Mineral Aggregates is ensured.

When discharged, the temperature of the HMA shall not exceed the maximum temperature recommended by the asphalt binder manufacturer.

A maximum water content of 1 percent in the HMA, at discharge, will be allowed 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 will be considered defective Material. The Contractor shall stop production of the HMA and discontinue the placing of HMA. As specified in Section 1-05.7, the Contractor shall provide a remedy acceptable to the Engineer addressing the water content of the HMA. Defective Material in place shall be removed and replaced with Material that meets the specified requirements.

Storing or holding of the HMA in approved storage facilities will be permitted during the daily operation but in no event shall the HMA be held for more than 24 hours. HMA held for more than 24 hours after mixing will be rejected. Rejected HMA shall be disposed of by the Contractor at no expense to the Owner. The storage facility shall have an accessible device located at the top of the cone or about the third point from the top. The device shall indicate the amount of material in storage. No HMA shall be accepted from the storage facility when the HMA in storage is below the top of the cone of the storage facility, 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, then the first 4 tons to be loaded out of the storage facility shall be wasted and disposed of at the Contractor's expense.

5-04.3(7)B ACCEPTANCE SAMPLING AND TESTING – HMA MIXTURE

Acceptance of HMA will be based on the following:

1. **Aggregates.** The acceptance criteria for aggregate properties of sand equivalent, flat and elongated, fine aggregate angularity and fracture will be their conformance to the requirements of Section 9-03.8(2).
2. **Hot Mix Asphalt Mixture.** The acceptance criteria for the HMA mixture shall be as specified in Section 9-03.8(7), HMA Tolerances and Adjustments.

A. Sampling

1. No samples will be obtained from either the first or last 25 tons of HMA produced in each production shift.
2. Samples for acceptance testing will be obtained on a random basis at the point of delivery in accordance with 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 (JMF) placed. A lot is represented by randomly selected samples that will be tested for acceptance. Only one 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 in accordance with Section 9-03.8(7). If the request is approved, all of the 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 begin.

Sampling evaluation will be performed on a random basis at the frequency of one sample per subplot. Sublot size will be determined to the nearest 100 tons to provide not less than two uniform sized sublots, based on proposal quantities, with a maximum subplot 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 subplot may be increased to a maximum of 2 times the subplot 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.

Sublot sample test results may be challenged by the Contractor.

To challenge the Laboratory's test results, the Contractor shall comply with the requirements of Section 1-04.5.

Resolution of this challenge shall be by a split of the original acceptance sample that will be 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 (V_a). 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:

<u>Property</u>	<u>Deviation from JMF</u> <u>Allowable deviation (%)</u>	<u>Standard Specification Reference</u>
U.S. No. 4 and larger sieves	± 4.0 % for each sieve	9-03.8(6)
U.S. No. 8 sieve	± 2.0 %	9-03.8(6)
U.S. No. 200 sieve	± 0.4 %	9-03.8(6)
Asphalt binder content	± 0.3 %	5-04.3(6)C1, item 18
Air Voids in the Compacted Mixture (V_a)	± 0.7 %	5-04.3(6)C1, item 24

If the results of the challenge sample testing are outside the allowable deviation established above for any of the above parameters, the Contractor agrees the subplot is defective and that the subplot shall be removed and replaced and the cost of retesting be deducted at the rates published in Section 1-05.7 from any monies due or that may come due the Contractor under the Contract. If the results of the challenge sample testing are within all parameters established above, the subplot will be accepted and the cost of retesting will be the Owner's responsibility.

D. Test Methods

Testing of HMA for compliance of volumetric properties (VMA, VFA V_a and Dust/Asphalt Ratio) will be by 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." 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 by WSDOT FOP for AASHTO T 308, "Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method." WAQTC FOP TM 6, "Moisture Content of Bituminous Mixtures by Oven." Testing for compliance of gradation will be by WAQTC FOP for AASHTO T 27/T 11.

E. Reject Mixture

- 1. Rejection by Contractor:** The Contractor may, prior to sampling, elect to remove any defective Material 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 shall be removed and replaced. In addition, the Engineer may also isolate and reject within a subplot any Material that is determined to be defective.

If, during paving, the Engineer determines Material being placed does not meet Specification, the Contractor shall shut down operations and shall not resume HMA placement until such time as 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 shall not be incorporated into the pavement. Any rejected HMA section of roadway shall be removed. The Contractor may request that he rejected Material be tested. If the Contractor elects to have the rejected Material tested, a minimum of three 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 meet Specification. In addition, the cost of sampling and testing shall be borne by the Contractor. If the Material meets Specification, the cost of sampling and testing will be 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 shall be laid upon an approved surface, spread, and struck off to the grade and elevation established. HMA paving equipment complying with Section 5-04.3(3)B shall be used to distribute the mixture.

A material transfer vehicle (MTV) shall be used on any paving operation where the daily placement exceeds 800 tons. Should a specific application arise where an MTV is not suitable, the Contractor shall submit a request for a waiver to the Engineer with explanation. The Engineer's approval is required for not using an MTV when daily placement is expected to exceed 800 tons.

Unless otherwise directed by the Engineer, the nominal compacted depth of any layer of any course shall conform to the following limits:

Material	Maximum
HMA Class 1"	0.35 feet
HMA Class 3/4"	0.30 feet
HMA Class 1/2"	0.25 feet
HMA Class 3/8"	0.10 feet

When more than one course is necessary to meet the final paving grade, the first course shall include any widening of the existing roadway and preleveling of the existing pavement surface. The preleveling course or courses shall be constructed so that the final wearing course has a uniform compacted depth and conforms to the finished grade and cross section elevations specified. Construction of one course upon another shall 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 one JMF is being utilized to produce HMA, the Material produced for each JMF shall be placed by separate spreading and compacting equipment. The intermingling of HMA produced from more than one JMF is prohibited. Each strip of HMA placed during a working shift shall 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 will be allowed without approval of the Engineer.

When laying HMA, the paver shall be operated 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 shall be adjusted to coordinate with the operation.

During mainline paving, the wings on the receiving hopper shall not be folded, and the mix level in the hopper shall 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 will be required. Lines shall be placed on both outer edges of the traveled way of each roadway. Horizontal control utilizing the reference lines will be permitted. The grade and slope for intermediate lanes shall be controlled automatically from reference lines, or by means of 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 will be 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 are failing to provide the necessary vertical control, the reference lines shall be promptly reinstalled by the Contractor before further placement of HMA.

5-04.3(8)A UTILITY ADJUSTMENTS

Utility castings shall be adjusted to finished grade prior to the construction of the final wearing course as described 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 shall be thoroughly and uniformly compacted. The completed course shall be free from ridges, ruts, humps, depressions, objectionable marks, and irregularities and shall conform to the line, grade, and cross-section shown in the Drawings. If necessary, the JMF may be altered in accordance with Section 9-03.8(7) to achieve desired results.

Compaction shall take place when the mixture is in the proper condition so that no undue displacement, cracking, or shoving occurs. All compaction equipment shall be Capable of producing the required compaction. Areas inaccessible to large compaction equipment shall 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, shall be removed and replaced at no additional cost with fresh material which shall be immediately compacted to conform with the surrounding area.

The type of rollers to be used and their relative position in the compaction sequence shall generally be the Contractor's option, provided Specification densities are attained. An exception shall be that pneumatic tired rollers shall 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 shall 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 shall 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 shall 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 CI having a specified compacted course thickness greater than 0.10 foot, the acceptable level of relative density shall be a minimum 92.0 percent of the reference maximum density. The reference maximum density will be determined by the Engineer as the moving average of the most recent three determinations for the JMF being placed to accommodate start-up for a large placement. Where less than three 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 subplot of an HMA CI will be determined as the average of five nuclear density gauge tests (after completion of the finish rolling) at randomly selected locations within each density subplot. In addition to the randomly selected locations, the Engineer may select any additional location(s) for testing that appears to be deficient or in any way defective. Such additional tests shall be included in the calculation of the average density for that subplot. The quantity represented by each subplot 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 subplot to a maximum of 600 tons. A lot shall be as defined 5-04.3(7)B.

5-04.3(9)B2 TEST RESULTS

Density sublots not meeting the prescribed minimum relative density shall be considered defective work, and shall be removed and replaced. No payment will be made for defective Material that fails to meet 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 shall be requested by no later than 12:00 AM of the next Working Day after receiving the test results. The cores will be taken at locations selected by the Engineer. Cores shall not be located in wheel paths. On sublots which 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 published in Section 1-05.7.

In addition to the randomly selected locations for relative density tests for a subplot, 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 subplot. Such isolated area determinations shall be 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 shall be as nearly continuous as possible, and the roller shall pass over the unprotected end of the freshly laid mixture only when the laying of the course is discontinued for such length of time as to permit the mixture to become chilled. When this work is resumed, the previously compacted mixture shall 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, a temporary wedge of HMA shall be constructed of a 5:1 H:V slope. The HMA in the temporary wedge shall be separated from the permanent HMA by strips of heavy wrapping paper. When paving operations are renewed, the wrapping paper shall be removed and the joint trimmed to a slightly beveled edge for the full thickness of the new HMA course. The Material which is cut away shall be disposed of and new mix shall be laid against the fresh cut. Rollers or tamping irons shall be used to seal the joint.

All joints shall be flush and provide a smooth transition across the meet line.

The longitudinal joint in any one layer shall be offset from the layer immediately below by not more than 6 inches nor less than 2 inches. All longitudinal joints constructed in the top layer shall be at a lane line or edge line of the traveled way. Where traffic conditions, project geometry or other condition 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. Two paving machines shall be used to construct longitudinal hot lap joints; a minimum average compacted density in accordance with 5-04.3(10) shall be achieved throughout the traffic lane; and construction equipment other than rollers shall not operate on any uncompacted mix.

Immediately following the compaction of the top wearing course, meet line joints where the new asphalt concrete abuts existing asphalt concrete pavements, Portland cement concrete pavements, oil mats, concrete curbs and gutter, etc., shall be sealed per 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 shall provide a smooth riding transition between the new surface and existing surface. Such work may require the modification of the existing roadway profile by burning, planing or milling in order 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, the existing abutting pavement shall be trimmed by chipping, planing, milling or such other acceptable method in order to insure a minimum depth of 2 inches of compacted asphalt concrete at the point of connection. Meet lines shall be trimmed straight and the edges vertical. Waste Material resulting from such trimming or chipping shall be disposed of by the Contractor.

Where the transition is to be made by shimming or feathering, it shall be accomplished at the time the final course is being constructed by raking out the oversize aggregate from the HMA class being used. The Contractor shall 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 case, structural HMA Class 3/8 Inch shall be used.

Surfaces to be in contact with the new asphalt shall be tacked in accordance with Section 5-04.3(4)C2.

Meet lines between new and existing surfaces shall 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) complying with Section 9-03.16.

5-04.3(11) RESERVED

5-04.3(12) SURFACE SMOOTHNESS

5-04.3(12)A GENERAL

The completed surface of all courses shall be of uniform texture, be smooth, have a continuous "plane" grade except across the crown. All surfaces shall be free from defects of all kinds. The completed surface of the wearing course shall not vary more than 1/8-inch from the lower edge of a 10-foot straightedge placed on the surface parallel to the centerline. The transverse slope of the completed surface of the wearing course shall vary not 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 shall be corrected to low places, or the removal of Material from high places by grinding with an acceptable grinding machine. The corrected deviation shall be sealed in accordance with Section 5-04.3(18). Where the Engineer determines grinding or filling does not allow for an acceptable repair, removal and replacement of the wearing course of asphalt concrete will be required. Correction of defects shall 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, these areas shall be removed and replaced to the extents determined by the Engineer.

However, if deviations are found which exceed the allowable tolerances but are not in excess of twice the allowable tolerances described above, and, in the opinion of the Engineer, correction by means of any of the methods specified above do not produce acceptable results as to 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 shall be vested entirely in the Engineer.

5-04.3(12)B CONCRETE OVERLAYING ASPHALT

When Portland cement concrete pavement is placed on asphalt concrete pavement, the surface tolerance of the asphalt concrete pavement shall be such that no elevation lies above the proposed finished grade minus the specified depth of Portland cement concrete pavement. Prior to placing the Portland cement concrete pavement, any such irregularities shall be brought to the required tolerance by grinding or other means acceptable to the Engineer.

5-04.3(13) RESERVED

5-04.3(14) RESERVED

5-04.3(15) WEATHER LIMITATIONS

Asphalt for prime coat shall not be applied when the ground temperature is lower than 50°F without written approval of the Engineer.

HMA shall not be placed 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 Limitation		
Compacted Thickness (Feet)	Wearing Course	Other Courses
Less than 0.10	55°F	45°F
0.10 to 0.20	45°F	35°F
0.21 to 0.35	35°F	35°F

5-04.3(16) RESERVED

5-04.3(17) PAVING AND PLANING UNDER TRAFFIC

5-04.3(17)A GENERAL

In addition the requirements of Section 1-07.23 and the traffic controls required in Section 1-10, unless the Contract specifies otherwise or the Engineer agrees to otherwise, the Contractor shall comply with the following:

- Intersections:** The Contractor shall keep intersections open to traffic at all times, **except when paving or planing operations through an intersection requires closure. Such closure shall be kept to the**

minimum time required to place and compact the HMA mixture, or plane as appropriate. For paving, such closure shall be scheduled to individual lanes or portions thereof that allow the traffic volumes and schedule of traffic volumes as required in the approved Traffic Control Plan. Work shall be scheduled so that adjacent intersections shall not be impacted at the same time. and shall comply with the traffic control restrictions required by the Traffic Engineer. Each individual intersection closure or partial closure, shall be addressed in the Traffic Control Plan to be submitted to and approved by the Engineer (see Section 1-10.2(5)).

When planing or paving and related construction must occur in an intersection, the Contractor shall consider scheduling and sequencing such work into quarters of the intersection, or half or more of an intersection with side street detours. The Contractor shall also be prepared to sequence the work to individual lanes or portions thereof.

Should closure of the intersection in its entirety be necessary, and no trolley service is impacted, such closure shall be kept to the minimum time required to place and compact the HMA mixture, plane, remove asphalt, tack coat, and as needed.

Any work in an intersection shall include advance warning in both signage and in Working Days advance notice as determined by the Engineer, to alert traffic and emergency services of the intersection closure or partial closure.

Work shall be scheduled so that consecutive intersections shall not have construction in-progress at the same time. New compacted HMA asphalt shall cool to ambient temperature before any traffic is allowed on it. Traffic shall not be 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:** The Contractor shall comply with the requirements of Section 1-10.3(4)C.

3. **Permanent pavement marking:** The Contractor shall comply with the requirements of Section 8-22.3(1).

5-04.3(17)B SUBMITTALS - PLANING PLAN AND HMA PAVING PLAN

The Contractor shall 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 begin date. These plans shall show, as to be discussed at the pre-planing briefing and pre-paving briefing, how the moving operation and traffic control are coordinated. When requested by the Engineer, the Contractor shall provide each operation's Traffic Control Plan on 24" x 36" 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 Drawing shall be 1 inch = 20 feet, or may be changed if the Engineer agrees sufficient detail is shown.

The planing operation and the paving operation includes, but is not limited to, metal detection, removal of asphalt and temporary asphalt of any kind, tack coat and drying, staging of supply trucks, paving train(s), rolling, scheduling, and as may be discussed at the briefing.

When intersections are to be partially or totally blocked, the Contractor shall provide a minimum 2 Working Days in advance, adequately sized and noticeable signage alerting traffic of closures to come. The Traffic Control Plan shall show where Peace Officers are to be stationed when signalization is to be, or may be, countermanded, and show areas where flaggers are proposed.

At a minimum, the planing and the paving plan shall include the following elements:

1. A copy of the approved traffic control plans (per 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(17)A).
3. Haul routes from Supplier facilities, and locations of temporary parking and staging areas, including return routes. The complete round trip shall be described as it relates to the sequencing of paving operations.
4. Names of, and locations of HMA Supplier facility(ies) to be used.
5. Listing of all equipment to be used for paving.
6. Listing 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. Such description shall 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 coordinations to be timely made.
8. Names, job titles, and contact information for field, office, and plant supervisory personnel.

5-04.3(17)C PRE-PAVING AND PRE-PLANING BRIEFING

At least two (2) Working Days **before** the first paving operation and the first planing operation, and as may be 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 shall be prepared to discuss that day's operations as they relate to other entities and the public's safety and convenience, including driveway and business access, garbage truck operations, Metro 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, emergency services, and as may be applicable. The Contractor, and Subcontractors as may be part of that day's operations, shall meet with the Engineer and discuss the proposed operation as it relates to the submitted planing plan and paving plan, approved Traffic Control Plan, public convenience and safety, and as may be necessary. Such discussion shall include, but not be limited to:

1. **General for both Paving Plan and for Planing Plan:**
 - A. The actual times of beginning 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 may be necessary;
 - E. Describe the sequencing of installation and types of temporary pavement markings as it relates to planing and to paving;
 - F. Describe the sequencing of installation of, and the removal of, temporary pavement patch material around exposed castings and as may be needed;
 - G. Describe the procedures and equipment to identify hidden metal in the pavement (such as survey monumentation, monitoring wells, street car rail, and castings) prior to planing (see Section 5-04.3(4)B3a);
 - H. Describe how flaggers will be coordinated with the planing, paving, and related operations;
 - I. Describe the sequencing of traffic controls for the process of rigid pavement base repairs; and
 - J. Other items the Engineer may deem necessary to address.
2. **Paving - additional topics:**
 - a) When begin applying tack and coordinating with paving;
 - b) The 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 equipment. Discuss the continuance of operator personnel for each type equipment as it relates to obtaining Specification requirements;
 - c) The number of JMFs to be placed and if more than one JMF, how the Contractor ensures that the different JMFs are distinguished, how pavers and MTVs are distinguished if more than one JMF is being placed at the time, and how pavers and MTVs are cleaned so that one JMF does not adversely influence the other JMF;
 - d) Describe 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(18) SEALING OF PAVEMENT SURFACES

Any wearing course or other pavement course to be used for the driving surface will be evaluated by the Engineer to determine whether a fog seal is required. Determination will be made when the results of nuclear or core density testing show that a seal is needed. The fog seal shall be CSS-1 or CSS-1h emulsified asphalt uniformly applied to the pavement. The finished application shall be free of streaks and bare spots. The emulsified asphalt shall be diluted at a rate of one part water to one part emulsified asphalt. The diluted emulsified asphalt shall be applied at the rate of 0.10 to 0.18 (0.03 to 0.05 residual) gallons per square yard. The emulsified asphalt shall be applied within the temperature range specified for these asphalt emulsions in Section 5-02.3(3). Unless otherwise approved by the Engineer, the fog seal shall be applied prior to opening to traffic.

5-04.3(19) ANTI-STRIPPING ADDITIVE

Anti-stripping additive shall be added to the HMA in accordance with the Engineer determined anti-stripping additive requirement as made known on the returned submittal (see Section 5-04.3(6)C)2.

5-04.3(20) SHOULDER PAVING

Shoulders, if required, shall be constructed to the lines, grades, and cross-sections specified. Material for building up shoulders shall be Mineral Aggregate Type 1.

5-04.3(21) NON-STRUCTURAL HMA APPLICATIONS

5-04.3(21)A HMA SIDEWALKS

Asphalt walkways shall be constructed at the locations and to the width specified on the Drawings. Unless the Contract specifies otherwise, asphalt walkways shall be constructed with a 4 inch section of compacted crushed rock Mineral Aggregate Type 2 and covered with 3 inches of compacted HMA Class ½ Inch.

5-04.3(21)B HMA DRIVEWAYS

Asphalt driveways shall be constructed as shown on the Drawings. Unless the Contract specifies otherwise, the Contractor shall provide 3 inches of compacted HMA of the class specified in the Contract over 4 inches of compacted Mineral Aggregate Type 2.

5-04.3(22) RESERVED**5-04.3(23) TEMPORARY PAVEMENT PATCHING**

Unless the Contract designates an HMA CL asphalt concrete as a temporary patch Material, the temporary asphalt patch Material shall be in accordance with Section 9-02.5.

The Contractor shall furnish, place and maintain a 4 inch minimum compacted thickness of temporary pavement patch Material over open cuts. Such temporary asphalt patching will be required where vehicular or pedestrian traffic must be accommodated and permanent pavement patching cannot be placed immediately. Trench backfill shall be compacted as specified in Section 7-17.3(3). Temporary pavement patch Material shall be compacted and leveled to coincide with adjacent surfaces.

In the event that the temporary surface subsides after the initial placement, additional temporary pavement patch Material shall be placed over the subsided Material as necessary to maintain a surface level with existing pavement. The Contractor shall timely maintain such temporary patching.

Prior to final restoration of the pavement, the Contractor shall 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.

5-04.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

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 shall 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 upon 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 inch maximum to cover removal of high spots, to cover extra thickness 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 order an area be planed in excess of 4 inches, that area planed in excess of 4 inch total depth will be measured in additional square yards of surface planed for up to an additional 4 inch 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 inch thickness will include multiples of 4 inches with the last planing pass up to 4 inch maximum. (Example – an area of pavement planed to 9.5 inch total depth will be measured as 3 times the square yardage for that area, or 4inch + 4 inch + 1.5 inch or up to 4 inch.). Measurement shall also include 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. An exception for measuring pavement patch for electrical conduit construction as specified in Section 8-33 will be based on actual measured dimensions with the width of restoration no greater than 24 inches.

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.

5-04.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 5-04 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "Pavement, HMA (Class)", per ton.

The Bid item price for "Pavement, HMA (Class)" shall include 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" shall include all costs for the work required to prepare the untreated roadway, including scarifying, blading, shaping, and compacting to remove irregularities and secure a uniform surface except prime coat treatment which will be paid in accordance with Section 5-02.

3. "Surface Preparation, Prelevel", per ton.

The Bid item price for "Surface Preparation, Prelevel" shall include 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" shall include 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" shall include 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" shall include 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 shall be at the sole expense of the Contractor.

7. **"Material Transfer Vehicle (MTV)"**, per ton.

The Bid item price for "Material Transfer Vehicle (MTV)" shall include all costs for the work required to place HMA through the MTV. All cost for the MTV not included in "Material Transfer Vehicle (MTV)" shall be included in other Bid items and no separate or additional payment will be made therefore.

8. **Other payment information.**

Payment for Mineral Aggregate (Type) will be made in accordance with Section 4-01.5.

Payment for removal will be made in accordance with 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), shall be 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 shall 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 shall be placed and compacted at no additional expense to the Owner.

Where the Engineer accepts area of pavement that does not meet the smoothness requirement as specified in Section 5-04.3(12)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 one 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 shall be at the Contractor's sole expense and no separate or additional payment will be made therefore.

Payment for backfill and compaction of the subgrade shall be included in the Bid item price for the particular Bid item(s) of Work necessitating such work.

Payment for subgrade preparation as required by Section 5-04.3(4)C1 will be in accordance with Section 2-06.5.

Payment for Material used for fog seal as specified in Section 5-04.3(18) 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(12).

All costs for anti-stripping additive as specified in Sections 5-04.3(6) and 5-04.3(19) shall be 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 shall be incidental to and included in the applicable Bid item prices and no separate or additional payment will be made therefore.

All costs to repair pavement damaged by the removal of temporary marking tape specified in Section 5-04.3(17) shall be at the Contractor's sole expense and no additional or separate payment will be made therefore.

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, shall be at the sole expense of the Contractor and no separate or additional payment will be made therefore.

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 therefore.

All cost associated with Contractor proposed and Engineer approved use of RAP, and use of substitute asphalt binder grade as specified in Section 5-04.2(1), shall be at no cost to the Owner and no separate or additional payment will be made therefore.

All cost to remove and replace newly placed pavement that is defective shall be at the Contractor's sole expense and no separate or additional payment will be made therefore.

All cost related to planing equipment that is damaged by contacting metal hidden in pavement shall be at the Contractor's sole expense and no separate or additional payment will be made therefore. 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, shall be in accordance with Section 7-20.5.

All cost related to addressing hidden metal found in pavement as required before beginning planing that are not shown on the Drawings, shall be in accordance with Section 1-04.7.

SECTION 5-05 PORTLAND CEMENT CONCRETE PAVEMENT

5-05.1 DESCRIPTION

Section 5-05 describes work consisting of constructing Portland cement concrete pavements in streets, roads, and alleys on a prepared subgrade or base course in conformity with the lines, grades, thicknesses, and typical cross-sections indicated on Standard Plans and as otherwise indicated in the Contract.

This work shall also consist of constructing Portland cement concrete edge walls, support walls and curb walls at locations shown on the Drawings, and shall further include concrete patching of various types of pavement cuts.

Concrete pavement patching is defined as the restoration of a small or narrow pavement structure cut, less than full panel width, resulting from trench excavation to install underground facilities. Concrete pavement restoration that requires full panel replacement shall be not be treated as "Patching".

5-05.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Portland Cement and Pozzolans	9-01
Concrete Aggregates	9-03.1
Joint Filler and Joint Sealant	9-04
Mortar for Edge and Support Wall	9-04.3(1)
Reinforcing Bar, Tie and Dowel Bars, and Wire Mesh Reinforcement	9-07
Concrete Curing Materials, Pozzolans, and Admixtures	9-23
Water	9-25.1
Epoxy Resins	9-26
Temporary Pavement Marking	9-29.4

The concrete mix for arterial pavement shall be Class 6.5 (1-1/2), and for residential streets and alleys shall be Class 6 (1-1/2).

Concrete for curb wall and for support wall shall be Class 6 (1-1/2).

Concrete mixes incorporating pozzolans may be utilized for all classes of concrete. Mix proportions will be subject to approval by the Engineer and shall meet the requirements of Section 9-23.9.

Cement concrete pavement patch shall be Class 6.5 (1-1/2) H.E.S.

Water reducing admixtures shall meet the requirements of Section 9-23.6.

The use of calcium chloride will not be allowed.

All concrete mix designs shall be submitted to the Engineer for approval at least 10 Working Days in advance of ordering.

5-05.3 CONSTRUCTION REQUIREMENTS

5-05.3(1) PROPORTIONING MATERIALS

Each batch of concrete delivered to the Project Site shall be accompanied with a Manufacturer's Certificate of Compliance indicating the batch weights.

The class of concrete for non-structural uses refers to the nominal number of sacks of Portland cement per cubic yard concrete mix, although this designation does not constitute a guarantee of yield. The figure in parenthesis indicates the maximum size of aggregate particle. Example: "CI 5 (1-1/2)" is a 5 sack Portland cement concrete mix with 1-1/2 inch maximum size coarse aggregate.

H.E.S. indicates high-early-strength Portland cement and may be included in the class of concrete. Example: "CI 6 (1-1/2) H.E.S." is a 6 sack high early strength Portland cement concrete mix with 1-1/2 inch maximum size coarse aggregate.

With approval of the Engineer, the Contractor may use high-early-strength Portland cement in any of the mixes (see submittal requirement in Section 5-05.2).

Air-entrained concrete shall be used.

The volume of entrained air in freshly mixed concrete shall conform to that specified in the following table:

Air Content of Freshly Mixed Concrete	
Maximum Size of Coarse Aggregate (Inches)	Air Content Percent by Volume
1-1/2, 2 and 3	5 ± 1
3/4 and 1	6 ± 1
3/8 and 1/2	7-1/2 ± 1

If the measured air content is found outside the range of values contained in the table, the Contractor shall immediately make changes in mixing or Materials as necessary to comply with the requirements for air content.

Fine and coarse aggregates shall be proportioned by weight except that if project pavement construction is small, volumetric proportioning may be used with advanced permission of the Engineer. In proportioning, the unit of measure for Portland cement will be by the 94 pound sack.

Weights of fine and coarse aggregate are based on a bulk specific gravity, saturated surface dry, of 2.67.

Concrete mixes shall be proportioned as specified in the table which follows. The weight of each size of aggregate is the estimated quantity to be used with one sack of cement. With approval of the Engineer (see submittal requirements in Section 5-05.2), the proportion of aggregate may be altered to give better workability.

Class of Concrete (Maximum Aggregate Size)	5 (3/4)	5 (1-1/2)	5.5 (1-1/2)	6 (3/4)	6 (1-1/2)	6.5 (1-1/2)	Section Reference
28 day Compressive Strength, lbs. per sq. in.	2,300	2,300	2,500	3,000	3,000	3,600	....
Sacks per Cubic Yard	5	5	5.5	6	6	6.5	....
Pounds dry Fine Aggregate No. 1	....	275	248	....	220	210	9-03.1(2)
Pounds dry Fine Aggregate No. 2	291	....	....	203	....	....	9-03.1(2)
Pounds No. 2 Coarse Aggregate	....	....	....	....	....	280	9-03.1(3)
Pounds No. 4 Coarse Aggregate	....	166	150	....	132	....	9-03.1(3)
Pounds No. 5 Coarse Aggregate	387	248	223	320	201	....	9-03.1(3)

In adjusting concrete mixes, the following water-cement ratios shall not be exceeded:

Cement Sacks (Sacks Per Cubic Yard)	Maximum Water (Gallons Per Sack)
4	8.2
5	6.5
5.5	6.0
6	5.5
6.5	5.1

"Sack" = 94 pound bag Portland cement.

5-05.3(2) CONSISTENCY (SLUMP REQUIREMENTS)

The Materials shall be mixed with sufficient water to produce a stiff concrete which holds its shape when deposited upon the base course or subgrade. Concrete placed during wet weather shall be mixed with sufficient water to produce a very stiff mixture. The consistency shall be such that separation of the mortar from the coarse aggregate shall not occur in handling.

Slump shall be measured in accordance with ASTM C 143 "Method of Test for Slump of Portland Cement Concrete".

The water/cement ratio shall not produce a mix with a slump greater than 2 inches for other than slip form construction, and 1/2 inch for slip form construction. Concrete slump with water-reducing agent shall not exceed 3-1/2 inches. A water-reducing agent shall be added to the concrete mix when:

1. The Contractor elects to hand-screed and/or hand-finish concrete paving work in lieu of using a mechanical finishing machine, or
2. Increased workability is necessary due to weather conditions or other variables, and is acceptable to the Engineer.

5-05.3(3) EQUIPMENT

Equipment necessary for handling Materials and performing all parts of pavement construction shall require approval by the Engineer as to design, capacity, and mechanical condition. The equipment shall be at the Project Site sufficiently ahead of the start of paving operations to be examined thoroughly.

1. **Batching plant and Equipment:**
 - a. **General:** The batching plant shall include bins, weighing hoppers, and scales for the fine aggregate and for each size of coarse aggregate. If cement is used in bulk, a bin, hopper, and separate scale for cement shall be included. The weighing hoppers shall be properly sealed and

vented to preclude dusting during operation. The batching plant shall be equipped with a suitable nonresettable batch counter which correctly indicates the number of batches proportioned.

- b. **Bins and hoppers:** Bins with adequate separate compartments for fine aggregate and for each size of the coarse aggregate shall be provided in the batching plant.
- c. **Scales:** Plant and truck scales shall meet the requirements of Section 1-09.2.
- d. The batching plant shall be equipped to proportion aggregates and bulk cement by means of automatic weighing devices of an approved type.

2. **Mixers:**

- a. **General:** Concrete may be mixed at a batching plant or wholly or in part in truck mixers. Each mixer shall have attached in a prominent place a manufacturer's plate showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades.
- b. **Batching plant:** Mixing shall be in an approved mixer Capable of combining the aggregates, cement, and water into a thoroughly mixed and uniform mass within the specified mixing period. The mixer shall be equipped with an approved timing device which automatically locks the discharge lever when the drum has been charged and releases it at the end of the mixing period. The device shall be equipped with a bell or other suitable warning device adjusted to give a clearly audible signal each time the lock is released.

Mixers shall be cleaned at suitable intervals. The pickup and throw-over blades in the drum or drums shall be repaired or replaced when they are worn down 3/4 inch or more. The Contractor shall have available at the Project Site a copy of the manufacturer's design, showing dimensions and arrangements of the blades in reference to original height and depth, or provide permanent marks on blades to show points of 3/4 inch wear from new conditions. Drilled holes 1/4 inch in diameter near each end and at midpoint of each blade are recommended.

- c. **Truck mixers and truck agitators:** Truck mixers used for mixing and hauling concrete, and truck agitators used for hauling plant-mixed concrete, shall conform to and accommodate the requirements of Sections 6-02.3(3) and 6-02.3(4).
- d. **Nonagitator trucks:** Bodies of nonagitating hauling equipment for concrete shall be smooth, mortar-tight, metal containers and shall be Capable of discharging the concrete at an acceptable controlled rate without segregation. If discharge of concrete is accomplished by tilting the body, the surface of the load shall be retarded by a suitable baffle. Covers shall be provided when needed for protection. Plant-mixed concrete may be transported in nonagitated vehicles provided that the concrete is delivered to the site of pavement construction 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.

3. **Finishing Equipment:**

- a. The standard method of constructing concrete pavement on roadways shall be with one or more self-propelled paving machines which spread, screed, shape and consolidate the freshly placed concrete between stationary side forms. The Contractor may option to use approved slip-form paving equipment designed to spread, consolidate, screed and float-finish the freshly placed concrete in one complete pass of the machine with minimum of hand finishing.
- b. On projects requiring less than 500 square yards of cement concrete pavement or on projects requiring individual placement areas of less than 500 square yards, irregular areas and at locations inaccessible to self-propelled paving equipment, cement concrete payment may be placed with approved placement and hand finishing equipment utilizing stationary side forms. Hand screeding and float finishing of cement concrete pavement may only be utilized on small irregular areas as allowed by the Engineer.
- c. Along with the basic tools required for compacting and finishing concrete pavement, a long handle, 10-foot metal straight edge for checking the surface smoothness as described in Section 5-05.3(12), shall be furnished by the Contractor and shall be at the site of pavement construction prior to the commencing of placing concrete. The straight edge shall be lightweight, straight and true, equipped with a long handle to allow for checking the smoothness of the surface along the entire width of the pavement section.

4. **Joint Sawing Equipment:**

- a. The Contractor shall provide approved power driven saws for sawing joints, adequate in number of units and power to complete the sawing at the required rate. The Contractor shall provide at least one standby saw in good working order. An ample supply of saw blades shall be maintained at the site of the pavement construction at all times during sawing operations. The Contractor shall provide adequate artificial lighting facilities for night sawing. All of this equipment shall be on the pavement construction site both before and continuously during concrete placement. Sawing equipment shall be available immediately and continuously upon call by the Contractor on a 24 hour basis, including Saturdays, Sundays and Holidays.

5. **Smoothness Testing Equipment:**

- a. Along with the basic tools required for compacting and finishing concrete pavement, a long-handle, 10-foot straight edge for checking the surface smoothness as described in Section

5-05.3(12) shall be furnished by the Contractor and shall be at the site of pavement construction prior to the commencing of placing concrete. The straight edge shall be lightweight, straight and true, equipped with a long handle to allow for checking the smoothness of the surface along the entire width of the pavement section.

- b. On large paving projects ("large" is defined as 1000 LF or more of continuous concrete pavement) the Contractor shall provide a California type computerized profilograph, complete with recorder, for determining the profile index of the pavement according to WSDOT Test Method No. 807.

The profilograph shall be on the Project Site, calibrated, in good working condition, and ready for operation before construction of any concrete pavement begins.

The operator shall be competent and experienced in operation of the equipment.

5-05.3(4) HANDLING, MEASURING, AND BATCHING MATERIALS

The batch plant site, layout, equipment, and provisions for transporting Material shall ensure a continuous supply of Material to the location of pavement construction. See Section 5-05.3(1) regarding batch ticket reporting requirements.

1. Measuring Materials:

- a. **Aggregates:** The fine aggregate and each size of coarse aggregate shall be measured by weighing, the weight for the particular aggregates used being proportional to their respective bulk specific gravities. The weighing of each size of Material shall be a separate and distinct operation.

Corrections shall be made for variations in weight of Materials due to the moisture content.

The equipment for weighing aggregates shall conform to the requirements of Section 1-09.2.

- b. **Cement:** Cement shall be weighed on scales meeting the requirements of Section 1-09.2. Adequate provision shall be made to prevent loss of cement between the batch box and the mixer.
- c. **Water:** Water may be measured either by volume or by weight. The accuracy of measuring the water shall be within a range of error of not over 1 percent.

2. Batching Materials:

- a. On all projects requiring more than 2,500 cubic yards of Portland cement concrete for paving, the batching plant shall be equipped to proportion aggregates and cement by weight by means of automatic and interlocked proportioning devices of approved type.

5-05.3(5) MIXING CONCRETE

5-05.3(5)A GENERAL

The concrete may be mixed in a batching plant or in truck mixers. The mixer shall be of an approved type and capacity. Mixing time shall be measured from the time all Materials are in the drum. Ready-mixed concrete shall be mixed and delivered in accordance with the requirements of Sections 6-02.3(3) and 6-02.3(4).

When mixed in a batching plant, the mixing time shall not be less than 50 seconds nor more than 90 seconds.

The mixer shall be operated at a drum speed as shown on the manufacturer's name plate on the mixer. Any concrete mixed less than the specified time shall be discarded and disposed of by the Contractor at no expense to the Owner. The volume of concrete mixed per batch shall not exceed the mixer's rated capacity, as shown on the manufacturer's standard rating plate on the mixer.

Each concrete mixing machine shall be equipped with a device for counting automatically the number of batches mixed during the day's operation.

All elements of a batch shall be simultaneously and continuously fed to the mixer to ensure uniform distribution of cement, water, aggregates, and admixtures.

Retempering concrete by adding water or by other means will not be permitted. Admixtures for increasing the workability or for accelerating the set will be permitted only when specified, or when approved by the Engineer.

5-05.3(5)B LIMITATIONS OF MIXING

Concrete shall not be mixed, placed, or finished when the natural light is inadequate, unless an adequate and approved artificial lighting system is operated.

Mixing and placing concrete shall be discontinued when a descending air temperature in the shade away from artificial heat reaches 40°F and shall not be resumed until an ascending air temperature in the shade and away from artificial heat reaches 35°F 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 prior to being placed in the mixer. The apparatus used shall heat the mass uniformly and shall be arranged to preclude the possible occurrence of overheated areas which might injure the Materials. The temperature of the mixed concrete shall be not less than 50°F and not more than 90°F at the time of discharge into the hauling conveyance. No concrete shall be mixed with frozen aggregates.

5-05.3(6) SUBGRADE

Subgrade shall be constructed, and maintained, in accordance with the requirements of Section 2-06.

Where thickened edges for pavements are required, such as shown on the Standard Plans, the subgrade shall be excavated and shaped to provide for the section shown.

Wherever possible, traffic and equipment shall be kept off the finished subgrade. If equipment must travel on the subgrade ahead of the paving, a power drag shall be carried immediately ahead of placing concrete. Irregularities in the subgrade caused by any equipment during the placement of concrete shall be smoothed out and compacted immediately ahead of placing the concrete.

5-05.3(7) PLACING, SPREADING, AND COMPACTING CONCRETE

All the requirements for concrete mix, density, finish and surface smoothness apply regardless of the methods used to place concrete pavement.

5-05.3(7)A CONCRETE PAVEMENT CONSTRUCTION - GENERAL

Concrete shall be placed, spread, and consolidated between stationary forms by means of an approved paving machine or an approved slip-form paver at the Contractor's option. Hand methods of spreading and consolidating concrete shall be limited to pavement patching, to small panel replacement, to irregular areas, and to pavement placed in confined areas.

Where pavement structures have grades of 4 percent or more, the direction of the paving operation shall be uphill, starting from the lowest street elevation.

Unless otherwise specified in the Contract, paving widths from 25 feet to 44 feet shall be paved in 2 operations with compensation allowed for thickened edge on each side of the included longitudinal construction joint. Should the Contractor be allowed to pave in more than 2 operations for the above widths, the additional thickened edges required due to installation of more than one construction joint shall be made at no additional expense to the Owner. When "hand" screeding methods are allowed, paving widths shall not exceed 12 feet on arterials or 13 feet on non-arterials. Full-width paving will be allowed only with written permission of the Engineer.

Keyways shall be provided at all longitudinal construction joints and at transverse construction joints without dowels.

Mixers and trucks shall be operated on the subgrade or on the shoulder adjacent to the lane being paved. Newly paved lanes shall not be used for mixers, trucks or other construction equipment unless the concrete pavement meets the requirements set forth in Section 5-05.3(17).

A protective ramp shall be constructed at the pavement structure edge where equipment may be driven on and off the existing pavement. The forms shall be left on the outside edge of the first lane at all turnouts until the pavement is opened to traffic.

Where tie bars are required, they shall be placed before the concrete is poured, except when slip form paving machines equipped with an approved tie bar insertion device are used (see Standard Plan no. 405). If the tie bars impede the flow of traffic, the tie bars shall be protected from traffic by bending down the back against the side form. Prior to placing concrete in the adjacent lane, the tie bars shall be straightened.

An 1/8-inch thick metal plate, 5 inches wide and no less than 10 feet long, shall be placed flat on top of the completed pavement along its edge at the common joint with the adjacent pavement slab to be poured. The concrete shall be struck off from this plate, either by machine or by hand placement methods.

All pavement and other surfaces in use by the Contractor shall be kept adequately moist to prevent the accumulation of dust on the freshly placed concrete.

5-05.3(7)B SLIP FORM CONSTRUCTION

At the option of the Contractor and with the approval of the Engineer, concrete pavement may be constructed by the use of slip-form paving equipment.

Slip-form paving equipment shall be provided with traveling side forms of sufficient dimensions, shape and strength to support the concrete laterally for a sufficient period of time during placement to produce pavement of the required cross section and the equipment shall spread, consolidate, screed, and float-finish the freshly placed concrete in such a manner as to provide a dense and homogenous pavement.

The concrete shall be distributed uniformly into final position by the slip-form paver and the horizontal deviation in alignment of the edges shall not exceed the 1/2 inch from the alignment established by the Engineer.

The paver shall vibrate the concrete for the full width and depth of the strip of pavement being placed and the vibration shall be adequate to provide a consistency of concrete that stands normal to the surface with sharp well defined edges. The sliding forms shall be rigidly held together laterally to prevent spreading of the forms.

The plastic concrete shall 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 shall not exceed 9 inches. The spacing of internal units shall be uniform and not exceed 18 inches.

The term internal vibration means vibration by vibrating units located within the specified thickness of pavement section and a minimum distance equal to the pavement thickness ahead of the screed.

The rate of vibration of each vibrating unit shall be not less than 7500 cycles per minute, and the amplitude of vibration shall be 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 shall be varied proportionately with the rate of travel to result in a uniform density and air content. The paving machine shall be equipped with a tachometer or other suitable device for measuring and indicating the actual frequency of vibrations.

The concrete shall be held at a uniform consistency, having a slump as specified in Section 5-05.3(2). The slip-form paver shall be operated with as nearly a continuous forward movement as possible and all operations of mixing, delivering, and spreading concrete shall be coordinated 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 shall also be stopped immediately. No tractive force shall be applied to the machine, except that which is controlled from the machine.

Regardless of the method or machinery used to construct pavement, depressed curb for driveways and ramps shall be provided at those locations indicated on the Drawings or as required by the Engineer. When a slip-form paving machine is used for pavement construction, the Contractor shall block out the pavement area beneath areas where depressed curb is to be constructed. Such blocked out pavement areas, together with the depressed curb sections, shall then be constructed concurrently with the cement concrete item needing the depressed curb.

When concrete is being placed adjacent to an existing pavement, that part of the equipment which is supported on the existing pavement, shall be equipped with protective pads on crawler tracks or rubber-tired wheels and shall be offset to run a sufficient distance from the edge of the pavement to avoid breaking or cracking the pavement edge.

After the concrete has been given a preliminary finish by the finishing devices in the slip-form paving equipment, the surface of the fresh concrete shall be checked with a straight-edge to comply with the tolerances and finish specified in Section 5-05.3(12).

With slip-form construction, tie bars shall be set in place along the longitudinal joint. Keyway will not be required on sawcut longitudinal joints.

5-05.3(7)C STATIONARY SIDE FORM CONSTRUCTION

Forms and headers and their placement shall meet the requirements of Section 5-05.3(21).

The concrete shall be placed upon the prepared subgrade or base between the forms to the required depth and cross section in a continuous operation between construction or expansion joints. No concrete shall be placed until the forms are approved by the Engineer.

The concrete shall be thoroughly consolidated by mechanical vibration. Complete consolidation is required along all forms or adjoining pavements by such means which prevent gravel pockets along the edges of the finished pavement. Any gravel pockets found after removing the forms shall be repaired by the Contractor.

When integral curb is being constructed with the pavement, fresh concrete for the integral curb shall be placed at such time which enables the top section of the curb to be consolidated, finished, and bonded to the pavement slab while the concrete is plastic.

Where curb is required, and such curb is not being placed integrally with the pavement slab, dowels shall be placed in the pavement slab as specified in Section 8-04.

5-05.3(7)D PLACING CONCRETE AT THROUGH JOINTS

Concrete placement around through joints shall be such that the through joint assembly shall not be disturbed and that it shall remain in a straight line perpendicular to the subgrade, as shown on the Standard Plans. The concrete shall then be vibrated along the entire length of the joint to consolidate the concrete and leave no rock pockets anywhere at the joint.

5-05.3(7)E PLACING CONCRETE WITH REINFORCING STEEL OR WIRE MESH

Concrete shall not be placed until the subgrade and the reinforcing steel or wire mesh has been approved by the Engineer. The Contractor shall use positive reinforcing steel or wire mesh as shown on Drawings and shall ensure the reinforcing steel or mesh is not displaced as the concrete is placed.

Reinforcement shall be free of dirt, mill scale, oil, grease, or other foreign Material that may impair bond. Steel, coated with rust, may be used if the oxidations are not deep or loose coated.

Requirements for placing and fastening reinforcing steel are specified in Section 6-02.3(24)D.

Successive mats of steel or wire mesh shall be securely lapped together and tied so that longitudinal bars lap a minimum 40 diameters and wire mesh laps 6 to 12 inches.

Reinforcement shall be laid as a continuous mat. Continuity shall be maintained between expansion joints. Steel shall terminate at the designated locations in the slab.

5-05.3(7)F COMPACTING CONCRETE

5-05.3(7)F1 GENERAL

All cement concrete pavement shall be vibrated. Vibration shall be by internal vibration, and/or surface vibration.

5-05.3(7)F2 INTERNAL VIBRATION

Internal vibrations shall comply with Section 6-02.3(8) except that slip-form paver vibration shall comply with Section 5-05.3(7)B, and combined vibration and machine compaction shall comply with Section 5-05.3(7)F4.

5-05.3(7)F3 MACHINE COMPACTION

The machine used for compacting shall be self-propelled and designed to run on the side forms. Movable parts shall be Capable of adjustment and they shall be adjusted so as to produce accurately the roadway sections shown on the Drawings. The machine shall be equipped with two reciprocating screeds. The tops of the forms shall be kept clean with a suitable device attached to the machine.

The travel of the machine on the forms shall be maintained true without lift, wobble or other variations which might prevent a precise strike off.

The machine shall be put in forward motion as soon as concrete is deposited on the subgrade. On the first pass, a roll of concrete shall be carried ahead of the screed. Screeds and tampers shall be operated so as not to disturb expansion joints and caps.

Machines shall be operated prior to placing longitudinal and transverse dummy joints.

Machines shall be operated at least twice and as many more times as may be necessary to compact concrete free from rock pockets, and to a section that can be finished properly.

Care shall be exercised not to overwork the concrete and being an excess of mortar to the surface.

5-05.3(7)F4 COMBINED VIBRATION AND MACHINE COMPACTION

The combined vibration and compaction equipment shall be demonstrated as being Capable of consolidating the concrete across the full width of the pavement into a homogenous mass, free of rock pockets, and without separation of mortar and aggregate.

The vibration equipment shall be either as described in Section 5-05.3(7)F3, or shall be an approved spreading machine to which is attached a vibrating unit composed of individual internal vibrators spaced not more than 29 inches apart. The vibrators shall be spaced equidistantly, and the distance from the side forms to the nearest vibrator shall not exceed 14 inches. The vibrators shall be carried behind and independent of the strike-off screed of the spreading machine, or ahead of and independent of the strike-off screed of the first compacting machine.

The vibrating unit shall not rest upon the side forms nor impart vibration to the strike-off screeds. The individual vibrators shall be attached to a frame in a manner which permits adjustment of both the depth of penetration into the concrete and the angle of the vibrator with the horizontal.

The entire vibrating unit shall allow raising the vibrator tips completely clear of the concrete surface.

The vibrator shall be Capable of vibrating at rates between 4,800 and 8,000 pulses per minute when inserted in the concrete. All vibrators shall be synchronized to vibrate at a frequency specified by the Engineer, within the limits established.

On the first trip over the freshly placed concrete the vibration equipment shall be submerged in the concrete to ensure adequate consolidation. The vibration equipment shall be operated on the first pass only. The vibration equipment shall not be operated when the machine is not in motion except when vibrating near an expansion joint.

After the first pass with vibration, additional passes without vibration shall comply with Section 5-05.3(7)F3.

5-05.3(7)F5 VIBRATING SCREED CONCRETE PAVEMENT CONSTRUCTION

The type of vibrating screed which the Contractor proposes to use, whether roller or beam, shall be subject to the approval of the Engineer. Upon request by the Engineer, a test section of pavement shall be placed for the purpose of demonstrating the capabilities of the screed to acceptably compact and strike off the concrete to the established grade and section.

Concrete shall be uniformly distributed between the forms and it shall then be compacted and screeded to the level of the top of the forms by means of the vibrating screed. Supplemental compaction by mechanical vibration of the concrete adjacent to the forms will be required if the concrete cannot be acceptably compacted by the vibrating screed.

The vibrating screed shall be operated over the freshly placed concrete in successive passes only a sufficient number of times to obtain maximum compaction. Over-vibration of the concrete, resulting in an excess of mortar at the surface of the pavement, will not be permitted.

After the final passages of the vibrating screed, the surface of the concrete shall be at the established pavement grade and cross section and shall be sufficiently smooth as to require only a very moderate amount of hand finishing for smoothness to meet approval of the Engineer.

5-05.3(8) JOINTS**5-05.3(8)A GENERAL**

Transverse and longitudinal joints shall be contraction or through joints (including construction joints). Joints shall be constructed in accordance with Standard Plan no. 405 and shall be of the type and at the locations indicated on the Drawings. The faces of all joints shall be constructed perpendicular to the surface of the cement concrete pavement.

5-05.3(8)B CONTRACTION JOINTS**5-05.3(8)B1 FORMED CONTRACTION JOINTS**

Formed contraction joints shall be constructed by embedding a ¼-inch thick premolded joint Material as indicated on Standard Plan no. 405. The depth of the formed joints shall be 1/3 of the pavement thickness. The filler shall be cut to the exact section of the joint. The length of the premolded joint filler shall extend to within 1/4-inch of any panel edge.

Transverse contraction joints (dummy joints) shall be placed after compaction and finishing of concrete have been completed and before initial set. A vertical groove shall be cut 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. The preformed joint Material shall then be embedded 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 joint filler shall be perpendicular to the surface and always in a straight line.

After the joint filler has been embedded in the concrete, the surface of the pavement shall be finished against the filler strip with hand floats to restore the surface finish. While performing this operation, the filler strip shall be maintained in a perpendicular position, true to alignment. After finishing the entire area, the joint shall be true to grade, smooth and without irregularities.

The premolded joint filler may be omitted provided the joints are subsequently sawed in accordance with the provisions of Section 5-05.3(8)B2.

5-05.3(8)B2 SAWED CONTRACTION JOINTS

Sawed contraction joints shall be constructed by sawing a vertical groove in the hardened concrete on an approved schedule after placing and before development of random cracks in the concrete slab. The depth of sawcut shall be 1/3 the pavement thickness and shall not cut underlying pavement tie bars and dowel bars (see Standard Plan no. 405). Transverse contraction joints shall be sawed before the longitudinal joints are sawed. The first set of transverse joints shall be sawed at a maximum of 60 foot intervals, as soon as the cut can be made without undue raveling of concrete. Intermediate joints shall be sawed immediately following the first set of joints. The Contractor shall provide the Engineer a minimum 4 hours advance notice of sawcutting.

Any scheduling for the sawing of joints that results in premature or uncontrolled cracking shall be revised immediately by adjusting the time interval between placing of concrete and the sawing of joints. After the revised schedule has been accepted by the Engineer, the sawing shall proceed as a continuous operation until all joints have been completed.

Two or more sawing units may be required to accomplish the sawing in order to minimize random cracking. Standby equipment shall be on the job to ensure continuity of sawing regardless of any breakdown of equipment.

Where curing membrane is used, the area disturbed by sawing of joints shall be resprayed immediately upon completion of the sawing operation and care shall be exercised to prevent the curing compound from getting into the groove. Joint sealing compound shall not adhere to concrete if curing compound is present.

The concrete saw shall be powered adequately to perform the required cutting. It shall cut a uniform groove to the required depth and not less than 3/16-inch nor more than 5/16-inch in width. The Contractor will be expected to so arrange the schedule of sawing joints, including initial sawing, at the required intervals so that every possible effort is made to control cracking by the use of judiciously spaced and timed sawed joints. In the event random cracks occur, they shall be repaired in accordance with Section 5-05.3(22). The Contractor shall provide at least one standby saw in good working order to insure continuous sawing as specified regardless of any breakdown of equipment. An ample supply of sawblades shall be maintained at the site of pavement construction at all times during sawing operations. The Contractor shall provide artificial lighting facilities for night sawing. All equipment required for sawing shall be at the pavement construction site both before and continuously during concrete placement. Sawing equipment shall be available immediately and continuously on a 24 hour basis, including Saturdays, Sundays and legal Holidays.

Damage to curing Material caused by sawing operations shall be repaired immediately after completion of sawing.

Formed transverse contraction joints shall be installed where designated by the Engineer, if necessary to prevent uncontrolled transverse cracks from occurring before the pavement can be sawed.

5-05.3(8)B3 SEALING SAWED CONTRACTION JOINTS

Sawed contraction joints shall be filled with a joint sealant filler conforming to the requirements of Section 9-04.2. Joints shall be thoroughly cleaned at the time of sealing. If hot-poured type sealant is used, the joints shall be dry. Care shall be taken to avoid air pockets. The hot-poured compound shall be applied in two or more layers, if deemed necessary by the Engineer. The cold-poured compound shall be applied under sufficient pressure to fill the groove from the bottom to a point approximately 1/4-inch below the surface of the concrete. The joint filled with cold-poured compound shall then be covered with a strip of nonabsorptive paper at least twice as wide as the joint. The paper shall be left in place.

If contraction joints are formed with plastic strips, sealing is not required.

Excess sealing Material shall be cleaned off the surface of the pavement before opening to traffic.

5-05.3(8)C THROUGH JOINTS**5-05.3(8)C1 EXPANSION JOINTS**

Expansion joints are placed only where shown on the Drawings. The joint alignment shall be at right angles to the pavement structure centerline unless otherwise specified in the Contract.

Longitudinal expansion joints shall be placed where shown on the Drawings or where required for concrete pavement between or along retaining walls, curbs or other structures.

Expansion joints shall be constructed with premolded Material, 3/4-inch in thickness, and conform to Section 9-04.1(2). They shall extend from 1 inch below the subgrade to 1 inch below the top of the pavement. Transverse expansion joints shall extend the full width of pavement structure.

The joint Material shall 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 shall be perpendicular to the paved surface and the holder shall be in place long enough to prevent sagging of the Material, especially on streets having steep grades.

In multiple lane construction, the joints shall be matched so as to form a continuous alignment across all lanes.

Expansion joints shall extend continuously through all curbs, special care being exercised to preserve alignment perpendicular to the pavement in the curb section.

A wood filler strip or metal cap shall be placed on the top of the premolded joint filler to form the groove 1 inch deep, and it shall remain in place until after the finishing and the concrete is sufficiently set to resist sloughing into the groove. The joint filler shall be stapled together at the ends to preserve continuity.

Immediately after removal of side forms, the edges of the pavement shall be carefully inspected and wherever the joint filler is not fully exposed, the concrete shall be chipped down until the edge of the filler is fully exposed for the entire depth.

5-05.3(8)C2 CONSTRUCTION JOINTS

All longitudinal construction joints shall be constructed with keyway and tie bars as detailed on Standard Plan no. 405. Along with keyway and tie bars, a thickened edge shall be required on pavements less than 9 inches in thickness for Type B joints, and less than 10 inches thickness for Type A joints.

Transverse construction joints formed by placing a header board transversely across the subgrade shall be made at the end of each day's paving or when placing of standard mixed concrete is discontinued for more than 60 minutes or when placing of high early strength concrete is discontinued for more than 30 minutes. The header board shall be located to conform to the spacing for the transverse contraction joints (or an expansion joint) and shall be left in place until the paving is resumed. If the location of the header board is to be a contraction joint, then the header shall have fasteners to the concrete side a wedge-shaped strip of wood or preformed plastic to form a key in the concrete. Thickened edge shall be constructed at the construction joint header to provide ample depth of concrete above and below the keyway. For dowel bar requirements, see Section 5-05.3(10).

Where preformed contraction joints are used, the joint made by the construction joint header shall have a 2-inch strip of joint Material imbedded against the hardened concrete when paving is resumed.

5-05.3(8)C3 SEALING THROUGH JOINTS

After the pavement is cured, and before carrying any traffic, the space left by the removal of the wood filler strip or the metal cap above the top of the expansion joint filler strip shall be thoroughly cleaned of all loose material. The 3/4-inch wide groove shall be completely free of any projecting concrete from the sides and the groove shall be continuous across the slab to each edge. It shall then be filled level with the pavement surface with joint sealant meeting the requirements of Sections 9-04.2(2).

The joint sealant Material shall be heated and placed in accordance with the manufacturer's instructions. Burned Material will be rejected. The through joint groove shall be dry at the time of pouring the sealing compound.

5-05.3(8)D JOINT LOCATION

5-05.3(8)D1 TRANSVERSE JOINTS

Standard spacing of transverse contraction joints along straight sections of pavement structures (between through expansion joints or between intersections or other irregular areas), shall be at intervals no greater than 15 feet across the full width of the pavement structure and at right angles to the center line of Traveled Way. Where the spacing between transverse through expansion joints or between intersections or other irregular areas are not in even multiples of 15 feet, the last several spaces approaching the expansion joint or header shall be varied by shortening the spaces. The Contractor shall give advance notice to the Engineer and coordinate the spacing. On horizontal curves, the joint spacing of 15 feet shall 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 shall be placed to match joint locations in the adjacent pavement. Where the existing joint spacing is greater than 15 feet, intermediate transverse joints shall be constructed. The Contractor shall give advance notice to the Engineer and coordinate the spacing.

For intersections and other irregular areas, the arrangement of contraction joints shall be in accordance with standard intersection patterns. The area of any one irregular panel formed by contraction joints in intersections shall not exceed 225 square feet and its greatest dimensions shall not exceed 15 feet. The Contractor shall give advance notice to the Engineer and coordinate the spacing.

Where uncontrolled cracks have appeared or exist in the adjacent lane, they shall be matched as nearly as possible by uniform transverse joints in the second lane. In the event uncontrolled cracks in the existing paved lane are too frequent or in random locations and impossible to match with a uniform spacing in the second lane, the two lanes shall be completely

separated by 3/4-inch joint Material along the length of the joint from 1/8 inch below the surface to one inch below the bottom of the concrete being placed.

Where integral curb or doweled curb is placed along the concrete pavement, premolded joint filler Material shall be placed 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 shall be considered transverse joints except those joints that terminate normal to the curb radii.

5-05.3(8)D2 LONGITUDINAL JOINTS

Standard locations for longitudinal joints for the following pavement widths, whether contraction or construction, shall be in accordance with the following table unless specified otherwise in the Contract.

Width Curb to Curb	Joint Locations
25 Feet	Center line
32 Feet	Center line and 10 feet each side of center
36 Feet	Center line and 10 feet each side of center
40 Feet	Center line and 12 feet each side of center
44 Feet	Center line and 11 feet each side of center or match existing joint

In the event the roadway is divided into two lanes, the construction joints shall be located on the center line of the roadway. In separate lane construction, a joint filler 1/4-inch by 2 inches shall be placed between the two lanes when the second lane is constructed.

5-05.3(9) CASTINGS AND STEEL REINFORCING BARS IN CONCRETE PAVEMENT

Reinforcing steel bars shall be used to reinforce concrete pavement and rigid base around Standard Plan nos. 230 and 361 castings except when the casting crosses or is less than 18 inches near any pavement joint. A casting 18 or fewer inches clear from any pavement joint shall have 2 squares of steel reinforcement (rebar) placed around the casting at mid-depth of the concrete pavement slab. No. 4 rebar shall be used to form the 2 separate squares with the squares rotated 45 degrees from each other. The clearance of any rebar from the casting shall be a minimum of 2 inches to a maximum of 6 inches. Each set of 4 rebars shall have rebar length such that each bar is lapped at each end with connecting bars with 3 inch overlap. In no case shall any rebar be within 3 inches of any pavement joint.

See Section 7-20.3(1)C for temporary transition tapers around exposed castings.

5-05.3(10) TIE BARS AND DOWEL BARS

5-05.3(10)A DOWEL BARS

Dowel bars will be required in new pavement at all transverse joints of arterials, intersections, and bus and commercial non-arterials. The dowels shall be installed at the midpoint of the thickness of the pavement, parallel to the surface of the pavement and perpendicular to the transverse joint. The tolerances for placement shall be 6 1/8-inch. The size and spacing of dowel bars shall be as indicated on Standard Plan no. 405. The dowel bars shall be held in place during the placing and setting of the concrete. Dowel bars are not required between new pavement and existing pavement, unless otherwise indicated in the Contract. Joints normal to curb radii will not require dowel.

The dowels shall be installed by method of seating the dowels or by use of a dowel bar cage extended across the width of the transverse joint or by other methods approved by the Engineer. Dowel bars shall be coated with grease to prevent corrosion and dowel seizure. The grease coating on the dowel bars shall remain intact after installing and placing the concrete. Where dowel cages are used to support the dowels, the metal rod or wire ties used to hold the cage together during shipping shall be totally removed after the cage has been placed and secured to the base or subgrade and prior to the placement of the concrete Material.

5-05.3(10)B TIE BARS

Tie bars shall be placed at all longitudinal construction joints in accordance with Standard Plan no. 405. Tie bars are not normally required at longitudinal contraction joints or longitudinal joints between new and existing pavement unless otherwise indicated in the Contract. Tie bars shall be located at the required elevation and spacing shown on the Drawings and placed in such a manner that the vertical edge of the concrete is not deformed or damaged during placement of the bars. Joints normal to curb radii will not require dowel.

5-05.3(11) FINISHING

5-05.3(11)A GENERAL

The pavement shall be consolidated and the surface finished true to grade and cross-section by hand or machine finishing methods. On all vertical curves at irregular intersections, modified tools shall be provided as necessary to secure a smooth, uniform contour and surface.

5-05.3(11)B SLIP-FORM CONSTRUCTION

After the concrete has been given a preliminary finish by means of finishing devices incorporated in the slip-form paving equipment, the surface of the fresh concrete shall be checked by the Contractor with a straightedge device not less than 10 feet in length. High areas indicated by the straightedge device shall be removed by the hand-float method. Each successive check with the straightedge device shall lap the previous check path by at least 1/2 of the length of the straightedge. The requirements of this paragraph may be waived, upon the approval of the Engineer, if the Contractor can successfully demonstrate that other means can consistently produce a surface meeting the 10-foot straightedge requirement specified in Section 5-05.3(12).

Any edge slump of the pavement, exclusive of specified edging, in excess of 1/4 inch shall be corrected before the concrete has hardened. If edge slump on any 1 foot or greater length of hardened concrete exceeds 1 inch, the entire panel between the transverse and longitudinal joints shall be removed and replaced with concrete true to the specified line, grade, and cross-section.

High spots exceeding 1/4-inch shall be reduced by suitable grinding methods. Low spots exceeding 1/4-inch shall be filled with an epoxy-bonded grout. The Contractor shall submit to the Engineer for approval, the proposed epoxy grout and the method of applying the epoxy grout repair.

5-05.3(11)C STATIONARY SIDE FORM CONSTRUCTION**5-05.3(11)C1 HAND FINISHING**

After the concrete has been struck off and consolidated, it shall be smoothed by longitudinal floating. Movement ahead shall be in successive advances of not more than 1/2 the length of the float. Floating shall continue until all irregularities are removed. Longitudinal floating shall follow compaction of the concrete by not less than 30 feet. Free water on the pavement shall be removed with the float or other suitable tool. After floating, the surface shall be scraped with a grout rod at least 10 feet in length with a long handle for operating at the edge of the pavement. The grout rod shall be operated to correct irregularities in the pavement surface and remove water and laitance. Contraction joints shall be placed after all floating has been completed in accordance with provisions of Section 5-05.3(8)B2.

5-05.3(11)C2 MACHINE FINISHING

The finishing machine shall be of a type approved by the Engineer. The machine shall be adjustable to both crown and plane of the finished pavement surface. The screed shall oscillate longitudinally during its travel transversely across the pavement. It shall be operated in the forward direction so that the screed passes over the same section of pavement at least 2 times during its transverse travel.

The finishing machine shall be moved over the pavement as many times as is necessary to give the pavement a smooth even textured surface, conforming to the exact crown and cross section specified on the Drawings.

The floating shall not be considered complete until all free water is removed from the surface.

The finishing operations shall be performed at a time and over such lengths of the pavement surface as existing conditions necessitate.

5-05.3(11)D EDGING

Before the final finishing is completed and before the concrete has taken the final set, the pavement shall be edged as indicated in the following table:

Location	Radius
Edge of Pavement	1/2-inch
Contraction Joints	1/4-inch
Through or Construction Joints	1/2-inch

Particular attention shall be given to edge at the appropriate time. The concrete shall have attained a partial set and all free water shall have disappeared so that the edged joints are clearly defined with no tearing or slump of the edges.

5-05.3(11)E FINAL FINISH

After edging but prior to texturing, the Contractor shall demonstrate to the Engineer that the surface is ready for texturing by performing the surface smoothness checks as called for in Section 5-05.3(12). Any areas which do not comply with the specified tolerances shall be corrected and rechecked prior to texturing.

As the pavement surface is checked and approved for smoothness, the Contractor shall finish the surface with a uniform, gritty texture, true to grade and cross section. The final finish shall be accomplished by one of the methods described as follows to achieve the specified surface texture.

Before using either the drag, brush or comb, the concrete shall have set sufficiently so that the surface is not overgrooved or gouged in the finishing operation.

Burlap Finish: A burlap drag having at least 3 feet of drag in contact with the pavement and as wide as the pavement section shall be dragged forward over the pavement surface. The burlap drag shall be wet and clean when in use. The burlap shall not be left on the pavement surface between dragging operations.

Brush Finish: After edging, the pavement shall be brushed transversely with a fiber or wire brush of a type approved by the Engineer. The brush strokes shall be perpendicular to the center line with the adjacent strokes slightly overlapped. Care should be taken to make sure texture finish is uniform throughout the pavement surface.

Rough Finish: The Contractor shall give the pavement a final finish surface by texturing with a comb perpendicular to the center line of the pavement. The comb shall produce striations approximately 0.015 foot in depth at approximately 1/2-inch spacings in the fresh concrete. The comb shall be operated mechanically either singly or in gangs with several placed end to end. Finishing shall take place with the elements of the comb set at 45 degrees to the concrete surface to eliminate dragging the mortar. If the striation equipment has not been previously approved, a test section shall be constructed prior to approval of the equipment. If the pavement has a raised curb without a formed concrete gutter, the texturing shall end 2 feet from the curb line. This 2-foot untextured strip shall be hand finished with a steel trowel.

5-05.3(11)F UTILITY ADJUSTMENTS

Utility castings shall be adjusted to finished grade prior to the construction of the final wearing course (Section 7-20).

5-05.3(12) SURFACE SMOOTHNESS

The surface smoothness shall be checked with a straightedge 10 feet long, mounted to a long handle to permit operation from outside the pavement. The straightedge shall be placed on the surface of the pavement parallel to the centerline and at intervals of no more than 5 feet across the full width of the pavement so as to bridge any depressions and touch all high spots. Should the surface of the pavement, when tested with a 10 foot straightedge, vary from the true surface grade more than 1/8-inch in 10 feet on arterials, 1/4-inch in 10 feet on residential streets, 3/8-inch in 10 feet in alleys, 3/8-inch in 10 feet in concrete bases, and 1/8-inch in 10 feet in concrete bases for unit pavers, the Contractor shall correct the surface grade by redoing it's finish operation.

On projects with large amounts of concrete paving ("large" is defined as constructing 1000 linear feet of continuous concrete pavement), the pavement smoothness shall be checked under supervision of the Engineer following placement of concrete, with equipment furnished and operated by the Contractor. Smoothness of all pavement placed, except small or irregular areas, shall be measured with a recording profilograph (see Section 5-05.3(3) item 5) parallel to centerline, from which the profile index will be determined by the Engineer in accordance with WSDOT Test Method No. 807.

The transverse slope of the finished pavement shall be uniform to a degree such that no variation greater than 1/8-inch is present when tested with a 10 foot straightedge laid in a direction perpendicular to the centerline.

In no case shall the grade in the pavement or gutter be such that allows ponding of water. If the surface smoothness of the pavement after curing is found to exceed the tolerance permitted, the high spots shall be ground until they meet tolerance. If the surface tolerance cannot be met acceptably by grinding, the pavement shall be removed and replaced in conformity with the Specifications.

Only equipment and methods that consistently produce a finished surface meeting the requirements specified herein shall be used. Use of equipment or methods which do not meet these Standard Specifications shall be discontinued until the Contractor can revise and demonstrate changes in construction operations that meet the requirements of the Specifications.

If for any reason these surface smoothness checks are not performed, the Engineer may require the Contractor, as a condition of acceptance, to submit a report from a testing laboratory approved by the Engineer certifying that the surface smoothness complies with the specified tolerances, and that the testing laboratory is certified to do smoothness testing by either WSDOT or AASHTO.

5-05.3(13) CURING

5-05.3(13)A CURING PERIOD

Regardless of the curing method used, the Contractor shall maintain the curing protection and protect from damage from any cause for at least the length of time listed in the table that follows for the various mixes, exclusive of the day the concrete is placed, or until the pavement is opened to traffic, whichever comes first:

Type II Portland Cement Concrete Pavement	7 Days
High-Early-Strength Cement Concrete Pavement	5 Days
Concrete Mixes Containing Fly Ash	14 Days

5-05.3(13)B CURING METHODS

5-05.3(13)B1 GENERAL

Immediately after the finishing operations have been completed and as soon as marring of the concrete can not occur, the entire surface of the newly placed concrete shall be covered and cured in accordance with one of the methods in the following subsections as the Contractor may elect.

Pavement edges which are exposed by the removal of the forms shall be protected by the immediate application of a curing medium of moist earth.

All curing Materials shall be free of all substances which are considered to be harmful to Portland cement. The curing medium shall be Capable of preventing checking, cracking, and dry spots regardless of conditions existing at the time of placement. Concrete placement will not be permitted unless curing Materials are on the Project Site and ready for immediate application. Failure to comply with all provisions of the curing procedures hereinafter specified will be sufficient reason to suspend all concrete operations.

When the curb section is to be placed separately, the surface of the pavement directly underneath the curb section shall be covered with a protective cover to protect that area from the curing agent when the pavement is sprayed.

5-05.3(13)B2 WHITE PIGMENTED CURING COMPOUND

White pigmented curing compound, meeting the requirements of Section 9-23.2, Type 2, Class B, shall be applied on the entire area of exposed surface of the new concrete with an approved mechanical spray machine. Wax base curing compound will not be allowed. The spray fog shall be protected from the wind with an adequate shield. It shall be applied uniformly at the rate of one gallon to not more than 150 square feet.

The curing compound shall be applied with equipment which ensures continuous agitation of the compound during spraying operations. The nozzle shall be of the two line type with sufficient air to properly atomize the compound.

The curing compound shall not be applied during or immediately after rainfall. If it becomes necessary to leave the pavement uncoated overnight, it shall be covered with polyethylene sheeting which shall remain in place until weather conditions are favorable for the application of the curing compound.

In the event that 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 shall apply a new coat of curing compound in one or two applications to the affected area at the rate which results in a film of curing value equal to that specified in the original coat.

Containers of curing compound shall be distributed on concrete pavement in a manner to enable the Engineer to determine the rate of application being used at any time. All curing compound placed in the spray tanks shall be withdrawn directly from manufacturer's original containers bearing the manufacturer's name, brand, and lot number.

Curing compound shall be thoroughly agitated in accordance with the manufacturer's recommendations before placing in the tank. The compound shall not be diluted by the addition of solvents nor be altered 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 shall be heated to restore proper fluidity but it shall not be heated above 100°F.

The curing compound shall 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. If hair checking develops in the pavement before finishing is completed, the Engineer may order the application of the curing compound at an earlier stage, in which event any concrete cut from the surface in finishing operations shall be removed entirely from the pavement. If additional mortar is then needed to fill torn areas, it shall be obtained ahead of the spraying operations. All areas cut by finishing tools subsequent to the application of the curing compound shall immediately be given new applications at the rate specified above.

The curing compound, after application, shall be protected by the Contractor from injury for the period of time specified above. All traffic shall be considered as injurious to the film of the applied compound.

The Contractor shall provide on the job a sufficient quantity of white polyethylene sheeting to cover all the pavement laid in three hours of maximum operation. This sheeting shall 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 shall be placed over the pavement in a manner approved by the Engineer.

Areas from which it is impossible to exclude traffic shall be protected by a covering of sand or earth not less than 1 foot in thickness or by other suitable and effective means. The protective covering shall be placed no earlier than 24 hours after application of the compound.

All liquid membrane-forming curing compounds shall be removed from the Portland cement concrete pavement to which traffic delineators are to be bonded. Curing compound removal shall not be started until the pavement has attained sufficient flexural strength for traffic to be allowed on it. The Contractor shall submit a proposed removal method to the Engineer and shall not begin the removal process until the Engineer has approved the removal method.

5-05.3(13)B3 WHITE POLYETHYLENE SHEETING

The sheeting shall be placed over the pavement immediately after finishing operations are completed, or at a time designated by the Engineer.

The sheeting shall be laid so that individual sheets overlap at least 2 feet, and the lapped areas shall be held in close contact with the pavement by weighting with earth or boards to prevent movement by the wind. The sheeting shall extend downward to cover the edges of the pavement and shall be secured to the subgrade with a continuous bank of earth or surfacing Material. Any holes occurring in the sheeting shall be patched immediately. The sheeting shall be maintained against injury and remain in place the minimum period of time as specified above.

White polyethylene sheeting shall conform to the requirements of Section 9-23.1.

5-05.3(13)B4 WET CURING

As an alternative to the above curing methods, the Contractor may wet cure the concrete pavement. Wet curing shall be accomplished by applying a continuous fog or mist spray to the entire pavement surface 24 hours a day for a

minimum of 7 days. If water runoff is not a concern, continuous sprinkling is acceptable. Sprinkling shall not begin until the concrete has achieved initial set as determined by AASHTO T 197 or other pre-approved method.

5-05.3(13)B5 TRANSPARENT CURING COMPOUND

The use of transparent liquid curing compounds shall be restricted to areas not exceeding 1,000 square yards.

The curing compound shall be Type 1D as specified in Section 9-23.2. Sufficient pigment shall be present so that the sprayed compound is easily discernible. The application and the curing shall be the same as for "White Liquid Membrane Curing Compound" in Section 5-05.3(13)B2.

5-05.3(13)B6 EMULSIFIED ASPHALT

Curing of concrete pavement when laid as a base for an asphalt wearing course shall comply with Section 5-05.3(20).

5-05.3(13)C CURING IN HOT WEATHER

In periods of low humidity, or drying winds, or high temperatures a fog spray shall be applied to concrete as soon after placement as conditions warrant in order to prevent the formation of shrinkage cracks. The spray shall be continued until conditions permit the application of a liquid curing membrane or other curing media. The Engineer shall make the decision when the use of a fog spray is necessary.

5-05.3(14) COLD WEATHER WORK

When the air temperature is expected to reach the freezing point during the day or night and the pavement has not cured for 50 percent of the time specified in Section 5-05.3(13)A, the concrete shall be protected from freezing. The Contractor shall, at no expense to the Owner, provide a sufficient supply of straw, hay, grass, earth, blankets, or other suitable insulating blanket material and spread it over the pavement to a sufficient depth to prevent freezing of the concrete. The Contractor shall be responsible for the quality and strength of the concrete thus cured. Any concrete injured by frost action or freezing shall be removed and replaced.

5-05.3(15) CONCRETE PAVEMENT CONSTRUCTION IN ADJACENT LANES

Refer to Section 5-05.3(7)A.

5-05.3(16) PROTECTION OF PAVEMENT

The Contractor shall protect the pavement and its appurtenances from any damage. Protection shall include 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 whatever other means may be necessary to accommodate local traffic and to protect the pavement during the curing period or until opened to traffic as specified in Section 5-05.3(17). Also see Sections 1-07.23 and 1-10.

5-05.3(17) OPENING PAVEMENTS TO TRAFFIC

The Contractor shall not open newly constructed cement concrete pavement to traffic, including construction equipment, until the pavement has cured for the period of time specified in Section 5-05.3(13)A and has attained the required compressive strength. Approval to open newly constructed pavement to the use of construction equipment (or other traffic) in less time than the time period specified in Section 5-05.3(13)A will be limited to those paving situations when the Contractor is unable to use the subgrade or base course of the lane being paved, or the shoulder adjacent to it, for paving equipment.

Approval will be conditioned upon the Contractor agreeing to the following restrictions:

1. The concrete in the newly paved lane has attained a flexural strength of 500 psi as determined with a Beam Test pursuant to AASHTO T 177 or ASTM C 293.
2. The Beam Test is performed at the Contractor's expense by an independent materials laboratory retained by the Contractor. The laboratory retained by the Contractor shall be a laboratory accredited by a recognized standards organization and be acceptable to the Engineer.
3. The surface of the new pavement shall be protected from scarring and abrasion by operating mixers, trucks, and other construction equipment on mats, skids, or other protective devices approved by the Engineer. Accumulation of sand, gravel, dirt, concrete or other debris deposited on the new pavement shall be removed daily. Curing compound protection damaged as a result of using the paved lane shall be replaced concurrent with spraying of curing compound on the newly placed concrete.
4. The Contractor shall remove and replace at no expense to the City any panels on the new pavement that are cracked or broken as a result of the Contractor's early opening of the lane to traffic.

Streets with curbs shall not be opened until the curb has cured for at least 72 hours and has attained 2500 psi strength. If the curb has not attained the above-mentioned 2500 pounds per square inch strength, the Contractor shall protect the curb by placing form lumber on the pavement 2 feet away from the curb, or standard barricades and maintain them (see Sections 1-07.23 and 1-10). Such curb protection shall remain in place as long as may be necessary for protection of the curb. See Section 8-04.3(1)E for concrete curb curing requirements.

Streets shall not be opened to traffic until the smoothness criteria specified in Section 5-05.3(12) have been verified by the Engineer.

Temporary pavement markings shall be installed, maintained, and subsequently removed in accordance with Sections 1-07.23(1) and 1-10.3(4)C.

Prior to opening for traffic, the Contractor shall clean the pavement. The Engineer will determine when the pavement is ready for traffic.

5-05.3(18) CEMENT CONCRETE APPROACHES

Concrete approaches shall be constructed at the locations shown on the Drawings or as staked by the Engineer and in accordance with WSDOT Standard Plan no. F4.

Concrete approach construction shall comply with the provisions of Section 5-05. In addition, placing, compacting, and finishing concrete approaches may be by hand methods as approved by the Engineer.

5-05.3(19) REINFORCED CONCRETE BRIDGE APPROACH SLABS

Approach slab concrete shall conform to the requirements of Section 6-02.3.

Reinforced concrete bridge approach slabs shall be constructed at the locations shown on the Drawings or as staked by the Engineer and in accordance with the Contract.

The approach slabs shall be constructed full bridge deck width from outside usable shoulder to outside usable shoulder at an elevation to match the Structure. Pavement ends and the bridge ends of the approach slabs shall be modified as shown on the Drawings to accommodate the grate inlets at the bridge ends if the grate inlets are required.

Screed rail support, installation, and finish machine requirements shall be as specified for bridge deck slabs.

Reinforced concrete bridge approach slab anchors shall be installed as detailed on the Drawings. For Method A anchor installations, the grout or adhesive used to install the anchors shall have a minimum compressive strength of 4000 psi at three days and be Capable of developing the ultimate strength of the anchor rod. The anchor rod shall be ASTM A 36 steel. Compressive strength shall be determined in accordance with AASHTO T 106. The anchors shall be installed parallel both to profile grade and center line of roadway. The Contractor shall secure the anchors to ensure that they do not become misaligned during concrete placement.

The compression seal shall be as noted in the Contract (see Section 6-02.3(13)B).

Finishing of the reinforced concrete bridge approach slabs shall be accomplished by either a combination of finishing machine and hand finishing or by hand finishing methods only. The finished and cured approach slabs shall be free from any deviation exceeding 1/8 inch under a 10-foot straightedge placed parallel and perpendicular to the center line of the roadway.

5-05.3(20) UNFINISHED CEMENT CONCRETE PAVEMENT

Cement concrete pavement that is intended as a base for an asphalt wearing course, shall conform to all requirements of Section 5-05 with the following exceptions:

1. The surface tolerance shall be 3/8 inch in 10 feet.
2. The surface of the concrete base, if hand compacted, may be struck off with only one strike-off rod.
3. Contraction joints shall be constructed as follows:
 - a. A weakened plane shall be made in the plastic concrete every 15 feet or to match existing cracks as designated by the Engineer;
 - b. The plane shall be weakened with a joint cutter to a minimum depth of 2 inches;
 - c. Bulging caused by the joint cutter shall be corrected by floating lightly; and
 - d. Joint Material shall be placed completely through the curb at the point where the weakened plane intersects the curb.
4. Liquid curing compounds which leave a waxy film on the concrete shall not be used for curing concrete base pavement. If cured with a liquid curing compound, it shall meet the requirements of Section 9-23.2 for the clear type and the rate of coverage shall be at least one gallon per 125 square feet; or emulsified asphalt CSS-1 or CRS-1 meeting the requirements of Section 9-02.1(6) applied at a rate between 0.15 gallon and 0.25 gallon per square yard of surface.

5-05.3(21) SIDE FORMS

Side forms shall have a height of not less than the specified depth of pavement, and thickened edge when applicable, and shall be of ample strength to resist deformation. They shall be provided with adequate devices for secure setting so that when in place they shall withstand, without visible springing or settlement, the weight, impact, and vibration of the finishing machines. The forms shall be free from warps, bends, or kinks.

Forms shall be drilled in advance for tie bar placement to line and grade where tie bars are specified.

Forms shall remain in place at least 12 hours after the concrete has been placed and shall be cleaned and oiled each time they are used. Curing compound shall be applied to the concrete immediately after the forms are removed.

The alignment and grade elevations of the forms shall be checked and the necessary corrections made by the Contractor immediately before placing the concrete. When any form has been disturbed or any subgrade thereunder has become unstable, the form shall be reset and rechecked.

Forms may be of wood or metal or any other material at the option of the Contractor, provided the forms as constructed result in a pavement of specified thickness, cross section, grade, and alignment as shown on the Drawings.

Forms shall be adequately supported to prevent deflection or movement, and result in concrete pavement conforming with the Contract. The top of the forms shall not deviate more than 1/8-inch in 10 feet and the alignment of forms shall be within 1/4-inch in 10 feet. The forms may be removed the day after pouring if the concrete is sufficiently set to withstand removal without danger of chipping or spalling. When forms are removed before the expiration of the curing period, the edges of the concrete shall be protected with moist earth or sprayed with curing compound. All forms shall be cleaned, oiled and examined for defects before they are used again.

5-05.3(22) REPAIR OR REPLACEMENT OF DEFECTIVE PAVEMENT PANELS

5-05.3(22)A GENERAL

Damage to new and existing concrete pavement caused by Contractor operations or by defective and unauthorized work (i.e. broken panels, cracks, nonworking joints, spalls, etc.) shall be addressed in accordance with Section 1-05.7.

5-05.3(22)B CRACK RESTORATION

Pavement slab containing more than one crack shall be removed and replaced in its entirety.

Prior to joint sealing, pavement slab containing a single crack shall be removed and replaced such that the minimum dimension of the removed slab is six (6) feet long and full panel width. The portion of panel to remain in place shall have a minimum dimension of six (6) feet in length and full panel width, otherwise the entire panel shall be replaced. There shall be no new joints closer than three (3) feet to an existing transverse joint. Saw cutting full pavement depth is required along all longitudinal joints and at transverse locations. Tie bars and dowel bars shall be used in accordance with Section 5-05.3(10).

5-05.3(22)C SPALL AND EDGE SLUMPING RESTORATION

Spalls and edge slumping shall be repaired by making vertical saw cuts at least three (3) inches outside the affected area and to a minimum depth of three (3) inches. Repair depths that exceed one third of the total slab depth or encounter dowel bars or reinforced steel will require full depth repair. When the affected area is directly against a longitudinal or transverse joint, a debonding medium (compressible joint insert or polyethylene strip) shall be placed between the existing concrete and the area to be patched. For transverse joints, the compressible joint material shall be placed into the existing joint one (1) inch below the depth of the repair and extended at least three (3) inches beyond each end of the patch boundaries. If the affected area is directly against an asphalt pavement, a formed edge even with the surface is required. The concrete in the affected area shall be chipped out to sound concrete with a pneumatic hammer with a maximum weight of 30 pounds. The formed cavity shall be sand blasted thoroughly clean and all loose material removed. Where required, an epoxy bonding agent shall be applied fully covering the dry cleaned surface of the cavity with a thin even coat. Placement of Portland cement concrete or epoxy concrete or mortar shall immediately follow the application of the epoxy bonding agent. The epoxy bonding agent shall meet the requirements of Section 9-26 for Type II epoxy (Portland cement concrete placement) or Type III epoxy (epoxy concrete or mortar placement). Low areas which grinding cannot feasibly remedy, shall be sandblasted, filled with epoxy bonding mortar, and textured by grinding. The epoxy bonding agent shall meet the requirements of Section 9-26 for Type II epoxy. The patch mixture shall be placed and vibrated to eliminate any voids. Vibrators greater than one (1) inch shall not be used. If cementitious repair material is used, the patch perimeter shall be sealed with a 1:1 cement:water grout. The patch mixture shall be cured according to the manufacturer's recommendation.

5-05.3(23) CEMENT CONCRETE PAVEMENT FOR ALLEY

5-05.3(23)A PAVEMENT AND ALLEY REQUIREMENTS

Cement concrete pavement for alleys shall meet the requirements of Section 5-05 and Standard Plan no. 403. Alleys shall meet the requirements for driveways in Section 8-19.

5-05.3(23)B EXTRA CONCRETE FOR ALLEY APPROACH RAMP

When constructing and finishing cement concrete alley pavement, the Engineer may in some cases require the Contractor to place additional concrete over the surface of the alley pavement to serve as an integral ramp or vehicular access to abutting private property. Such extra concrete shall be placed and finished to the additional thickness directed by the Engineer. Additional thickness for such ramps shall not exceed 6 inches above the original planned concrete surface at any point, and will be addressed in accordance with Section 1-04.4. See Standard Plan no. 430.

5-05.3(23)C CURB WALL AND SUPPORT WALL

5-05.3(23)C1 GENERAL

Where shown on the Drawings, the Contractor shall construct the curb wall, and either the edge wall or support wall as shown on Standard Plan no. 403. The alley width indicated on the Drawings shall be taken to the face of the curb and as shown on Standard Plan no. 403.

After removal of forms, all lips and edgings shall be removed. Bolts or concrete ties shall 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 shall be done. If, however, the surface is unacceptable, these surfaces shall 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 shall be rubbed with a damp sack.

5-05.3(23)C2 CURB WALL

Curb wall shall be constructed as indicated on Standard Plan no. 801.

5-05.3(23)C3 SUPPORT WALL

Support wall shall be constructed as indicated on Standard Plan no. 800.

5-05.3(24) CONCRETE UNDERPINNING

Where designated by the Engineer, existing concrete foundations left above grade shall be supported with concrete underpinning.

5-05.3(25) WATER

Water for pavement construction shall be furnished as provided in Section 2-07 (also see Section 9-25.1).

5-05.3(26) PAVEMENT PATCHING**5-05.3(26)A GENERAL**

Concrete pavement restoration shall be considered "Pavement Patch" when due to a trench cut and the width of the opening is less than the full concrete panel width. Concrete pavement patching shall be scheduled to accommodate the demands of traffic, and shall be performed as rapidly as possible to accommodate public travel.

The placing and compaction of the trench backfill shall be in accordance with the applicable Sections of Division 7 and Division 8, and the preparation and compaction of the subgrade shall be in accordance with Section 2-06.

Before applying the patch, all pavement cuts shall be trued so that the cut edges of pavement form a rectangle with straight edges and vertical faces. The use of a concrete saw will be required for Portland cement concrete pavement as specified in Section 2-02.3(6). Line drilling will be allowed for asphalt overlaid Portland cement rigid pavement base.

Cement concrete pavement patch shall be the class of concrete specified in Section 5-05.2. Curing compound shall be as specified in Section 5-05.3(13).

Signing, barricades, lights and other warning devices shall be as specified in Sections 1-07.23 and 1-10 and shall be maintained until the patch is completed and ready for traffic.

5-05.3(26)B CEMENT CONCRETE PAVEMENT

Streets which have rigid type pavements surfaced with asphalt concrete shall be patched as shown on Standard Plan nos. 404a and 404b. The thickness of concrete pavement patch shall match the existing rigid base or 9 inches, whichever is greater. The top surface of the concrete shall match the top surface of the existing rigid base; in no case shall the top of the concrete be higher than the top of the existing rigid base. Brush finishing will not be required. Joints shall be placed to match existing joints. Curing shall be accomplished with STE-1 asphalt emulsion diluted with water.

When the existing street surface is cement concrete, the concrete pavement patch shall be placed, compacted, and struck off to the grade of the adjacent pavement. Through joints and dummy joints shall be placed and edged to match existing joints. The surface shall be finished and brushed with a fiber brush or combs or tines. Approved curing compound shall be placed on the finished concrete immediately after finishing.

5-05.3(27) TEMPORARY PAVEMENT PATCHING

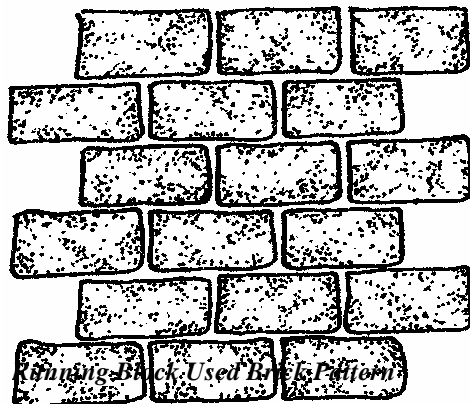
Temporary pavement patching shall be in accordance with Section 5-04.3(23).

5-05.3(28) CASTINGS IN CONCRETE PAVEMENT

See Sections 5-05.3(9) and 7-20.

5-05.3(29) STAMPED CONCRETE SURFACE TREATMENT

Stamped concrete surface treatment is defined as additional work necessary to imprint concrete pavement,



while concrete is still in a plastic stage, with a "running bond used brick" pattern. The Contractor shall refer to the sketch on the left for pattern details. Nominal size for a typical brick shall be 8 inches long by 4 inches wide. The long edge of brick shall be laid perpendicular to the crosswalk. All work shall be installed by a licensed contractor and supervised by a foreman who has completed at least three prior installations of stamped concrete. All work shall comply with the specification and quality standards issued by the supplier of the imprinting tools.

No stamped concrete work shall begin until the Engineer gives this direction. The concrete shall be placed and screed to the finished grade and floated to a uniform surface. The Contractor shall use the required imprinting tools to apply the desired impressions to the crosswalk surfacing while the concrete is still in the plastic stage of set. After initial curing, the surface impressions shall be grouted when required.

5-05.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for pavement or pavement base will be by the square yard of concrete in place, including the area placed underneath curbs. No deduction will be made for castings in pavement.

Measurement for thickened edge will be by the linear foot as measured along the thicker face of the thickened edge.

Measurement for concrete underpinning will be by cubic yard placed as computed by the Engineer.

Measurement for edge wall, support wall and curb wall will be per cubic yard of concrete based on neat lines indicated on Standard Plan nos. 403, 800, and 801.

Steel required for pavement reinforcement (Section 5-05.3(7)E) will be measured by the pound of rebar in place.

Tiebars and dowels required for pavement and curbs, and reinforcing steel for castings will not be measured.

Measurement for curb constructed with alley pavement will be in accordance with Section 8-04.

Measurement for Stamped Concrete Surface Treatment will be per square yard.

Measurement of concrete pavement patching will be by the cubic yard for cement concrete patching. Quantities for surface restorations for trench excavations, other than for electrical conduit trench as specified in Section 5-04.4, will be based upon computations made by the Engineer using the required pavement patch thickness and the removal criteria specified in Section 2-02.3(3). Concrete pavement restoration requiring full concrete pavement panel replacement will be measured as pavement or pavement base as specified in this Section.

5-05.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 5-05 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **"Pavement, Cement Concrete (Class), (Thickness)"**, per square yard.

2. **"Pavement Base, Cement Concrete (Class), (Thickness)"**, per square yard.

The Bid item prices for "Pavement, Cement Concrete (Class), (Thickness)" and for "Pavement Base, Cement Concrete (Class) (Thickness)" shall include all costs for the work required to furnish and install concrete pavement as indicated in the Contract.

3. **"Pavement, Thickened Edge (18 inch x 3 inch)"**, per linear foot.

The Bid item price for "Pavement, Thickened Edge (18 inch x 3 inch)" shall include all costs for the work required to shape and compact the subgrade for the thickened edge including the concrete.

4. **"Underpinning, Cement Concrete CL 5 (3/4)"**, per cubic yard.

The Bid item price for "Underpinning, Cement Concrete CL 5 (3/4)" shall include all costs for the work required to furnish and place the underpinning and reinforcing steel including as needed excavation.

5. **"Wall, Cement Concrete, Edge, Type 403"**, per cubic yard.

The Bid item price for "Wall, Cement Concrete, Edge, Type 403" shall include all costs for the work required to construct the edge wall as shown on Standard Plan 403 including but not limited to excavation and disposal.

6. **"Wall, Cement Concrete, Support, Type 800"**, per cubic yard.

The Bid item price for "Wall, Cement Concrete, Support, Type 800" shall include all costs for the work required to construct the wall as shown on Standard Plan no. 800. Payment for excavation, for disposal of materials, and for reinforcing steel (including steel extending into pavement slab) for the support wall shall be considered included in the Bid item price.

7. **"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) shall include all costs for the work required to construct the wall as shown on Standard Plan no. 801. Payment for excavation, for disposal of materials, and for reinforcing steel for curb wall shall be considered included in the Bid item price.

8. **"Pavement Patch, Cement Concrete Class 6.5 (1-1/2), H.E.S."**, per cubic yard.

The Bid item price for "Pavement Patch, Cement Concrete Class 6.5 (1-1/2), H.E.S." shall include the costs for the work not otherwise provided for in Section 5-05.5 but necessary to maintain and permanently restore, as applicable, pavements or other traffic bearing surfaces which have been opened by trench excavation or similar work. All incidental work required to complete the patching of street surfaces, including installing joints where required, shall be considered incidental to this Bid item

9. **"Stamped Concrete Surface Treatment"**, per square yard.

The Bid item price for "Stamped Concrete Surface Treatment", shall include all costs for the work necessary to install the specified textured pavement treatment complete in-place, including but not limited to release agents, admixtures, imprinting tools, grouting material, finishes and edge finishes, as specified in Section 5-05.3(24), and as necessary.

Payment for concrete pavement shall be paid separately in accordance with this Section.

10. **Other payment information**

Payment for roadway ballast and crushed rock surfacing will be as "Mineral Aggregate, (Type)" per Section 4-01.5.

All costs in connection with replacing Portland cement with fly ash as specified shall be included in the Bid item price for the various classes of concrete involved. If the concrete is to be paid for other than by class of concrete, all costs involved with replacing Portland cement with fly ash as specified shall be included in the Bid item price for the applicable Bid item.

All costs required to furnish and mix additional Portland cement to concrete as specified in Section 9-01.4; to repair defective pavement slab as specified in Section 5-05.3(22); and to repair new pavement injured by frost action shall be considered defective work and will be paid in accordance with Section 1-05.7.

Cost for temporary pavement marking, Section 5-05.3(17), shall be considered incidental to the pavement Bid item.

Payment for backfill and compaction of trench subgrade shall be included in the Bid item price for the trench Bid item.

Payment for steel reinforcing bar for reinforced concrete pavement and for bridge approach slab will be paid separately in accordance with Section 6-02.5.

Steel required for tiebars, dowels, curbs and pavement, and for reinforcement around castings will be considered included in the Bid item price of the pavement Bid item and no separate or additional payment will be made.

Payment for "Pavement Patch, Temporary" will be in accordance with Section 5-04.5

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DIVISION 6 STRUCTURES**SECTION 6-01 GENERAL REQUIREMENTS - STRUCTURES****6-01.1 DESCRIPTION**

Section 6-01 relates to structural, and incidental items used in any or all types of existing or proposed Structures. The provisions of Section 6-01 supplement the detailed Specifications provided for any given Structure unless specified otherwise in the Contract.

6-01.2 FOUNDATION DATA

See Section 1-02.4(2) for subsurface information.

6-01.3 CLEARING THE SITE

The Contractor shall clear the entire site for the proposed structure to the limits staked by the Engineer.

6-01.4 APPEARANCE OF STRUCTURES

To achieve a more pleasing appearance, the Engineer may require the Contractor to make minor adjustments to the height and alignment of bridge railings, traffic barrier, and structural curbs.

6-01.5 RESERVED**6-01.6 LOAD RESTRICTIONS ON BRIDGES UNDER CONSTRUCTION**

Bridges under construction shall remain closed to all traffic, including construction equipment, until the substructure and the superstructure, through the roadway deck, are complete for the entire Structure, except as provided herein. Completion includes release of all falsework, removal of all forms, and attainment of the minimum design concrete strength and specified age of the concrete in accordance with these Specifications. Construction traffic shall not occupy the Structure until the Engineer allows. Once the Structure is complete and is accepted by the Engineer, Section 1-07.7 shall govern all traffic loading, including all construction loading.

If necessary and safe to do so, and if the Contractor requests it in writing, the Engineer may allow traffic on a bridge prior to completion. However, the Contractor shall first submit the following information:

1. Describe the extent of the Structure completion at time of the proposed equipment loading.
2. Describe the loading arrangement, movement, and position of traffic (equipment) on the bridge.
3. Provide stress calculations 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 in accordance with Section 1-05.3(12), and
4. State that the Contractor assumes all risk for damage.

6-01.7 NAVIGABLE STREAMS

The Contractor shall keep navigable streams clear so that water traffic may pass safely, providing and maintaining all lights and signals required by the U.S. Coast Guard. The Contractor shall 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.

6-01.8 RESERVED**6-01.9 SHOP DRAWINGS**

Shop Drawing requirements shall comply with Section 1-05.3 with the following exceptions:

The Shop Drawings and calculations shall be provided far enough in advance of actual need to allow for the review process by the Engineer or other agencies, which may result in no exception taken, make correction noted, rejection, revision and re-submittal, or submit specified item. The Engineer will require up to 30 days for review from the date the submittals are received by the Engineer until they are sent to the Contractor. This time period may increase if the Shop Drawings submitted either do not meet the Contract requirements, or do not contain sufficient detail.

Unless designated otherwise by the Contractor, submittals of Shop Drawings will be reviewed in the order they are received by the Engineer. In the event that several sets of Shop Drawings are submitted simultaneously, the Contractor shall designate the sequence in which these Shop Drawings are to be reviewed. If the Contractor does not submit a Shop Drawing designated review sequence for simultaneous Shop Drawing submittals, the review sequence shall be at the Engineer's discretion.

Shop Drawings and calculations shall be prepared by (or under the direction of) a professional engineer, licensed under Title 18 RCW, State of Washington, and shall carry the professional engineer's signature and seal, in accordance with Section 1-05.3(12).

6-01.10 RESERVED**6-01.11 NAME PLATES**

The Contractor shall install no permanent plates or markers on a Structure unless the Contract designates it.

6-01.12 STRUCTURE CLEANUP

Roadside and final cleanup shall be as specified in Section 1-04.11.

6-01.13 ARCHITECTURAL FEATURES

Each Material incorporated in the Work shall be uniform in texture and color for consistency in appearance, unless otherwise indicated in the Contract.

To ensure uniform texture and color, the Contractor shall obtain all cement for the Structure from the same manufacturing plant unless the Engineer waives this requirement in writing.

6-01.14 PREMOLDED JOINT FILLER

When the Contract calls for premolded joint filler, the Contractor shall fasten it with galvanized wire nails to one side of the joint. The nails shall be spaced no more than 6 inches apart and shall be 1-1/2 inches from the edges over the entire joint area. The nails shall be at least 1-1/2 inches longer than the thickness of the filler.

The Contractor may substitute for the nails any adhesive by submitting adhesive catalog cuts, and a Manufacturer's Certificate of Compliance stating 1) - the adhesive is compatible with Resilient Bituminous Preformed Expansion Joint Filler meeting the requirements of ASTM D1751 or AASHTO M 213, and 2) be Capable of bonding the filler to Portland cement concrete.

6-01.15 NORMAL TEMPERATURE

Bridge Drawings state horizontal and vertical dimensions at a normal temperature of 64 °F.

6-01.16 MAINTENANCE OF BRIDGE DRAINS

The Contractor shall keep existing and new bridge drains open and functioning during construction. Before bridge drain work begins, the Contractor shall verify existing drains are clear and free flowing, and if not, the Contractor shall immediately notify the Engineer. Maintenance includes keeping drains clean, free of debris, and free flowing. Before acceptance of the bridge drains, the existing and new bridge drains shall be tested for drainage, and clogged or non-flowing drains shall be cleaned and cleared to a free-flowing state acceptable to the Engineer.

SECTION 6-02 CONCRETE STRUCTURES

6-02.1 DESCRIPTION

Section 6-02 applies to the construction of all roadway Structures and their parts made of Portland cement concrete with or without reinforcement. Any part of a Structure to be made of other than Portland cement concrete shall be built as required in the Standard Specifications other than Section 6-02.

6-02.1A DEFINITION

For purposes of Section 6-02, Roadway Structures shall mean bridges and retaining walls and their parts with or without reinforcing steel.

6-02.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Portland Cement and Pozzolans	9-01
Aggregates for Portland Cement Concrete and Gravel Backfill	9-03
Joint and Crack Sealing Materials	9-04
Reinforcing Steel, and Epoxy-Coated Reinforcing Steel	9-07
Paints	9-08
Prestressed Concrete Girders	9-19
Concrete Curing Materials, Pozzolans, and Admixtures	9-23
Plastic Waterstop	9-24
Water	9-25
Elastomeric Bearing Pads	9-35

Bridge drains shall comply with Section 6-02.3(36). Downspouts shall comply with Section 6-02.3(29).

6-02.3 CONSTRUCTION REQUIREMENTS

6-02.3(1) CLASSIFICATION OF STRUCTURAL CONCRETE

The class and designation of concrete to be used shall be as specified in the Contract.

Concrete class: The numerical class of concrete defines the specified minimum compressive strength at 28 days in accordance with ASTM C 39.

Concrete designation: The letter designation following the class of concrete identifies the specific use as follows:

Letter Designation	Designated Concrete Application
P	Piling
W	Underwater
D	Deck

As an example, concrete class 6000D is concrete designated for decks that require a 28 day compressive strength of at least 6,000 psi.

The Contractor may request, by written notice, permission to use a higher class of concrete or different concrete designation. The Contractor may also request the use of different aggregate gradations, use of one or more pozzolans as a substitution in the total cementitious material, use of additional admixtures, and other reasonable changes in the mix design. Such requests will be evaluated for acceptance based on the specified class of concrete, the specified concrete designation, possible change in concrete designation as it applies to the specified application, the accommodating of concrete placement, or other benefits or improvements. Such request shall include the reasons for such change including the benefits in performance of the concrete for that intended application, benefits to concrete placement, any test or performance data demonstrating the change in mix design as beneficial, and other information as applicable. The Engineer will respond in writing within 10 Working Days of receiving such request. The Contractor shall bear any added costs that result from the Engineer's accepting such change. Any such request shall be considered a submittal in accordance with Section 1-05.3.

6-02.3(2) PROPORTIONING MATERIALS

6-02.3(2)A GENERAL

The total water soluble Chloride ion (Cl-) content of the mixed concrete shall not exceed 0.06 percent by weight of cementitious material for prestressed concrete nor 0.10 percent by weight of cementitious material for reinforced concrete. An initial evaluation may be obtained by testing individual concrete ingredients for:

- 1) total chloride ion content per AASHTO T 260 and totaling these to determine the total water soluble Chloride ion (Cl-), or
- 2) the total water soluble Chloride ion (Cl-) in accordance with ASTM C 1218.

Unless otherwise specified, the Contractor shall use Type 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. The use of fly ash and ground granulated blast furnace slag is optional for all other classes of concrete, except ground granulated blast furnace slag will not be allowed in decks.

Fly ash, if used, shall conform to Section 9-01.6(1). Ground granulated blast furnace slag shall conform to Section 9-01.6(2). When pozzolans are included in the concrete mix, the total weight of both these materials shall be as specified in Section 9-23.9.

The water/cement ratio shall be 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.

As an alternative to the use of 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(4) Blended Hydraulic Cements may be used.

6-02.3(2)B CONTRACTOR MIX DESIGN

The Contractor shall provide a mix design for all classes and designations of concrete specified in the Contract. No concrete shall be placed until the Engineer has approved the mix design. The required average 28 day compressive strength shall be selected per ACI 318, chapter 5, Section 5.3.2. ACI 211.1 and ACI 318 shall be used to determine proportions. The proposed mix for Class 4000P shall provide a minimum fly ash content per cubic yard of 100 pounds and a minimum cement content per cubic yard of 600 pounds. The proposed mix for Class 4000D shall provide a minimum fly ash content per cubic yard of 75 pounds and a minimum cement content per cubic yard of 660 pounds. All other concrete mix designs, except those for lean concrete and commercial concrete, shall have a minimum cementitious material content of 564 pounds per cubic yard of concrete.

The Contractor shall submit a mix design to the Engineer for approval and shall provide a unique identification for each mix design and shall include the mix proportions per cubic yard, the proposed sources, the average 28 day compressive strength for which the mix is designed, the fineness modulus, water cement ratio, and the aggregate correction factor per ASTM C 231. Concrete placeability, workability, and strength shall be the responsibility of the Contractor. The Contractor shall notify the Engineer by written notice of any mix design modifications at least 10 Working Days in advance.

Fine aggregate shall conform to Section 9-03.1(2) Class 1 or Class 2.

Coarse aggregate shall conform to Section 9-03.1(3). The nominal maximum size aggregate for Class 4000P shall be 1/2 inch. The nominal maximum size aggregate for Class 4000D shall be 3/4 inch.

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.

Class 4000D and 4000P concrete shall include a water reducing admixture in the amount 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.

Air content shall be no less than 5.0 percent and no greater than 7.0 percent for all concrete placed above the finished ground line.

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 shall be submitted as a part of the Contractor's concrete mix design.

6-02.3(3) READY MIX CONCRETE**6-02.3(3)A GENERAL**

All concrete for roadway structures shall be batched in a prequalified manual, semi-automatic, or automatic plant with certification maintained current within a time period not exceeding two (2) years by the National Ready Mix Concrete Association (NRMCA). Information concerning NRMCA certification may be obtained from the National Ready Mix Concrete Association at 900 Spring Street, Silver Springs, MD 20910. The Engineer is not responsible for any delays to the Contractor due to problems in getting the plant certified.

6-02.3(3)B RESERVED**6-02.3(3)C JOB SITE MIXING**

For small quantities of concrete, the Contractor may mix concrete at the Project Site provided the Contractor has in advance provided written notice requested in writing and received written permission from the Engineer. The Contractor's written notice shall include a mix design, batching and mixing procedures, and a list of the equipment performing the mixing at the Project Site. All Project Site mixed concrete shall 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 as approved by the Engineer, provided the hand mixing is done on a watertight platform in a way that distributes materials evenly throughout the mix. Mixing shall continue long enough to produce a homogeneous mixture. No Project Site mixed batch shall exceed one-half ($1/2$) cubic yard.

Concrete mixed at the Project Site shall never be placed in water.

6-02.3(3)D CONSISTENCY

The maximum slump for vibrated concrete shall be:

1. 3.5 inches for vibrated concrete placed in all bridge roadway slabs, bridge approach slabs, and flat slab bridge superstructures.
2. 4.5 inches for all other vibrated concrete.

The maximum slump for non-vibrated concrete shall be 7 inches including Classes 4000P and 4000W.

6-02.3(3)E TEMPERATURE AND TIME FOR PLACEMENT

Concrete temperatures shall remain between 55°F and 90°F while it is being placed. Precast concrete that is heat cured per Section 602.3(25)E shall remain between 50°F and 90°F while being placed. The batch of concrete shall be discharged at the Project Site no more than 90 minutes (1-1/2 hours) after the cementitious material is added to the concrete mixture. The time to discharge may be extended to 105 minutes (1-3/4 hours) if the temperature of the concrete being placed is less than 75°F.

6-02.3(4) ACCEPTANCE OF CONCRETE**6-02.3(4)A GENERAL**

All concrete for roadway Structures will be accepted based on conformance to the requirement for temperature, slump, air content for concrete placed above finished ground line, and the specified compressive strength at 28 days for sublots as tested and determined by the Engineer. For non-roadway Structure concrete, acceptance by the Engineer will be by Manufacturer's Certificate of Compliance unless the Contract specifies otherwise.

A subplot 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 subplot will be deemed to have met the specified compressive strength requirement when both of the following conditions are met:

1. Individual strength tests do not fall below the specified strength by more than 12-1/2 % or 500 psi, whichever is least, and
2. An individual strength test averaged with the two 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 fail to satisfy one or both of the above requirements, 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. Cores, if allowed, will be obtained by the Contractor in accordance with ASTM C 42 and delivered to the contracting agency for testing in accordance with ASTM C 39. 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 seven days before testing, and will be tested air dry.

Acceptance for each subplot by the core method requires that the average compressive strength of three cores be at least 85 percent of the specified strength with no one 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 subplot.

If the Contractor elects to core, cores shall be obtained no later than 50 days after initial concrete placement. The Engineer will concur in the locations to be cored. Repair of cored areas shall be the responsibility of the Contractor. The cost incurred in coring and testing these cores, including repair of core locations, shall be borne by the Contractor.

6-02.3(4)B MANUFACTURER'S CERTIFICATE OF COMPLIANCE

The concrete producer shall provide a Manufacturer's Certificate of Compliance for each truckload of delivered concrete verifying that the delivered concrete is in compliance with the mix design, and shall include:

1. Manufacturer's plant (batching facility),
2. Owner contract number (PW# found on page 1 of the Agreement Form),
3. Date,
4. Time batched,
5. Truck No.,
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 No. (The mill test number as required by Section 9-01.3 is the basis for acceptance of cement.),
10. Pozzolan(s) (if used) brand(s) and Type(s),
11. Approved aggregate gradation designation, and
12. Mix design weight per cubic yard and actual batched weights for:
 - a. Cement,
 - b. Pozzolan including fly ash, slag, microsilica fume (for each type pozzolan 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), and
 - f. Admixture(s) brand and type, and total quantity each in batch.

The Manufacturer's Certificate of Compliance shall be signed by a responsible representative of the concrete Supplier, affirming the accuracy of the information provided.

6-02.3(4)C CONFORMANCE TO MIX DESIGN

Cement, coarse and fine aggregate weights shall be within the following tolerances of the mix design:

Batch Volumes less than or equal to 4 cubic yards		
Component	Tolerance	
Portland Cement	+5%	-1%
Aggregate	+10%	-2%

Batch Volumes more than 4 cubic yards		
Component	Tolerance	
Portland Cement	+5%	-1%
Aggregate	+2%	-2%

If the total cementitious material weight is made up of different components, these component weights shall be within the following tolerances:

Cementitious Material	Tolerance of that specified in the mix design
Portland cement weight	+5% or -1%
Fly ash weight	±5%
Microsilica weight	±10%
Slag	±5%

Water shall not exceed the maximum water specified in the mix design.

6-02.3(4)D TEST METHODS

Acceptance testing will be performed by the Engineer in accordance with the following:

Test Method	Test Description
AASHTO Test Method T 22 ASTM C 39	Compressive Strength of Cylindrical Concrete Specimens
WSDOT FOP for AASHTO T 23 ASTM C 31	Making and Curing Concrete Test Specimens in the Field
WSDOT FOP for AASHTO Test Method T 119 ASTM C 143	Slump of Hydraulic Cement Concrete
WAQTC FOP for TM 2 ASTM C 172	Sampling Freshly Mixed Concrete
WAQTC FOP for AASHTO T 152 ASTM C 231	Air Content of Freshly Mixed Concrete by the Pressure Method
AASHTO Test Method T 231 ASTM C 617	Capping Cylindrical Concrete Specimens
WSDOT FOP for AASHTO Test Method T 309 ASTM C 1064	Temperature of Freshly Mixed Portland Cement Concrete

6-02.3(4)E POINT OF ACCEPTANCE

Determination of concrete properties for acceptance will be made based on samples taken at the discharge of the placement system.

It shall be the Contractor's responsibility to provide adequate and representative samples of the fresh concrete to a location designated by the Engineer for the testing of concrete properties and making of cylinder specimens. Samples shall 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(4)F WATER/CEMENT RATIO CONFORMANCE

The actual water cement ratio shall be determined from the certified proportions of the mix, adjusting for Project Site 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 shall not exceed the maximum water cement ratio in the mix design, and shall meet the requirements for consistency as described in Section 6-02.3(3)D. If water is added, an air and temperature test will be taken prior to resuming placement to ensure that specification conformance has been maintained.

6-02.3(4)G SAMPLING AND TESTING FREQUENCY FOR TEMPERATURE, CONSISTENCY, AND AIR CONTENT

Concrete properties shall be determined from concrete as delivered to the Project Site and as accepted by the Contractor for placement. The Engineer will test for acceptance of concrete for slump, temperature, and air content, if applicable.

Sampling and testing will be performed before concrete placement from the first truck load. Concrete shall 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 prior to testing for acceptance. Sampling and testing will continue for each load until two successive loads meet all applicable acceptance test requirements. After two successive tests indicate that the concrete is within specified limits, the sampling and testing frequency may decrease to one for every five truck loads.

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 two successive subsequent tests indicate that the concrete is within the specified limits, the random sampling and testing frequency of one for every five truck loads may resume.

Sampling and testing for a placement of one class of concrete consisting of 50 cubic yards or less will be as listed above, except:

1. Sampling and testing will continue until one load meets all of the applicable acceptance requirements, and
2. After one 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(4)H SAMPLING AND TESTING FOR UNIT WEIGHT AND COMPRESSIVE STRENGTH

Acceptance testing for compressive strength will be conducted at the same frequency as specified in Section 6-02.3(4)G.

6-02.3(4)I REJECTING CONCRETE

Rejection Without Testing — The Engineer, prior to sampling, may reject any batch or load of concrete that appears defective in composition; such as cement content or aggregate proportions or slump. Rejected material shall not be incorporated in the Structure.

6-02.3(5) PLACING CONCRETE**6-02.3(5)A DAILY MEETING - BEFORE CONCRETE PLACEMENT**

Before placing each days concrete, the Contractor shall arrange for a pre-concrete placement meeting with the Engineer to ensure the Contractor is fully prepared for that day's specific concrete placement process in its entirety.

6-02.3(5)B GENERAL

The Contractor shall 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 shall 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 the placement of any reinforcing in it; or
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 shall pump it dry before placing concrete. If this is impossible, an underwater concrete seal shall be placed that complies with Section 6-02.3(5)B. This seal shall be thick enough to resist any uplift.

All foundations and forms shall be moistened with water just before the concrete is placed. Any standing water on the foundation or in the form shall be removed.

The Contractor shall place concrete in the forms as soon as possible after mixing. The concrete shall always be plastic and workable.

Concrete placement shall be continuous, with no interruption longer than 30 minutes between adjoining layers unless the Engineer approves a longer time. Each layer shall be placed and consolidated before the preceding layer takes initial set. After initial set, the forms shall not be jarred, and projecting ends of reinforcing bars shall not be disturbed.

In girders or walls, concrete shall be placed in continuous, horizontal layers 1.5 to 2.5 feet deep. Compaction shall leave no line of separation between layers. In each part of a form, the concrete shall be deposited as near its final position as possible.

Any method for placing and consolidating shall not segregate aggregates or displace reinforcing steel. Any method shall leave a compact, dense, and impervious concrete with smooth faces on exposed surfaces. Plastering is not permitted. Any section of defective concrete shall be removed at the Contractor's expense.

To prevent aggregates from separating, the length of any conveyor belt used to transport concrete shall not exceed 300 feet. If the mix needs protection from sun or rain, the Contractor shall cover the belt. When concrete pumps are used for placement, a Contractor's representative shall, prior to use on the first placement of each day, visually inspect the pumps water chamber for water leakage. No pump shall be used that allows free water to flow past the piston.

If a concrete pump is used as the placing system, the pump priming slurry shall 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 disposed of.

If the concrete will drop more than 5 feet, it shall be deposited through a sheet metal (or other approved) conduit. If the form slopes, the concrete shall be lowered through approved conduit to keep it from sliding down one side of the form. No aluminum conduits or tremies shall be used to pump or place concrete.

Before placing concrete for roadway slabs on steel spans, the Contractor shall release the falsework under the bridge and let the span swing free on its supports. Concrete in flat slab bridges shall be placed in one continuous operation for each span or series of continuous spans.

Concrete for roadway slabs and the stems of T-beams or box-girders shall be placed in separate operations if the beam or girder stem is more than 3 feet deep. First the stem shall be filled to the bottom of the slab fillets. Roadway slab concrete shall not be placed until enough time has passed to permit 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 beams, girders, roadway slabs, piers, columns, walls, and traffic and pedestrian barriers, etc., shall be placed in a continuous operation.

No traffic or pedestrian barrier shall be placed until after the roadway slabs are complete for the entire structure. No concrete barriers shall be placed until the falsework has been released and the span supports itself. The Contractor may choose not to release the deck overhang falsework prior to the barrier placement. The Contractor shall 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 do not exceed the design capacity of the girder component. This analysis is not required for bridges with concrete superstructures. No barrier, curb, or sidewalk shall be placed on steel or prestressed concrete girder bridges until the roadway slab reaches a compressive strength of at least 3,000 psi.

The Contractor may construct traffic and pedestrian barriers by the slipform method. However, the barrier may not deviate more than $\frac{1}{4}$ inch when measured by a 10-foot straightedge held longitudinally on the front, back, and top surfaces.

6-02.3(5)C WEATHER AND TEMPERATURE LIMITS TO PROTECT CONCRETE

Hot Weather Protection

The Contractor shall provide concrete within the specified temperature limits by:

1. Shading or cooling aggregate stockpiles (sprinkling of fine aggregate stockpiles with water is not allowed). If sprinkling of the coarse aggregates is to be used, the stockpiles moisture content shall be monitored and the mixing water adjusted for the free water in the aggregate. In addition, when removing the coarse aggregate, it shall be removed from at least 1 foot above the bottom of the stockpile.
2. 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, the Engineer may require approved temperature-reduction measures be taken before the placement begins.

If air temperature exceeds 90°F, the Contractor shall 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 concrete mix. The Contractor shall reduce the time between mixing and placing to a minimum and shall not permit mixer trucks to remain in the sun while waiting to discharge concrete. Chutes, conveyors, and pump lines shall be shaded.

If bridge roadway slabs are placed while air temperature exceeds 90°F, the Contractor shall:

- 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; and
- 4) Provide at the site water-fogging equipment to be used if needed after finishing to prevent plastic cracks.

If the evaporation rate at the concreting site is 0.20 pounds per square foot of surface per hour or more as determined from table 6-02.3(5)-1, the Contractor shall surround the fresh concrete with an enclosure. This enclosure shall protect the concrete from wind blowing across its surface until the curing compound is applied. If casting deck concrete is 80°F or hotter, the Contractor shall install approved equipment at the site clearly displaying relative humidity and wind velocity.

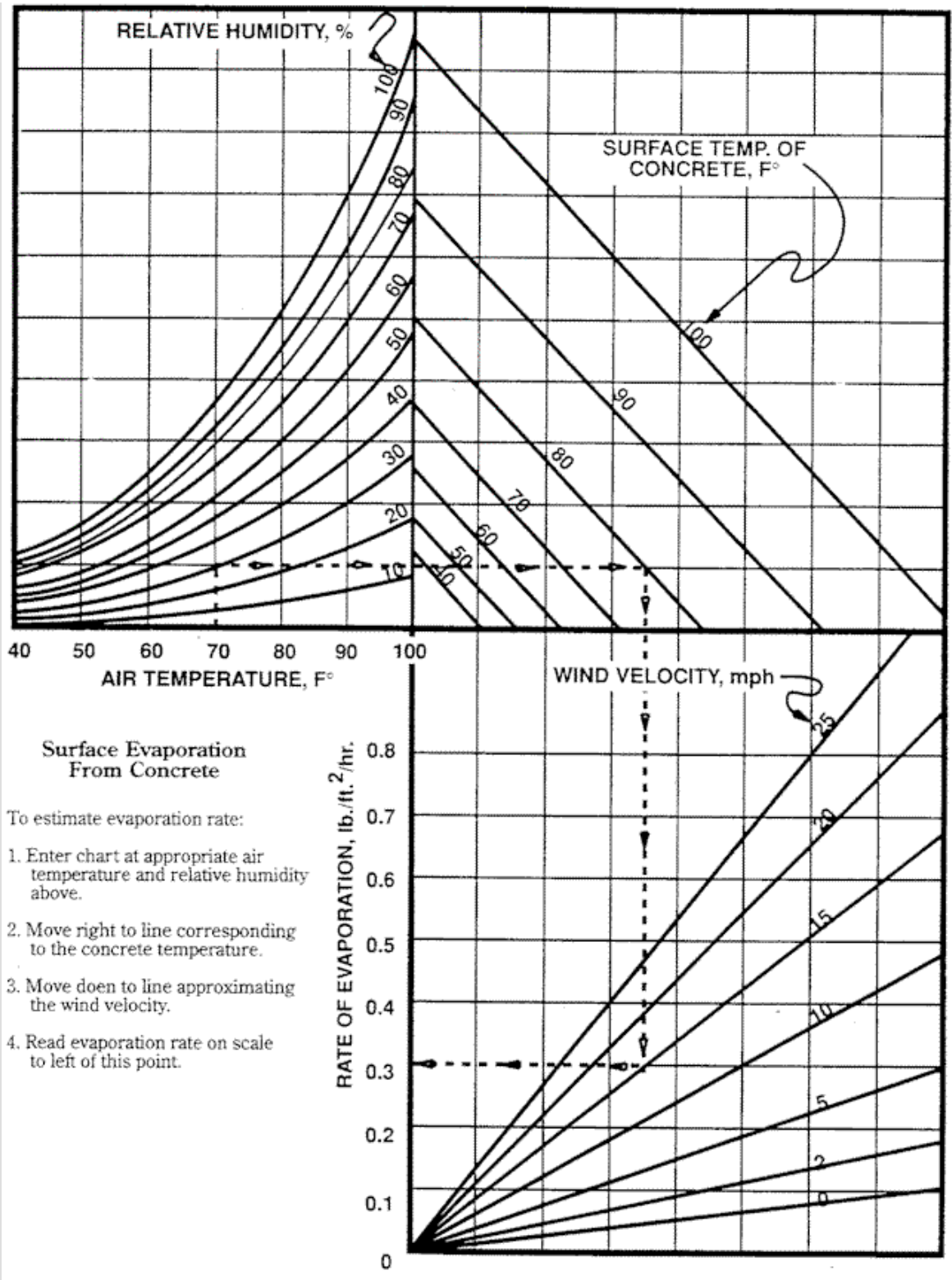


Table 6-02.3(5)-1 Surface Evaporation from Concrete

Cold Weather Protection

The Contractor is solely responsible for protecting concrete from inclement weather during the entire curing period. The Contractor shall provide a written procedure for cold weather concreting to the Engineer for review and approval. The procedure shall detail how the Contractor shall prevent the concrete temperature from falling below 50° F. Extra protection shall be provided for areas especially vulnerable to freezing (such as exposed top surfaces, corners and edges, thin sections, and concrete placed into steel forms). Permission given 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 shall still have the right to reject the work although the work were carried out with the Engineer's permission.

If weather forecasts predict air temperatures below 35°F during the seven days just after the concrete placement, the Contractor may place the concrete only if its approved cold weather concreting written procedure is implemented.

The Contractor shall provide and maintain a maturity meter in the concrete at a location specified by the Engineer for each concrete placement. During curing, data from the maturity meter shall be readily available to the Engineer. The Contractor shall record and provide time and temperature data on hourly intervals.

The Contractor shall not mix nor place concrete while the air temperature is below 35°F, unless the water or aggregates (or both) are heated to at least 70°F. The aggregate temperature shall not exceed 150°F. If the water is heated to more than 150°F, it shall be mixed with the aggregates before the cement is added. Any equipment and methods shall heat the materials evenly. Concrete placed in shafts and piles below the ground surface 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 shall increase mixing time enough to permit the super-dry aggregates to absorb moisture.

Any concrete placed in air temperatures below 35°F shall be immediately protected. In addition to the monitoring of the concrete temperature with a maturity meter, the Contractor shall provide recording thermometers or other approved devices to monitor the surface temperature of the concrete. The concrete surface temperature shall be maintained at or above 50°F and the relative humidity shall be maintained above 80 percent. These conditions shall be maintained for a minimum of seven days or for the cure period required by Section 6-02.3(11), whichever is longer. If artificial heat is used to maintain the temperature inside an enclosure, moisture shall be added to the enclosure to maintain the relative humidity as previously stated. The Contractor shall stop adding moisture 24 hours before removing the heat.

If at any period during curing, the concrete temperature falls below 50°F on the maturity meter or recording thermometer, no curing time is awarded for that day and the required curing time will be extended day for day where the temperature falls below 50°F. Should the Contractor fail to adequately protect the concrete and the temperature of the concrete falls below 35°F during curing, the Engineer may reject it.

6-02.3(5)D PLACING CONCRETE IN FOUNDATION SEALS

If the Contract requires a concrete seal, the Contractor shall place the concrete underwater inside a watertight cofferdam, tube, or caisson. Seal concrete shall be placed in a compact mass in still water. It shall remain undisturbed and in still water until fully set. While seal concrete is being deposited, the water elevation inside and outside the cofferdam shall remain equal to prevent any flow through the seal in either direction. The cofferdam shall be vented at the vent elevation shown in the Contract. The thickness of the seal is based upon this vent elevation.

The seal shall be at least 18 inches thick unless the Contract indicates otherwise.

To place seal concrete underwater, the Contractor shall use a concrete pump or tremie. The tremie shall have a hopper at the top that empties into a watertight tube at least 10 inches in diameter. The discharge end of the tube on the tremie or concrete pump shall include a device to seal out water while the tube is first filled with concrete. Tube supports shall permit the discharge end to move freely across the entire work area and to drop rapidly to slow or stop the flow.

One tremie or tube may be used for any "unit" right-angled area up to 324 square feet and with no side dimension greater than 18 feet. One tremie or tube may be used for all other "unit" shaped areas with no inside clear dimension greater than 18 feet. Any shaped area with a "unit" greater than specified in the preceding 2 sentences shall have an additional tube or tremie for each additional "unit".

Throughout the underwater concrete placement operation, the discharge end of the tube shall remain submerged in the concrete and the tube shall always contain enough concrete to prevent water from entering. The concrete placement shall 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 by core drilling or other tests that the seal contains no voids or horizontal joints. If testing reveals voids or joints, the Contractor shall repair them or replace the seal at no expense to the Owner.

Concrete Class 4000W shall be used for seals, and it shall meet the consistency requirements of Section 6-02.3(3)D.

6-02.3(5)E DEWATERING CONCRETE SEALS AND FOUNDATIONS

After a concrete seal is constructed, the Contractor shall pump the water out of the cofferdam and place the rest of the concrete in the dry. This pumping shall not begin until the seal has sufficient strength to withstand the hydrostatic pressure (three days for gravity seals and ten days for seals containing piling or shafts).

If weighted cribs are used to resist hydrostatic pressure at the bottom of the seal, the Contractor shall anchor them to the foundation seal. Any method used (such as dowels or keys) shall transfer the entire weight of the crib to the seal.

Pumping shall be done in a way that ensures concrete not being carried away.

6-02.3(6) CONCRETE EXPOSED TO SEA WATER

If sea water will contact a completed concrete Structure, the Contractor shall:

1. Mix the concrete for at least 2 minutes.
2. Control water content to produce concrete that will be as impermeable as possible.
3. Place concrete in a manner to avoid the formation of rock 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 (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.

6-02.3(7) CONCRETE EXPOSED TO ALKALINE SOILS OR WATER

Concrete proposed for placement in environments with exposure to alkaline soils or water shall have requirements as specified in the Contract.

6-02.3(8) VIBRATION OF CONCRETE

The Contractor shall supply enough vibrators to consolidate the concrete (except that placed underwater) according to the requirements of this Specification section. Each vibrator shall:

1. Be designed to operate while submerged in the concrete,
2. Vibrate at a rate of at least 7,000 pulses per minute, and
3. Receive the Engineer's approval on its type and method of use.

Immediately after concrete is placed, vibration shall be applied in the fresh batch at the point of deposit. In doing so, the Contractor shall:

- 1) Space the vibrators evenly, no farther apart than twice the radius of the visible effects of the vibration;
- 2) Ensure that vibration intensity is great enough to visibly affect a weight of 1 inch slump concrete across a radius of at least 18 inches;
- 3) 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;
- 4) Protect partially hardened concrete (i.e., nonplastic, 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;
- 5) Not allow vibration to continue in one place long enough to form pools of grout;
- 6) Continue vibration long enough to consolidate the concrete thoroughly, but not so long as to segregate it;
- 7) Withdraw the vibrators slowly when the process is complete; and
- 8) 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 shall not draw water or laitance to the surface. In high lifts, the top layer shall 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 shall hand tamp the concrete.

6-02.3(9) RESERVED

6-02.3(10) ROADWAY SLABS

6-02.3(10)A GENERAL

A preconcreting conference shall be held 5 to 10 Working Days prior to placing concrete to discuss construction procedures, personnel, and equipment to be used. Those attending shall include:

1. (Representing the Contractor) The superintendent and all foremen in charge of placing steel reinforcing bars, of placing the concrete, and of finishing it; and
2. (Representing the Owner) The Engineer and key inspection Assistants.

If the project includes more than one slab, and if the Contractor's key personnel change between concreting operations, an additional conference shall be held just before each slab is placed.

The Contractor shall not place roadway slabs until the Engineer agrees that:

- 1) Concrete production and placement rates are high enough to meet placing and finishing deadlines;
- 2) Finishers with enough experience have been employed; and
- 3) Adequate finishing tools and equipment are at the site.

The finishing machine shall be self-propelled and be Capable of forward and reverse movement under positive control. The finishing machine shall be equipped with a rotating cylindrical single or double drum screed not exceeding 60 inches in length. The finishing machine shall have the necessary adjustments to produce the required cross-section, line, and grade. Provisions shall be made for the raising and lowering of all screeds under positive control. The upper vertical limit of screed travel shall permit the screed to clear the finished concrete surface. When placing concrete abutting a previously

placed slab, the side of the finishing machine adjacent to the existing slab shall be equipped to travel on the existing slab. If performance is not acceptable, the Engineer may reject the equipment, any concrete already placed, or both.

The Contractor may use hand-operated strike-boards only for special conditions and for small areas (less than 10 feet in width and 200 feet in length) only when the Engineer approves. These boards shall be sturdy and able to strike off the width of a full roadway lane without intermediate screeds. Strike-boards, screed rails, and any specially made auxiliary equipment shall receive the Engineer's approval before use. All finishing requirements in these Specifications apply to hand-operated finishing equipment.

Screed rails shall rest on adjustable supports that can be removed with the least possible disturbance to the screeded concrete. The supports shall rest on structural members or on forms rigid enough to resist deflection. Supports shall be removable to at least 2 inches below the finished surface. If possible, the Contractor shall place screeds outside the finishing area. However, if they are placed inside the area, they shall be placed above the finished surface.

Screed rails (with their supports) shall be strong enough and stiff enough to permit the finishing machine to operate effectively on them. All screed rails shall be placed and secured for the full length of the slab before the concreting begins. If the Engineer approves in advance, the Contractor may move rails ahead onto previously set supports while concreting progresses. But such movable rails and their supports shall 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 floorbeams, with the strike-board moving at right angles to the centerline of the roadway.

Before any concrete is placed, the finishing machine shall be operated over the entire length of the slab to check screed deflection. Concrete placement may begin only if the Engineer gives approval of screed deflection based on this test.

Immediately before placing concrete, the Contractor shall check (and adjust if necessary) all falsework and wedges to minimize settlement and deflection from the added weight of the concrete slab. The Contractor shall also install devices, such as telltales, by which the Engineer can readily measure settlement and deflection.

The Contractor shall schedule the concrete placement so that it can be completely finished during daylight. When the remaining daylight has diminished to limit adequate visibility, finishing is permitted if the Contractor provides adequate lighting and the Engineer approves the adequacy of the lighting.

The placement operation shall cover the full width of the roadway or the full width between construction joints. The Contractor shall locate any construction joint over a beam or web that can support the slab on either side of the joint. The joint shall not occur over a pier unless the Contract permits. Each joint shall be formed vertically and in true alignment. The Contractor shall 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 slabs shall comply with Section 6-02.3(5)A. The placement method requires approval by the Engineer. In placing the concrete, the Contractor shall:

- (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 revibrate any concrete surface area where workers have stopped prior to 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 strikeboard 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 bringing excessive amounts of mortar to the surface) to create a surface that is true and ready for final finish; and
- (9) Leave a thin, even film of mortar on the concrete surface after the last pass of the strike-board.

Workers shall 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 shall fill the voids with concrete (not mortar).

The Contractor shall float the concrete surface left by the finishing machine to remove roughness, minor irregularities, and seal the surface of the concrete. Floating shall leave a smooth and even surface. The floats shall be at least 4 feet long. Each transverse pass of the float shall overlap the previous pass by at least half the length of the float. The first floating shall be at right angles to the strike-off. The second floating shall be at right angles to the centerline of the span. A smooth riding surface shall be maintained across construction joints.

Expansion joints shall be finished with a 1/2 inch radius edger.

After floating, but while the concrete remains plastic, the Contractor shall test the entire slab for flatness (allowing for crown, camber, and vertical curvature). The testing shall be done with a 10-foot straightedge held on the surface. The straightedge shall be advanced in successive positions parallel to the centerline, moving not more than one-half the length of the straightedge each time it advances. This procedure shall be repeated with the straightedge held perpendicular to the centerline. An acceptable surface shall be one free from deviations of more than 1/8 inch under the 10-foot straightedge.

If the test reveals depressions, the Contractor shall fill them with freshly mixed concrete, strike off, consolidate, and refinish them. High areas shall be cut down and refinished. Re-testing and refinishing shall continue until an acceptable, deviation free surface is produced. The hardened concrete shall meet all smoothness requirements of these Specifications even though the tests require corrective work.

The Contractor shall texture the bridge deck by combing the final surface perpendicular to the centerline. Made of a single row of metal tines, the comb shall 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 shall 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 shall produce the required texture without displacing larger particles of aggregate. Texturing shall end 2 feet from curb lines. This 2-foot untextured strip shall be hand finished with a steel trowel.

If the Contract calls for an overlay (to be constructed on the same Contract) such as asphalt concrete, latex modified concrete, epoxy concrete, or similar, the Contractor shall produce the final finish by dragging a strip of damp, seamless burlap lengthwise over the full width of the slab or by brooming it lightly. A burlap drag shall equal the slab in width. Approximately 3 feet of the drag shall contact the surface, with the least possible bow in its leading edge. The burlap shall be kept wet and free of hardened lumps of concrete. When it fails to produce the required finish, the Contractor shall replace it. When not in use, it shall be lifted clear of the slab.

The surface shall not vary more than 1/8-inch under a 10-foot straightedge placed parallel and perpendicular to the centerline after the slab has cured.

The Contractor shall cut high spots down with a diamond faced, saw-type cutting machine. This machine shall cut through mortar and aggregate without breaking or dislodging the aggregate or causing spalls.

Low spots shall be built up utilizing a grout or concrete with a strength equal to or greater than the required 28-day strength of the roadway slab concrete. The method of build-up shall be submitted to the Engineer for approval prior to use.

The surface texture on any area cut down or built up shall match closely that of the surrounding deck. The entire bridge roadway slab shall provide a smooth riding surface.

Concrete for sidewalk slabs shall 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 straightedge. An edging tool shall be used to finish all sidewalk edges and expansion joints. The final surface shall have a granular texture that does not turn slick when wet.

6-02.3(11) CURING CONCRETE

6-02.3(11)A GENERAL

After placement, concrete surfaces shall be cured as follows:

Concrete Surface	Curing
Slabs (roadway, except those using Class 4000W ¹ ; bridge approach slabs, bridge side walks; culvert tops; roofs of cut and cover tunnels)	curing compound covered by white, reflective type sheeting or continuous wet curing for at least 10 days.
Roadway slabs using concrete Class 4000W ¹	continuous wet cure with heavy quilted blankets or burlap only, for 14 days.
Retaining walls, culvert sidewalls, and culvert floors	continuous moisture for at least ten days.

Note 1: water reducing admixture per Section 9-23.6 required.

All other concrete surfaces (except traffic barriers and rail bases) shall be cured with continuous moisture for at least three days.

The Contractor may provide continuous moisture by watering a covering of heavy quilted blankets, by watering and covering with a white reflective type sheeting, or by wetting the outside surfaces of wood forms.

When curing roadway slabs with wet heavy quilted blankets or burlap, a fog or mist spray of water shall be sprayed on the entire concrete surface before the bleed water has evaporated. As soon as the concrete has achieved initial set, the surface shall be covered with presoaked heavy quilted blankets or burlap. The fog or mist spray shall be applied continuously until the presoaked heavy quilted blankets or burlap are placed. If the fog or mist spray cannot be applied continuously, two coats of curing compound (that complies with Section 9-23.2) shall be applied after the initial fog or mist spray application and before the presoaked heavy quilted blankets or burlap are placed.

When using curing compound, the Contractor shall apply two coats of compound to the fresh concrete. The compound shall comply with Section 9-23.2 and shall be applied immediately after finishing and after the visible bleed of water has evaporated. The second coat shall be applied in a pattern perpendicular to that of the first coat. The two coats shall total at least 1 gallon per 150 square feet and shall obscure the original color of the concrete. If any curing compound spills on construction joints or reinforcing steel, the Contractor shall remove the compound from the construction joint or reinforcing steel before the next concrete pour.

Unless the Contract calls for an asphalt overlay, the Contractor shall use white pigmented curing compound (Type 2), agitating it thoroughly just before and during application. If other Material is to bond with the concrete surface, the Contractor shall remove the curing compound by sandblasting or by acceptable high pressure water washing prior to placing the other Material.

The Contractor shall have on-site, back-up spray equipment, enough workers, and a bridge from which they shall apply the curing compound. The Contractor shall be prepared to demonstrate at least one day before the pour, that the workers and equipment can apply the compound as specified. No later than the morning after applying the curing compound,

the Contractor shall cover the top surfaces with white, reflective sheeting, leaving it in place for at least ten days. The sheeting shall be kept in place by taping or weighting the edges where they overlap.

If the Contract calls for an asphalt overlay, the Contractor shall use the clear curing compound (Type 1D), applying at least 1 gallon per 150 square feet to the concrete slab.

6-02.3(11)B CURING AND FINISHING CONCRETE TRAFFIC AND PEDESTRIAN BARRIER

The Contractor shall supply enough water and workers to cure and finish concrete barrier as required in this Section.

Fixed-Form Barrier:

The edge chamfers shall be formed by attaching chamfer strips to the barrier forms. After troweling, edging a barrier, and while the forms remain in place, the Contractor shall:

1. Brush the top surface with a fine bristle brush;
2. Cover the top surface with heavy, quilted blankets; and
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 shall:

- 1) Remove all lips and edgings with sharp tools or chisels;
- 2) Fill all holes with mortar;
- 3) True up corners of openings;
- 4) Remove concrete projecting beyond the true surface by stoning or grinding;
- 5) Cover the barrier with heavy, quilted blankets (burlap shall not be used); and
- 6) Keep the blankets continuously wet for at least 7 days.

The Contractor may do the finishing work described in steps a. through d. after removing the forms if the entire barrier, except for the immediate work area, is kept covered and kept wet. Otherwise, no finishing work may be done until at least 10 days after pouring.

After the 10-day curing period, the Contractor shall remove from the barrier all form-release agent, mud, dust, and other foreign substances in either of two ways: (1) by light sandblasting and washing with water, or (2) by spraying with a high-pressure water jet. The water jet equipment shall use clean fresh water and shall produce (at the nozzle) at least 1500 psi with a discharge of at least 3 gpm. The water jet nozzle shall have a 25-degree tip and shall be held no more than 9 inches from the surface being washed.

After cleaning, the Contractor shall use brushes to rub 1:1 mortar into air holes and small crevices on all surfaces except the brushed top. This mortar shall consist of 1 part Portland cement (of the same brand used in the concrete) and 1 part uncontaminated fine plaster sand. As soon as the mortar takes its initial set, the Contractor shall rub it off with a piece of sacking or carpet. The barrier shall then be covered with wet quilted blankets for at least 48 hours.

No curing compound shall be used on fixed-form concrete barrier. The completed surface of the concrete shall be even in color and texture.

Slip-Form Barrier:

The edge radius shall be formed by attaching radius strips to the barrier slip forming.

The Contractor shall finish slip-form barrier by steel troweling to close all surface pockmarks and holes. The Contractor shall finish plain surface barrier by lightly brushing the front and back face with vertical strokes and the top surface with crosswise strokes.

After finishing, the Contractor shall cure the slip-form barrier by using either method A (curing compound) or method B (wet blankets) described as follows:

Method A: Under the curing compound method, the Contractor shall:

- (1) Spray 2 coats of clear curing compound (Type 1D) on the concrete surface after the free water has disappeared (Coverage of combined coats shall equal at least 1 gallon per 150 square feet);
- (2) No later than the morning after applying the curing compound, cover the barrier with white, reflective sheeting for at least 10 days; and
- (3) After the 10-day curing period, remove the curing compound completely by light sandblasting or by spraying with a high-pressure water jet to produce an even surface appearance. The water jet equipment shall use clean fresh water and shall produce (at the nozzle) at least 2500 psi with a discharge of at least 4 gpm. The water jet nozzle shall have a 25-degree tip and shall 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 Contractor's curing compound concrete sealer submittal and if found acceptable, will approve the proposal in writing. As a minimum, the Contractor's submittal shall include:
 - a) Product Identity,
 - b) Manufacturer's recommended application rate,
 - c) Method of application and necessary equipment,
 - d) Material Safety Data Sheet (MSDS), and
 - e) Sample of the material for testing

Allow 14 Working Days for evaluating the proposal and testing the material.

Method B: Under the wet cure method, the Contractor shall:

- 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; and

- 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 JOINT

The Contractor may change construction joints indicated on the Drawings by adding, deleting, or relocating. Any request for such changes shall be submitted to the Engineer for review in accordance with Section 1-05.3(5) showing the added, deleted, or relocated construction joints. Such changes to construction joints shall be at the sole risk of the Contractor and shall be at no additional cost to the Owner.

All construction joints shall be formed neatly with grade strips or other approved methods. The Engineer will not accept irregular or wavy construction joints. Wire mesh forming material shall not be used. All joints shall be horizontal, vertical, or perpendicular to the main reinforcement. The Contractor shall not use an edger on any construction joint, and shall remove any lip or edging before making the adjacent pour.

If the Drawings require a roughened surface on the joint, the Contractor shall strike it off to leave grooves at right angles to the length of the member. The grooves shall 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 shall repeat the process before the concrete reaches initial set. The final surface shall be clean and without laitance or loose material.

The Contractor shall include shear keys at all construction joints where a roughened surface is not required on the Drawings. These shear keys shall provide a positive, mechanical bond. Shear keys shall be formed depressions and the forms shall not be removed until the concrete has been in place at least 12 hours. Forms shall 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 shall:

1. Be formed with 2 by 8 inch 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, crossbeam, etc.(measured transverse of the stem); and
4. Be spaced at 16 inches center to center.
5. In other locations not addressed by items 1, 2, 3, or 4 immediately preceding, shear keys shall equal approximately one third of the joint area and shall be approximately 1-1/2 inches deep, unless the Contract indicates otherwise.

Before placing new concrete against cured concrete, the Contractor shall thoroughly clean and roughen the cured face and wet it with water. Before placing the reinforcing mat for footings on seals, the Contractor shall:

- (1) remove all scum, laitance, and loose gravel and sediment;
- (2) clean the construction joint at the top of the seals; and
- (3) 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(13) EXPANSION JOINTS AND COMPRESSION SEALS

6-02.3(13)A EXPANSION JOINTS

This Section outlines the requirements of specific expansion joints shown on the Drawings, unless the Contract specifies otherwise.

Joints made of a vulcanized, elastomeric compound (with neoprene as the only polymer) shall be installed with an approved lubricant adhesive as recommended by the manufacturer. The length of a seal shall match that required on the Drawings without splicing or stretching.

Open joints shall be formed with a template made of wood, metal, or other suitable material. Insertion and removal of the template shall be done without chipping or breaking the edges or otherwise damaging the concrete. Joint surfaces shall be parallel with a tolerance varying not more than 1/16 the joint spacing in any 10 foot length.

Any part of an expansion joint running parallel to the direction of expansion shall provide a clearance of at least 1/2 inch between the two surfaces. The clearance shall be produced by inserting and removing a spacer strip. The Contractor shall ensure that the surfaces meet the parallel requirements to prevent any wedging from expansion and contraction.

All poured rubber joint sealer (and any required primer) shall conform with Section 9-04.2(2).

The expansion joints shall be as shown and noted on the Drawings.

The Contractor shall submit Shop Drawings of the expansion joints proposed for use to the Engineer. Submittal of Shop Drawings shall be in accordance with provisions of Section 1-05.3. The Shop Drawings shall show details of the system(s), including materials and dimensions, method of installation, method of sealing the system to prevent leakage of water through the joint, and the manufacturer's written installation procedures.

After the joint system(s) is installed, the joint area shall be sandbagged, flooded with 4 inches of water for 24 hours and inspected from below the joint for leakage. If leakage is observed, the joint system shall be repaired as recommended by the manufacturer including review of the manufacturer's recommendation by the Engineer.

To aid in assuring proper use and installation of the expansion joint system under job conditions, the Contractor shall have available during installation of the joint system and at no additional cost to the Owner, the services of a qualified, full-time field representative of the manufacturer of the expansion joint system to be installed in the project. Recommendations made

by the manufacturer's representative and reviewed by the Engineer, shall be adhered to by the Contractor at no additional cost to the Owner.

The expansion joints shall seal the roadway deck surface, curbs, and sidewalks to prevent water from passing through the joint to portions of the Structure below. Installation of the expansion joints and painting of the exposed metal parts shall be in accordance with the manufacturer's recommendations. The sealant recommended by the manufacturer supplying the expansion joint shall be submitted for review by the Engineer before installation. The transition of the expansion joint from the roadway, up the curb face and horizontally to the back of the curb shall be in a continuous factory fabricated curb/gutter unit.

The seats for the expansion joints shall be absolutely parallel to longitudinal and transverse roadway grade and shall match the transverse crown of the final pavement surface. All spalls, low areas or high areas in the expansion joint seat shall be recontoured so that the variation is no more than 1/16 inch from a 10-foot straightedge on a constant cross slope and from a 3-foot straightedge on a parabolic crown. Each successive check with the straightedge device shall lap the previous check by at least 1/2 of the length of the straightedge. All concrete outside corners of the expansion joint slot shall have a radius of rounding of 1/4 inch.

When the expansion joint seat consists of steel plates or steel angles, all high areas shall be ground and all low areas having a depth of less than 1/4 inch from the true seat contour shall be filled with an approved epoxy. Areas with a depth greater than 1/4 inch shall be filled with an approved epoxy sand grout. The tolerance from a 10-foot or 3-foot straightedge shall be the same as stated above for concrete seats.

The expansion joint material shall have full firm bearing for the entire length and width of the joint. The expansion joint material shall be placed so that its top surface is recessed 1/8 inch \pm 1/16 inch below the driving surface of the pavement on both sides of the expansion joint.

Shims, washers or other devices shall not be used below the expansion joint material to bring the joint either to proper elevation or to proper tolerance.

All aluminum surfaces that will be in contact with concrete shall be coated with zinc chromate or a bituminous paint as recommended by the manufacturer.

6-02.3(13)B COMPRESSION SEAL

6-02.3(13)B1 GENERAL

The groove or recess for compression seals shall have parallel sides and be constructed to the proper depth. The width of the recess shall not vary more than 1/16 inch in a distance of 10 feet. The bottom shall be a smooth surface parallel to the surface of the roadway, curb, or sidewalk.

The Contractor shall furnish and install compression seals of the size and type specified at the locations indicated on the Drawings and according to the following provisions:

The seals shall conform to the requirements of ASTM D 2000 and shall be formed by an extrusion process resulting in a dense neoprene with uniform dimensions and smooth exterior surface.

The cross section of the seal shall be shaped to allow adequate compression of the seal under design conditions. The length of seals shall be as indicated on the Drawings. Stretching of the seals will not be permitted. Details of the seal, including corner joints and type of material to bond joints shall be submitted to the Engineer for review before submitting samples for lot acceptance. A lot shall be considered all material of one size produced during one production run for use on the project. A sample shall consist of a 3-foot length of actual seal. The Supplier of the joint seals shall furnish the Engineer a Manufacturer's Certificate of Compliance stating the test results for the Material complies with the Specification requirements including catalog cuts and Shop Drawings.

The seal shall be installed with an approved lubricant adhesive in accordance with the manufacturer's recommendations. The lubricant adhesive shall be delivered in containers plainly marked with the manufacturer's name or trademark, lot number and date of manufacture. A one pint sample of lubricant adhesive shall be furnished to the Engineer for approval prior to installation.

6-02.3(13)B2 PREPARATION OF SURFACES FOR INSTALLATION

All surfaces to receive elastomeric compression seal shall be free from dirt, water, oil, rust, frost, spalls, cracks, and any loose debris.

It is imperative that a clean opening, with 1/4 inch rounded top edges, shall be produced for the specified opening and for the full depth of joint required. All joint grooves shall be inspected for spalling after the joints are constructed and all foreign materials removed from the joint grooves. Spalling that increases the specified size of the joint groove beyond the following limits shall be repaired by patching with epoxy mortar:

1. Spalls over 1/4 inch wide and over 1/2 inch below the surface of the pavement; and
2. Spalls over 1/4 inch wide and 2 inches or more in length, regardless of the depth of spall below the surface of the pavement.

6-02.3(13)B3 INSTALLATION

Where indicated on the Drawings, the Contractor shall install the proper seals in accordance with the Contract. The air temperature shall be below 85°F at the time of installation.

Compression seals shall be recessed 3/8 inch from the finished grade with a tolerance of 1/16 inch in 10 feet.

At end joints or miter joints as shown on the Drawings, a 1/4-inch thick neoprene sponge shall be bonded to the seal ends with an approved cyanoacrylate adhesive. The neoprene sponge shall be cut to the size and shape of the nominal dimensions of the uncompressed seal. The seal plus the sponge shall be slightly longer than the gap to be filled so that the sponge is in a state of compression against the ends of the seal. The cyanoacrylate adhesive shall only be applied to outer webs and top web of the seal to allow entrapped air to escape.

At seal upturn or downturn locations, the installation procedure shall be as follows (see detail on the Drawings):

1. Locate 1/2-inch diameter hole and drill through seal as shown, using a standard twist drill;
2. Using a sharp long blade knife or hacksaw, cut lower section of seal to 1/2-inch diameter hole as shown;
3. Bend seal in desired position and install as shown; and
4. Complete seal installation following normal sealing instructions.

The seal surface to be bonded shall be cleaned with toluene or other solvent recommended by the seal manufacturer prior to applying adhesive. Controls shall be in place for controlling and containing the toluene or other solvent material as required in Section 1-07. A continuous coat of adhesive shall be applied to both joint interfaces immediately prior to seal installation. Adhesive shall not be applied below 40°F. The compression seal shall be placed such that the top surface, or surface facing the front of the curb, shall be recessed 1/8-inch \pm 1/16 inch into the adjacent concrete surface.

6-02.3(14) FINISHING CONCRETE SURFACES

6-02.3(14)A GENERAL

All concrete shall show a smooth, dense, non-porous face after the forms are removed. The removing and replacing of any concrete showing porous, or not smooth, or non-dense concrete shall be at no additional cost to the Owner. The Contractor shall clean and refinish any stained or discolored surfaces that may have resulted from his/her work or from construction delays.

Subsections 6-02.3(14)B, 6-02.3(14)C, and 6-02.3(14)D describe three classes of surface finishing. The Contractor shall comply with these subsections unless the Contract requires otherwise.

6-02.3(14)B CLASS 1 SURFACE FINISH

The Contractor shall apply a Class 1 surface finish to all rail bases, curbs, traffic barrier, pedestrian barrier, and ornamental concrete members.

Class 1 surface finish requires the same treatment as Class 2 surface finish (see the following Section) but also includes the finishing steps outlined in Section 6-02.3(11)B.

6-02.3(14)C CLASS 2 SURFACE FINISH

The Contractor shall apply a Class 2 surface finish to:

1. All surfaces on the superstructures at highway grade separations and railroad undercrossings (but not under surfaces of slab spans, filled spandrel arches and floor slabs between girders, or near horizontal bottom slabs of box girders, or inside vertical surfaces of girders, or concrete cast in steel forms);
2. All above finished ground surfaces of bridge piers, columns, abutments, retaining walls, and Culvert head walls, but not columns cast in steel forms, whenever these surfaces are visible from any walkway or roadway within 150 feet;
3. All outside surfaces, vertical or sloping, of each superstructure including the undersurfaces of cantilevered floor slabs that overhang outside girders or box girders; and
4. All surfaces of open spandrel arch rings, spandrel columns, and abutment towers.

The Contractor shall comply with steps a. through h. that follow. The Contractor may omit steps c. through h. below when steel forms have been used and when the surface of filled holes matches the texture and color of the area around them. To create a Class 2 surface finish, the Contractor shall:

- a. Remove all bolts and all lips and edgings where form members have met;
- b. Fill all holes greater than 1/4-inch with 1:2 mortar floated to an even, uniform finish that is flush with surrounding surface;
- c. Thoroughly wash the surface of the concrete with water;
- d. Brush on a 1:1 mortar mix (made of the same brand of cement as was used in the concrete), working it well into the small air holes and other crevices in the face of the concrete;
- e. Brush on no more mortar than can be finished in 1 day;
- f. Rub the mortar off with burlap or a piece of carpet as soon as it takes initial set and before it reaches final set;
- g. Fog-spray water over the finish as soon as the mortar paint has reached final set; and
- h. Keep the surface damp for at least 2 days.

If the mortar becomes too hard to rub off as described in step f., the Contractor shall remove it with a carborundum stone and water. Random grinding is not permitted.

6-02.3(14)D CLASS 3 SURFACE FINISH

The Contractor shall apply a Class 3 surface finish to:

1. All above-ground surfaces not receiving a Class 1 or Class 2 surface finish as specified above; and
2. All surfaces that are to be underground or covered with fill. The Engineer may waive the requirement for removing tight form ties and filling small air holes.

To produce a Class 3 surface finish, the Contractor shall:

- 1) Remove all bolts and all lips and edgings where form members have met; and
- 2) Fill all holes greater than 1/4-inch with 1 part Portland cement to 2 part fine aggregate (Section 9-03.1(2)) mortar with just enough water to make a stiff consistency floated to an even, flush finish.

Nothing further is required if the Engineer decides these 2 steps have produced an acceptable surface finish. Otherwise, the Contractor shall follow other Class 2 surface finish steps until the Engineer approves the work as a final Class 3 surface finish.

6-02.3(15) DATE NUMERALS

Standard date numerals shall be placed where shown on the Drawings. The date shall be for the year in which the Structure is completed. When a traffic barrier is placed on an existing Structure, the date shall be for the year in which the original structure was completed.

6-02.3(16) SHOP DRAWINGS FOR FALSEWORK AND FORMWORK

6-02.3(16)A GENERAL

The Contractor shall submit all Shop Drawings for falsework and formwork for review directly to the Engineer in accordance with Section 1-05.3. All falsework and formwork shall be constructed in accordance with Engineer reviewed falsework and formwork Shop Drawings.

Except for the placement of falsework foundation pads and piles, the construction of any unit of falsework shall not start until the Engineer has reviewed the falsework Shop Drawing submittal for that unit. Driven piles for falsework, temporary concrete footings, or timber mudsills may be placed as described in Section 6-02.3(17)E prior to the Engineer's review 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)D; or
2. The falsework requires prior placement of shoring or cofferdams as described in Section 2-09.3(3)D.

If the project involves a railroad or the U.S. Bureau of Reclamation, the following additional sets for the portion of the project that involves the railroad or U.S. Bureau of Reclamation shall be sent to the Engineer:

- 1) Four sets for each railroad company affected; and
- 2) Six sets for the U.S. Bureau of Reclamation.

The Engineer will review the falsework and formwork Shop Drawings and calculations, and will request the required reviews from the appropriate railroad company or the U.S. Bureau of Reclamation. After the Engineer has received any comments from the railroad company or the U.S. Bureau of Reclamation, two copies of the reviewed falsework and formwork Shop Drawings, with comment when applicable, will be returned to the Contractor.

Shop Drawing review 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 shall be based on:

- (1) Applied loads and conditions which are no less severe than those described in Section 6-02.3(17)B, "Design Loads;"
- (2) Allowable stresses and deflections which are no greater than those described in Section 6-02.3(17)C, "Allowable Stresses and Deflections;"
- (3) Special loads and requirements no less severe than those described in Section 6-02.3(17)D, "Falsework and Formwork at Special Locations;" and
- (4) Conditions required by other Sections of 6-02.3(17), "Falsework and Formwork".

The falsework and formwork Shop Drawings shall be scale drawings showing the details of proposed construction, including, but not limited to.

- a. sizes and properties of all members and components;
- b. spacing of bents, posts, studs, wales, stringers, wedges and bracing;
- c. rates of concrete placement, placement sequence, direction of placement, and location of construction joints; and
- d. identify falsework devices and safe working load as well as identifying any bolts or threaded rods used with the devices including their diameter, length, type, grade, and required torque.

Show in the falsework Shop Drawing submittals the proximity of falsework to utilities or any nearby Structures including underground Structures. Formwork accessories shall be identified according to Section 6-02.3(17)I, "Formwork Accessories". All assumptions, dimensions, material properties, and other data used in making the structural analysis shall be noted on the Shop Drawing submittal.

In accordance with the requirements of Section 1-05.3(12), all falsework and formwork Shop Drawings and design calculations shall 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. The Contractor shall furnish two copies of the associated design calculations to the Engineer for examination as a condition for review. The design calculations shall show the stresses and deflections in load supporting members. Construction details which may be shown in the form of sketches on the calculation sheets shall be shown in the falsework or formwork Shop Drawings as well. Falsework or formwork Shop Drawings will not be reviewed in any case where it is necessary to refer to the calculation sheets for information needed for complete understanding of the falsework and formwork Shop Drawings or how to construct the falsework and formwork.

6-02.3(16)B REVISED AND PRE-APPROVED FALSEWORK AND FORMWORK SHOP DRAWINGS

Pre-approval of falsework and formwork Shop Drawings will not be allowed.

Contractor revisions to reviewed Shop Drawings returned by the Engineer shall require a resubmittal of the reviewed Shop Drawings clearly indicating all revision with supporting calculation. The Contractor shall take into consideration any additional time required by the Engineer to perform additional review of previously reviewed Shop Drawings. The Contractor agrees to make no claim whatsoever both for adjustment to Contract Time and/or for additional compensation.

6-02.3(17) FALSEWORK AND FORMWORK**6-02.3(17)A GENERAL**

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 shall set falsework, to produce in the finished structure, the lines and grades indicated on the Drawings. The setting of falsework shall allow for shrinkage, settlement, falsework girder camber, and any structural camber the Contract requires.

Concrete forms shall be mortar tight and true to the dimensions, lines, and grades of the concrete structure. Curved surfaces shown on the Drawings shall be constructed as curved surfaces and not chorded, except as allowed in Section 6-02.3(17)K. Concrete formwork shall prevent overstress and excess deflection as defined in Section 6-02.3(17)C. The rate of depositing concrete in the forms shall not exceed the placement rate in the submitted and reviewed formwork Shop Drawing. The interior form shape and dimensions shall also ensure that the finished concrete conforms with the Drawings.

If the new Structure is near or part of an existing one, the Contractor shall not suspend or support falsework on the existing structure unless the Contract states otherwise. For prestress girder and Tbeam bridge widenings or stage construction, the roadway deck and the diaphragm forms may be supported from the existing structure or previous stage, if approved by the Engineer. For steel plate girder bridge widenings or stage construction, only the roadway deck forms may be supported from the existing structure or previous stage, if approved by the Engineer. See Section 6-02.3(17)F for additional conditions.

Forms designed to stay in place on bridge roadway slabs shall not be made of steel or precast concrete panels.

For post-tensioned structures, both falsework and forms shall be designed to carry the additional loads caused by the post-tensioning operations. The Contractor shall construct supporting falsework in a way that leaves the superstructure free to contract and lift off the falsework during post-tensioning. Forms that remain inside box girders to support the placement of the roadway slab concrete shall, by design, not resist girder contraction. See Section 6-02.3(26) for additional conditions.

Concrete barriers shall be used to protect falsework adjacent to traffic from damage by vehicles.

6-02.3(17)B DESIGN LOADS

The design load for falsework shall consist of the sum of dead and live vertical loads, and a design horizontal load. The minimum total design load for any falsework shall not be less than 100 pounds per square foot for combined live and dead load regardless of structure thickness.

The entire superstructure cross-section, except for traffic barrier, shall be considered to be 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 prior to the top slab, may be considered to be self supporting between falsework bents at the time 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 shall 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 shall 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 shall be assumed to be not less than 160 pounds per cubic foot.

Live loads shall consist of the actual weight 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 Shop Drawing submittal 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 shall be:

The sum of all identifiable horizontal loads exerted by equipment, construction sequence, sidesway 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 shall the design horizontal load be less than three 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 shall 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 the elements in

the tower face normal to the applied wind. The shape factor for heavy-duty steel shoring towers shall be taken as 2.2. Wind pressure values shall be determined from the following table:

WIND PRESSURE ON HEAVY-DUTY STEEL SHORING TOWERS		
Height Zone (Feet above Ground)	Wind Pressure Value	
	Adjacent to Traffic	At Other Locations
0 to 30	20 psf	15 psf
30 to 50	25 psf	20 psf
50 to 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, shall 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, excluding the areas between falsework posts or towers where diagonal bracing is not used. Wind pressure values shall be determined 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 to 30	2.0 Q psf	1.5 Q psf
30 to 50	2.5 Q psf	2.0 Q psf
50 to 100	3.0 Q psf	2.5 Q psf
Over 100	3.5 Q psf	3.0 Q psf

The value of Q in the above tabulation shall be determined as follows:

$$Q = 1 + 0.2W; \text{ but } Q \text{ shall not be more than } 10.$$

Where: W is the width of the falsework system, in feet, measured in the direction of the wind force being considered.

The falsework system shall also be designed so that it is sufficiently stable to resist overturning prior to the placement of the concrete. The minimum factor of safety against falsework overturning in all directions from the assumed horizontal load for all stages of construction shall be 1.25. If the required resisting moment is less than 1.25 times the overturning moment, the difference shall be resisted by bracing, cable guys, or other means of external support.

Design of falsework shall include the vertical component, whether positive or negative, of bracing loads imposed by the design horizontal load. Design of falsework shall include the effects of any horizontal displacement due to stretch of the bracing, particularly when using cable or rod bracing systems.

If the concrete is to be post-tensioned, the falsework shall be designed to support any increased or redistributed loads caused by the prestressing forces.

6-02.3(17)C 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 shall 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 shall be as follows:

Deflection:

Deflection resulting from dead load and concrete pressure for exposed visible surfaces, such as the sides and bottoms of girders, regardless of the fact that the deflection due to the weight of all successive placements of concrete, reinforcing steel and forms may be compensated for by camber strips; sides of abutments, wingwalls, piers, retaining walls, and columns = 1/500 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, regardless of the fact that the deflection due to the weight of all successive placements of concrete, reinforcing steel and forms may be compensated for by camber strips = 1/360 of the span.

In the foregoing, the span length shall 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 shall be taken as the clear span plus 1-1/2 inches. Also, dead load shall 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. For members constructed in several successive placements, such as concrete box girder and concrete T-beam girder structures, falsework components shall 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.

Timber:

Each species and grade of timber or lumber used in constructing falsework and formwork shall be identified in the Shop Drawings. The allowable stresses and loads shall not exceed the lesser of stresses and loads given in the following table or factored stresses for designated species and grade in Table 7.3 of the Timber Construction Manual, Third Edition by the American Institute of Timber Construction.

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.	$\frac{480,000 \text{ psi}}{(L/d)^2}$
Flexural stress for members with a nominal depth greater than 8 inches.	1,800 psi
Flexural stress psi 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 is the unsupported length; and
- d is the least dimension of a square or rectangular column, or the width of a square of equivalent cross-sectional area for round columns.

The allowable stress for compression perpendicular to the grain, and for horizontal shear shall 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)J.

Plywood for formwork shall be designed in accordance with 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, wet stresses shall be used and then adjusted for forming conditions such as duration of load, and experience factors. Concrete pour pressures shall be per Section 6-02.3(17)K.

Steel:

For identified grades of steel, design stresses shall not exceed those specified in the Manual of Steel Construction - Allowable Stress Design, Ninth Edition by the American Institute of Steel Construction, except as follows:

Compression, flexural but not to exceed $0.6F_y$	$\frac{12,000,000 \text{ psi}}{Ld/bt}$
The modulus of elasticity (E) shall 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 shall not exceed the following:

- Yield point f_y 30,000 psi
- Tension, axial, and flexural.....16,000 psi
- Compression, axial..... $14,150 - 0.37(KL/r)^2$ psi
except L/r shall not exceed 120
- 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..... $16,000 - 5.2(L/b)^2$ psi
.....16,000 psi and L/b not greater than 39
- The modulus of elasticity (E) shall be.....29,000,000 psi

Where:

- L is the unsupported length;
- d is 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 is the flange width;
- t is the thickness of the compression flange;
- r is the radius of gyration of the compression flange about the weak axis of the member; and
- F_y is the specified minimum yield stress, psi, for the grade of steel used.

All dimensions are expressed in inches.

6-02.3(17)D FALSEWORK AND FORMWORK AT SPECIAL LOCATIONS

In addition to the minimum requirements specified in Sections 6-02.3(17)B and 6-02.3(17)C, falsework over or adjacent to roadways or railroads which are open to traffic or the public shall be designed and constructed so that the falsework is stable if subjected to impact by vehicles. The use of damaged materials, unidentifiable material, salvaged steel or steel with burned holes or questionable weldments shall not be used for falsework described in this Specification Section.

For the purposes of this Specification Section, the following public or private facilities shall 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 shall be as specified in Contract.

Falsework posts or shoring tower systems which support members that cross over a roadway or railroad shall be considered as adjacent to roadways or railroads. Other falsework posts or shoring towers shall be 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 shall provide any additional features for the work needed to ensure that the falsework is 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 shall comply with the provisions in Section 1-07.23, Section 1-10, and Section 6-02.3(17)N. The falsework design at special locations, shall 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, shall be the greater of the following:

- 1) 150 percent of the design load calculated in accordance with Section 6-02.3(17)C, but not including any increased or redistributed loads caused by the post-tensioning forces; or
- 2) 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 shall consist of either steel with a minimum section modulus about each axis of 9.5 inches cubed (or 9.5 inch³) or sound timbers with a minimum section modulus about each axis of 250 inches cubed (or 250 inch³).

Each falsework post or shoring tower leg adjacent to roadways or railroads shall be mechanically connected to its supporting footing at its base, or otherwise laterally restrained, to withstand a load 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 shall 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 shall be mechanically connected to the falsework cap or framing. The mechanical connections shall be Capable of resisting a load in any direction, including uplift on the stringer, of not less than 500 pounds. All associated connections shall be installed before traffic is allowed to pass beneath the span.

When timber members are used to brace falsework bents which are located adjacent to roadways or railroads, all connections shall be bolted through the members using 5/8-inch diameter or larger bolts.

Concrete traffic barrier shall be used to protect all falsework adjacent to traveled roadways. The falsework shall be located so that falsework footings, mudsills, or piles are at least 2 feet clear of the traffic barrier and all other falsework members shall also be at least 2 feet clear of the traffic barrier. Traffic barrier used to protect falsework shall not be fastened, guyed, or blocked to any falsework but shall be fastened to the pavement according to details shown on the Drawings. The installation of concrete traffic barrier shall be completed before falsework erection is begun. The traffic barrier at the falsework shall not be removed until approved by the Engineer. Falsework openings which are provided for the Contractor's own use (not for public use) shall 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 shall be at least 3 inches.

Falsework bents within 20 feet of the center line of a railroad track shall be braced to resist the required horizontal load or 2,000 pounds whichever is greater.

In addition to the requirements of Section 1-07.23, pedestrian openings through falsework shall be paved or surfaced with full width continuous wood walks which shall be wheel chair accessible and shall be kept clear. Pedestrians shall be protected from objects and water falling from construction above. Overhead protection for pedestrians shall extend at least 4 feet beyond the edge of the bridge deck. Shop Drawings and details of the overhead protection and pathway shall be submitted with the falsework Shop Drawing submittals to the Engineer for review. Pedestrian openings through falsework shall be illuminated by temporary lighting, constructed and maintained by the Contractor. The temporary lighting shall be constructed in accordance with local electrical code requirements. The temporary lighting shall be steady burning and shall be a minimum 60 watt, 120 volt lamps with molded waterproof lamp holders spaced at 25 feet centers maximum. All costs

relating to pedestrian pathway paving, wood walks, overhead protection, maintenance, operating costs, and temporary pedestrian lighting shall be incidental to applicable Bid items of Work and shall be at no additional cost to the Owner.

6-02.3(17)E FALSEWORK SUPPORT SYSTEMS: PILES, TEMPORARY CONCRETE FOOTINGS, TIMBER MUDDSILLS, MANUFACTURED SHORING TOWERS, CAPS, POSTS

The Contractor shall support all falsework on either driven piles, temporary concrete footings, or timber mudsills. Temporary concrete footings shall be designed as reinforced concrete which may be either cast in place or precast. All components for a falsework support system shall be sized for the maximum design loads and allowable stresses described in the preceding Sections.

The falsework Shop Drawing submittals shall 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 in the Contract, no deviation will be permitted.

If the Contract calls for piles 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.

Piles:

When using piles to support the falsework, the Contractor's falsework Shop Drawing submittal shall specify the minimum required bearing and depth of penetration for the piles. The falsework Shop Drawing submittals shall also show the maximum horizontal distance that the top of a falsework pile may be pulled in order to position it under its cap. The falsework Shop Drawing submittal shall 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 shall account for pile stresses due to combined axial and flexural stress and secondary stresses.

Untreated timber piles shall be banded at the top before driving. The following shall be identified in the falsework Shop Drawing submittal: lengths, minimum tip diameter, and expected diameter at ground line. The Contractor shall comply with the requirements of Section 9-10.1(1). The maximum allowable load for timber piles shall be 45 tons.

Steel piles shall be identified in the falsework Shop Drawing submittal. If steel pipe pile is used, the pipe diameter and wall thickness shall be identified in the falsework Shop Drawing submittal. Steel piles shall meet the requirements of Section 9-10.5. The applicable Specifications in Section 6-05 shall be used to determine the bearing capacity of the falsework piles. The pile bearing capacity may instead be determined by test loading the pile to twice the falsework design load if approved in writing by the Engineer. The Contractor shall provide the Engineer an opportunity to witness these tests and to submit a plan of the test and cross-sections showing the locations and elevations of the proposed tests to the Engineer for approval.

Temporary Concrete Footings and Timber Mudsills:

Timber mudsills or temporary concrete footings may be used in place of driven piles if Contractor provided tests show that the soil can support twice the falsework design load, and that the mudsill or temporary concrete footing shall not settle more than 1/4-inch when loaded with the design load. The tests shall be done at the falsework site, at the same elevation of the mudsill, and conducted under conditions representative of the actual site conditions. The acceptable tests for various soil types are:

1. **Granular Soil** - The Contractor shall conduct on-site tests according to the AASHTO T 235 "Standard Method Test for Bearing Capacity of Soil for Static Load on Spread Footings". The Contractor shall provide 2 Working Days advance notice for the Engineer to witness these tests, and shall submit a plan of the test and cross-sections showing the locations and elevations of the proposed tests to the Engineer for approval at least 5 Working Days in advance.
2. **Fine Grained or Organic Soil** - The Contractor shall employ a geotechnical engineer licensed as a Professional Engineer in the State of Washington to investigate the foundation soils and shall present certification in writing that each mudsill or temporary footing shall meet the load-settlement requirements described above. The allowable bearing capacities, elevations and locations of specific falsework mudsills shall be listed in the certification. Soils information used to determine the soil bearing capacity and settlement shall be submitted with the written certification to the Engineer for review and approval.

Timber mudsills or temporary concrete footings for falsework shall be designed to carry the loads imposed upon 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 shall 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. Mudsills shall be designed for bearing capacities at the location that they are to be used. Timber mudsills or temporary concrete footings shall be designed as unyielding 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 square foot) shall be shown in the falsework Shop Drawing submittals. The minimum edge distances from the edge of the post or shoring tower leg to the edge or end of the mudsill member shall be shown in the falsework Shop Drawing submittals. Timber mudsills and temporary concrete footings shall 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 shall be shown in the falsework Shop Drawing submittals. Footings or mudsills which are stepped or placed above an excavation shall have all related geometry and slope stability items identified in the falsework

Shop Drawing submittal. Details and calculations for any shoring system to support the embankment or excavation shall be included.

Mudsills or temporary concrete footings placed in benches in slopes shall be set back from the face of the slope one-half the mudsill or temporary concrete footing width, but not less than 1 foot 0 inch. The bench including the setback shall 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 shall be no steeper than 1-1/2 horizontal to 1 vertical.

Falsework shall be founded on a solid footing, safe against undermining, protected from softening, and Capable of supporting the loads imposed. The preparation of the soil to receive the temporary footing is important to ensure that the falsework does not experience localized settlement that could result in falsework failure. In preparing the soil for a timber mudsill or temporary concrete footing, the Contractor shall:

- 1) Place mudsills or footing on dry soil that is either undisturbed or compacted to 95 percent of maximum density, as determined by the compaction control tests in Section 2-03.3(14)E performed by the Contractor and submitted to the Engineer for review;
- 2) 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;
- 3) Place grout or a compacted layer of fine material under the mudsill if it is supported by rock or coarse sand and gravel;
- 4) Provide the Engineer with a sample of any off-site material to be used under the mudsill;
- 5) Allow up to five Working Days for the Engineer's review before using the off-site material; and
- 6) 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 shall be shown in the falsework Shop Drawing submittals. These shall include falsework footing settlement and joint take-up. Total anticipated settlements shall not exceed one inch including joint take-up. When using mudsills, the Contractor shall prepare for the possibility of reshoring with the use of such devices as screw jacks or hydraulic jacks and adjustment of wedge packs. The placing of concrete shall be discontinued if unanticipated settlement occurs, including settlements that deviate more than 3/8-inch from those indicated on the reviewed falsework Shop Drawing submittal. Concrete placement shall not resume until the Contractor provides corrective measures that are acceptable to the Engineer. Placing of concrete shall be discontinued if acceptable corrective measures are not provided to the Engineer prior to initial set of the concrete in the affected area. All unacceptable concrete shall be removed.

Where the maximum leg load exceeds 30 kips, foundations for individual steel towers shall be designed and constructed to provide uniform settlement at each tower leg for all loading conditions.

Bents, Shoring Towers, Piles, Posts, and Caps:

Shop Drawings for falsework bents or shoring tower systems, including manufactured tower systems shall have plan, cross-section, and elevation view scale Shop Drawings showing all geometry. Show in the falsework Shop Drawing submittals 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 piles shall be shown in the falsework Shop Drawing submittals. Column, pile, or tower heights shall be indicated. Member sizes, wall thickness and diameter of steel pipe columns or piles shall be shown in the falsework Shop Drawing submittals. Location of wedges, minimum bearing area and type of wedge material shall be identified in the falsework Shop Drawing submittals. Bracing size, location, material and all connections shall be described in the falsework Shop Drawing submittals.

The relationship of the falsework bents or shoring tower systems to the permanent Structure's pier and footing shall be shown. Load paths shall be as direct as possible. Loads shall be applied through the shear centers of all members to avoid torsion and buckling conditions. Where applied loads cause twisting, biaxial bending, or axial loading with bending, the affected members shall be designed for combined stresses and stability.

Posts or columns shall be constructed plumb with tops and bottoms carefully cut to provide full end bearing. Caps shall be installed at all bents supported by posts or piles unless Engineer reviewed falsework Shop Drawing submittals specifically permit otherwise. Caps shall be fastened to the piles or posts. The falsework shall be Capable of supporting nonuniform or localized loading without adverse effect. For example, the loading of cantilevered ends of stringers or caps shall not cause a condition of instability in the adjacent unloaded members.

Timber posts and piles shall be fastened to the caps and mudsills using through-bolted connections, drift pins, or other connections indicated on the Shop Drawings and reviewed by the Engineer. The minimum diameter of round timber posts shall be shown in the falsework Shop Drawing submittals. Timber caps and timber mudsills shall be checked for crushing from columns or piles under maximum load.

Steel posts and piles shall be welded or bolted to the caps and to the foundation. Steel members shall be checked for buckling, web yielding, and web crippling.

Wedges shall be used to permit formwork to be taken up and released uniformly. Wedges shall be oak. Cedar or other soft wood wedges or shims shall not be used anywhere in a falsework or forming system. Wedges shall be used at the top or the bottom of shores, but not at both top and bottom. After the final adjustment of the shore elevation is complete, the wedges shall be fastened securely to the sill or cap beam. The method of securely fastening wedges shall be included in the submittal. Only one set of wedges, with one optional block, shall be used at one location. Screw jacks, or other devices shown on the Shop Drawings for the Engineer's review, shall be used 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 shall be constructed of steel with snug fitting steel or concrete pistons. Sand jacks shall be filled with dry sand and the jack protected from moisture throughout its use. They shall be designed and installed in such a way to prevent the unintentional migration or loss of sand. All sand jacks shall be tested per Section 6-02.3(17)H.

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 shall be installed at the time each element of the falsework is erected and shall remain in place until the falsework is removed. For other requirements see Section 6-02.3(17)D.

Transverse construction joints in the superstructure shall be supported by falsework at the joint location. The falsework shall be constructed in such a manner that subsequent pours shall not produce additional stresses in the concrete already in place.

Manufactured Shoring Tower Systems and Devices:

Manufactured proprietary shoring tower systems shall be identified in the falsework Shop Drawing submittal by make and model and safe working load capacity per leg. The safe working load for shoring tower systems shall be based upon a minimum 2-1/2 to 1 factor of safety.

The safe working load capacity, anticipated deflection (or settlement), make and model shall be identified in the falsework submittal 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 shall be based on a minimum ultimate strength safety factor of 2 to 1. The safe working load for field fabricated devices and all single shores shall be based on a minimum ultimate strength safety factor of 3 to 1.

The safe working load of all devices shall not be exceeded. The design loads shall be as defined by Section 6-02.3(17)B. The maximum allowable free end deflection of deck overhang brackets under working loads applied shall not exceed 3/16 inch regardless of the fact that the deflection may be compensated for by pre-cambering or of setting the elevations high. The Contractor shall 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, shall not be installed.

Shoring tower or device capacity as shown in catalogs or brochures published by the manufacturer shall be considered as the maximum load which the shoring is able to safely support under ideal conditions. These maximum values shall 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 two 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 other technical data shall be submitted with the falsework Shop Drawing submittals to verify the load-carrying capacity, deflection, and manufacturers installation requirements of any manufactured product or device proposed for use. Upon request by the Engineer, the Contractor shall submit 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 shown in the following sections for manufactured proprietary shoring tower systems and devices shall be complied with when preparing falsework Shop Drawing submittals, calculations, and installing these shoring tower systems and devices as falsework.

Alternative criteria and/or systems may be allowed if a written statement on the manufacturer's letter head, signed by the shoring or device manufacturer (not signed by a material Supplier or the Contractor) is submitted to the Engineer for review and addresses the following:

- (1) Identity of the specific Contract on which the alternative criteria and/or system applies;
- (2) Description of the alternative criteria and/or system;
- (3) Technical data and test reports;
- (4) The conditions under which the particular alternative criteria may be followed; and
- (5) That a design based on the alternative criteria shall not overstress or over deflect any shoring component or device nor reduce the required safety factor.

In any case where the falsework Shop Drawing submittals 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)H to verify the safe working load and deflection characteristics.

For all tower systems, tower leg loads shall not exceed the limiting values under any loading condition or sequence. Frame extensions and any reduced capacity shall be shown in the falsework Shop Drawing submittals. Screw jacks shall fit tight in the leg assemblies without wobble. Screw jacks shall be plumb and straight. Shoring towers shall be installed plumb, and load distribution beams shall be arranged such that vertical loads are distributed to all legs for all successive concrete placements. There shall be no eccentric loads on shoring tower heads unless the heads have been designed for such loading. Shoring towers shall remain square or rectangular in plan view and shall not be skewed. There shall be no interchanging of parts from one manufactured shoring system to another. Bent or faulty components shall not be used.

For manufactured shoring towers that allow ganging of frames, the number of ganged frames shall be limited to one frame per opposing side of a tower, and the total number of legs per ganged tower shall not exceed eight legs. Ganged frames shall be installed per the manufacturer's published standards using the manufacturer's components. Other gang arrangements shall not be used.

For manufactured steel shoring tower systems, the Contractor shall have bracing designed and installed for horizontal loads and falsework overturning per Section 6-02.3(17)B. Minimum bracing criteria and allowable leg loads are described in the following paragraphs.

All shoring tower systems and bracing shall be thoroughly inspected by the Contractor for plumb vertical support members, secure connections, and straight bracing members immediately prior to, 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 shall not be placed until adjustments have brought the shoring towers within the acceptable tolerance.

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 one leg of a frame shall not exceed four times the load on the other leg under any given loading condition or sequence. The maximum load on one of the two frames making up a tower shall not exceed four times the load on the opposite frame under any given loading condition or sequence. If swivel-head screw jacks are used, the allowable leg loads shall not exceed that shown in the following table:

Maximum Allowable Leg Load in Pounds				
Extension Frame Height	2'-0"	3'-0"	4'-0"	5'-0"
Screw height 12" or less	11,000	11,000	10,000	9,400
Screw height exceeds 12"	8,200	8,200	8,000	7,800

If fixed-head screw jacks are used at the top of the extension frame, the maximum allowable load per leg shall be 11,000 pounds for all extension frame heights up to five feet with screw jack height extensions of 12 inches or less. Fixed-head screw jacks exceeding 12 inches shall use the values in the table above. Screw jack extensions shall not exceed the manufacturer's published recommendations. Extension frames shall be braced. Side cross-braces are required for extension heights up to 2 feet 0 inches. Both side and end cross-braces are required from over 2 feet 0 inches to 5 feet 0 inches extension heights.

Supplemental bracing shall be installed on shoring towers 20 feet or more in height and shall connect rows of towers to each other so rows of frames are continuously cross-braced in one plane. Supplemental bracing shall be installed as follows:

1. In the transverse direction (the direction parallel to the frame), one horizontal brace and one diagonal brace shall be attached to each tower face, for every three frames of shoring height, including an extension frame if used. The lowest horizontal brace shall be located near the top of the third tower frame, and any additional horizontal braces spaced no farther than three frames apart. The diagonal braces shall be located on opposite tower faces, and shall 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 four frames or more, a horizontal brace shall be installed on one 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 four frames apart. When shoring height is six frames or more, diagonal cross-bracing shall 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 shall be attached to each frame extension or screw jack of the tower within 6 inches of the top. These braces shall be in addition to bracing previously described.

The bracing shall be fastened securely to each frame leg and shall be located within 6 inches of the frame member intersections. The ends of diagonal braces shall not be attached to shoring frames at locations where towers have little or no load. Diagonal brace ends shall 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, thus precluding lift-off due to the vertical component of the brace reaction. Supplemental bracing shall be shown in the falsework Shop Drawing submittal. The connection details, including the method of connection and exact location of the connecting devices, shall be in accordance with the manufacturer's recommendations and shall be shown in the falsework Shop Drawing submittals.

Ladder Type Base Frames:

Ladder type base frame shoring shall 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 shall not exceed 10,000 pounds;
- 2) If the shoring system consists of two or three tiers of base frames, leg loads shall not exceed 7,500 pounds;
- 3) If an extension staff is used, the maximum allowable leg load shall be reduced to 6,000 pounds; and
- 4) The maximum load on one leg of a frame shall not exceed four times the load on the other leg under any given loading condition or sequence. The maximum load on one of the two frames making up a tower shall not exceed four times the load on the opposite frame under any given loading condition or sequence.

Maximum allowable leg loads as shown above shall 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 shall not exceed 12 inches. Swivel-head screw jacks shall 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 shall 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 shall be attached to each staff extension or screw jack of the tower within 6 inches of the top. These braces shall be attached per conditions described previously for cross-braced frames.

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 shall meet 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 shall be reduced to 20 kips per tower leg;
- (2) The screw-jack adjustment shall not exceed 14 inches;
- (3) Extension frames shall be braced. Side cross-braces are required for all extension-frame heights. In addition, end cross-braces (braces across the face of the extension frame) shall be provided for extension frame heights of 3 feet 0 inches or more;
- (4) The maximum load on one leg of a frame, or on one frame of a tower, shall not exceed four times the load on the opposite leg or frame under any given loading condition or sequence;
- (5) Shoring towers 20 feet or more in height shall have supplemental bracing installed in accordance with 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); and
- (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 shall be attached to each frame extension or screw jack of the tower within 6 inches of the top. These braces shall 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 five frames plus a fully-extended extension frame plus the maximum allowable screw-jack adjustment. For any proposed use exceeding this limiting height, the Contractor shall submit a statement signed by the shoring manufacturer covering the specific installation. The statement shall provide assurance that the shoring shall carry the loads to be imposed without overstressing any shoring component or reducing the required safety factor.

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 utilized as single-post shores braced in one direction only, the shores shall 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 in accordance with 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 two or more units stacked one above the other, either with or without an extension unit, the differential leg loading within a given tower unit shall not exceed the following limitations:

DIFFERENTIAL LEG LOADING	
Maximum load on any leg in the tower unit	Maximum to Minimum load ratio
10 kips or less	10 to 1
10 kips to 50 kips	6 to 1
50 kips to 75 kips	5 to 1
75 kips or more	4 to 1

A complete stress analysis of steel beams used as continuous caps over two or more tower units shall be performed to determine the effect of continuity on tower leg loads. Resulting moment shear shall 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 shall 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)B. When designing external bracing, including cable bracing, attention shall be given to the bracing connection to the falsework. Connections shall 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 shall be shown in the falsework Shop Drawing submittals.

6-02.3(17)F STRINGERS, BEAMS, JOISTS, ROADWAY SLAB SUPPORT, AND DECK OVERHANGS

All stringers, beams, joists, and roadway slab support shall be designed for the design loads, deflections, and allowable stresses described in the preceding Sections 6-02.3(17)B, 6-02.3(17)C, and 6-02.3(17)D and for the following conditions.

At points of support, stringers, beams, joists, and trusses shall be restrained against rotation about their longitudinal axis. The effect of biaxial bending shall be investigated in all cases 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 shall 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 shall be stiff enough so that the differential deflection due to the roadway slab pour is no more than 3/16 inch between the outside edge of the roadway slab and the exterior web even if camber strips can compensate for deflection.

Friction shall not be relied upon for lateral stability of beams or stringers. If the compression flange of a beam is not laterally restrained, the allowable bending stress shall 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 buckles, positive restraint shall be provided in both directions. Flange restraint shall be designed for a minimum load of two percent of the calculated compression force in the beam flange at the point under consideration.

Camber strips shall be used to compensate for falsework take-up and deflection, vertical alignment, and the anticipated structure dead load deflection shown in the camber diagram on the Drawings. Camber is the adjustment to the profile of a load-supporting beam or stringer so that the completed structure shall 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 weight. This dead load camber shall be increased by:

- (1) Amount of anticipated falsework take up;
- (2) Anticipated deflection of the falsework beam or stringer under the actual load imposed; and
- (3) Any vertical curve compensation.

Camber strips shall be fastened by nailing to the top of wood members, or by clamping or banding in the case of steel members. Camber strips shall 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 roadway slab shall rest on ledgers or similar supports and shall not be supported from the bottom slab except as the following provides. The form supports shall be fastened within 18 inches of the top of the web walls, producing a clear span between web walls. The roadway slab forms may be supported or posted from the bottom slab if all the following conditions are met:

1. Permanent access, shown on the Drawings, is provided to the cells;
2. Centerline to centerline distance between web walls is greater than 10 feet;
3. Falsework stringers designed for total load, stresses and deflections per Sections 6-02.3(17)B and 6-02.3(17)C are located directly below each row of posts;
4. Posts have adequate lateral restraint; and
5. All forms (including the roadway deck forms), posts, and bracing are completely removed.

The falsework and forms on concrete box girder structures supporting a sloping web and deck overhang shall consist of a lateral support system. The support system shall be designed to resist all rotational forces acting on the stem, including those caused by the placement of deck slab concrete, roadway deck formwork weight, finishing machine, and other live loads. Stem reinforcing steel shall not be stressed by the construction of the roadway deck slab placement. Overhang brackets shall not be used for the support of roadway slab forms from sloping web concrete box girder bridges.

Deck slab forms between girders or webs shall 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, shall be designed as falsework. Falsework supporting deck slabs and overhangs on girder bridges shall be supported directly by the girders so that there shall be no differential settlement between the girders and the deck forms during placement of deck concrete.

6-02.3(17)G BRACING

All falsework bracing systems shall 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 shall be shown in the falsework Shop Drawing submittals. Falsework diagonal bracing shall 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 shall have connections designed per Section 6-02.3(17)J. Any damaged cross-bracing, such as split timber members, shall be replaced. Steel strapping shall avoid making sharp angles or right-angle bends. A means of preventing accidental loss of tension shall be provided for steel strapping. See Sections 6-02.3(17)B, 6-02.3(17)C and 6-02.3(17)D for design loads and allowable stresses.

Bracing shall 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 shall be designed to carry tension as well as compression. All components, connection details and specific locations shall be shown in the falsework Shop Drawing submittals. Bracing, blocking, struts, and ties required for positive lateral restraint of beam flanges shall be installed at right angles to the beam in plan view. If possible, bracing in adjacent bays shall 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 shall not exceed twice the depth of the beam.

All falsework and bracing shall be inspected by the Contractor for plumbness of vertical support members, secure connections, tight cables, and straight bracing members immediately prior to, during, and immediately after every concrete placement.

Bracing shall 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 which is open to the public. All details of the falsework system that contribute to horizontal stability and resistance to impact, including the bolts in bracing, shall be installed at the time each element of the falsework is erected and shall remain in place until the falsework is removed. The falsework Shop Drawing submittals shall 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 shall be included in the design of such bracing or methods. Loads, connections, and materials for falsework adjacent to roadways, shall also be in accordance with Section 6-02.3(17)D.

Cable or Tension Bracing Systems:

All elements of the bracing system shall be shown in the falsework Shop Drawing submittals when cables, wire rope, steel rod, or other types of tension bracing members are used as external bracing to resist horizontal forces, or are used as temporary bracing to support bents while falsework is being erected or removed adjacent to traffic. Bracing shall not be attached to concrete traffic barrier, guardrail posts, or guardrail. Any damaged bracing, such as frayed and kinked guying systems, shall be immediately replaced. Wire rope shall not make a sharp angle bend or a right-angle bend. A means of preventing accidental loss of tension in the wire rope shall be provided. The following information shall be submitted to the Engineer for review:

- 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 shall 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, plate clamps, etc.) to be used and the efficiency factor for each type. If cables are to be spliced, the splicing method shall 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 weight 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; and
- 7) Determination of the potential stretch or elongation of the tension member under the design load and if the resulting lateral deflection causes 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 shall be furnished with the falsework Shop Drawing submittal. Technical data shall 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 as may be needed to identify the cable.

In the absence of sufficient technical data to identify the cable, or if it is old and obviously worn, the Contractor shall 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 shall be 3 to 1. The Contractor shall notify the Engineer at least 2 Working Days in advance for witnessing these tests.

When cable bracing is used to prevent the overturning of heavy-duty shoring, attention shall be given to the connections by which forces are transferred from the shoring to the cables. Cable restraint shall be designed to act through the cap system to prevent the inadvertent application of forces which the shoring is not designed to withstand. Cables shall not be attached to any tower component.

Cable splices made by lapping and clipping with "Crosby" type clamps shall not be used. Other splicing methods may be used. Cable strength shall be verified by a load test at each location where the cable is spliced.

When cables are used as external bracing to resist overturning of a falsework system, the horizontal load to be carried by the cables shall be calculated as follows:

- (1) When used with heavy-duty shoring systems, cables shall 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;
- (2) When used with pipe-frame shoring systems where supplemental bracing is required, cables shall 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; and
- (3) 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 shall be designed to resist 1.25 times the total overturning moment.

The maximum allowable cable design load shall be determined using the following criteria and the tables immediately following:

1. If the cable is new or if the cable is in uniformly good condition, and if the cable can be identified by reference to a manufacturer's catalog or other technical publication, then the allowable load shall be the ultimate strength of the cable as specified by the manufacturer, multiplied by the efficiency of the cable connector ("Connector Efficiency"), 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 is still in serviceable condition, or the cable is new or nearly new but cannot be found in a manufacturer's catalog, then the Contractor shall perform load breaking tests. In this case, the cable design load shall not exceed the breaking strength determined by the load test, multiplied by the "Connector Efficiency" factor, and divided by a safety factor of 3; and
3. If the cable is used and is still in serviceable condition, or the cable is a new or nearly new cable which cannot be identified, and if load breaking tests are not performed, then the cable design load shall not exceed the safe working load ("Safe Load") shown in the Wire Rope Capacities table multiplied by the cable "Connector Efficiency".

Cable connectors shall be designed in accordance with criteria shown in the following tables "Efficiency of Wire Rope Connections" and "Applying Wire Rope Clips". Cable safe working loads are provided in table "Wire Rope Capacities".

Efficiency of Wire Rope Connections (As compared to Safe Loads on Wire Rope)	
Type of Connection	Connector Efficiency
Wire Rope	100%
Sockets – Zinc Type	100%
Wedge Sockets	70%
Clips – Crosby Type with Thimble	80%
Knot and Clip (Contractors Knot)	50%
Plate Clamp-Three 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%

WIRE ROPE CAPACITIES		
Safe Load in Pounds for New Plow Steel Hoisting Rope 6 Strands of 19 Wires, Hemp Center (Safety Factor of 6)		
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
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

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 six rope diameters apart to give adequate holding power. A wire-rope thimble shall be used 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 as follows:

Number of Clips and Spacing for Safe Application			
Improved Plow Steel Rope Diameter (Inches)	Number of Clips		Min. 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

Anchor Blocks:

Concrete anchor blocks and connections used to resist forces from external bracing shall be shown in the falsework Shop Drawing submittal. Concrete anchor blocks shall be proportioned to resist both sliding and overturning. When designing anchor block stability, the weight of the anchor block shall be reduced by the vertical component of the cable or brace tension to obtain the net or effective weight to be used in the anchorage computations. The coefficient of friction assumed in the design shall not exceed the following:

Setting	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

Note: Multiply the friction coefficient by 0.67 if it is likely the supporting material is wet or shall 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 shall be designed to resist both horizontal and vertical forces.

Temporary Bracing for Bridge Girders:

Bridge girders (such as steel plate girders and prestressed girders) shall be braced and tied to resist forces applied during construction that would cause rotation or torsion in the girders. Falsework support brackets or braces shall not be welded to structural steel members or reinforcing steel.

On prestressed girder spans, the Contractor shall install cross-bracing between girders at each end and midspan to prevent lateral movement or rotation. This bracing shall be placed immediately after erection of the girders. The bracing shall not be removed until the diaphragms or the deck have been placed and cured for a minimum of 24 hours.

When deck overhang or the distance from the centerline of the exterior girder, or outside girder of a staged construction, to the near edge of the roadway slab on a prestressed girder span exceeds the distances listed in the table that follows, the Contractor shall provide extra bracing for the exterior girder at the midpoint between diaphragms (or at more frequent intervals). This bracing shall include:

- (1) a cross-tie connecting the top flange of each exterior girder with its counterpart on the other side, and
- (2) braces between the bottom flanges and top flanges of all girders.

Girder Series	Distance in Inches
W42G	30
W50G	42
W58G	63
W74G	66

If a concrete finishing machine is supported at the outside edge of the slab, the Contractor shall account for its added weight in the design of bracing.

Roadway deck forming systems may require bracing or ties between girders for the girder to adequately support the form loading. When braces, struts, or ties are required, they shall be designed and detailed by the Contractor in accordance with Section 6-02.3(16)A and shall be shown in the falsework/formwork Shop Drawing submittal to the Engineer for review. These braces, struts, and ties shall be furnished and installed by the Contractor at no additional cost to the Owner.

6-02.3(17)H TESTING FALSEWORK DEVICES

The Contractor shall establish the load capacity and deflection (or settlement) of all friction collars and clamps, brackets, hangers, saddles, sand jacks, and similar devices. The Contractor shall utilize an independent testing laboratory accredited in accordance with ASTM E 1595 and approved by the Engineer to establish these values. Laboratory tests shall use the same materials and design that shall be used on the project. Test loads shall be applied to the device in the same manner that the device is to experience loading on the project. Any bolts or threaded rods used with the device shall be identified as to diameter, length, type, grade, and torque. Any wedges, blocks, or shims used with the device on the project shall also be tested with the device. Any adjustable jack system used as a part of a device shall be tested with the device and shall have its maximum safe working extended height identified. Devices shall not be tested in contact with the permanent structure. Independent members with the same properties as the permanent structure shall be used to test device connections.

At least fourteen (14) days prior to the test, the Contractor shall submit a test procedure and scale drawing for the Engineer's review showing how the device is to be tested and how data is to be collected. The Contractor shall provide the Engineer at least 2 Working Days advance notice for an opportunity to witness these tests.

In addition to the requirements of Section 1-06.5, the approved independent testing laboratory identified in this Specification Section shall provide a certified test report which shall be signed and dated. The test report shall:

1. clearly identify the device tested including trademarks and model numbers;
2. identify all parts and materials used, including grade of steel, or lumber, member section dimensions;
3. show location, size, and the maximum tested extended height of any adjustable jacks;
4. indicate condition of materials used in the device;
5. indicate the size, length and location of all welds; and
6. indicate how much torque was used with all bolts and threaded rods.

The report shall also describe:

- a. how the device was tested,
- b. report the results of the test,
- c. provide a scale drawing of the device showing the location(s) of where deflections or settlements were measured, and
- d. show where load was applied.

Deflections or settlements shall be measured at each load increment and the results shall be clearly graphed and labeled. Prior to installation of falsework devices named in this Specification Section, the Contractor shall submit the certified test reports to the Engineer for review.

The safe working load for shop manufactured devices named in this section shall be derived by dividing the ultimate strength by a safety factor of 2.0. The safe working load for field fabricated or field modified devices (including the use of timber blocks or wedges with the device) shall be determined by dividing the ultimate strength by a safety factor of 3.0. Working load shall include weights 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 shall be 3/16 inch even though deflection may be compensated for by pre-cambering or setting the elevations high. The Contractor shall comply with all manufacturer's specifications, including those relating to bolt torque, cleaning and oiling of parts, and the reuse of material. Devices that are deteriorated, bent, warped or have poorly fitted connections or welds, shall not be installed.

6-02.3(17)I FORMWORK ACCESSORIES

Formwork accessories such as form ties, form anchors, form hangers, anchoring inserts, and similar hardware shall be specifically identified in the formwork Shop Drawings. The identification shall include the name and size of the hardware, the manufacturer, the safe working load, and the factor of safety. The grade of steel shall also be indicated for threaded rods, coil rods, and similar hardware. Wire form ties taper ties and welding or clamping formwork accessories to Drawings reinforcing steel shall not be used. Driven types of anchorages for fastening forms or form supports to concrete, and Contractor fabricated "J" hooks shall not be used. Field drilling of holes in prestressed girders is not allowed.

The following table from ACI 347R-88 provides minimum safety factors for formwork accessories. The hardware proposed shall meet these minimum ultimate strength requirements or the manufacturer's minimum requirements, whichever provides the greater factor of safety. The Contractor shall attach copies of the manufacturer's catalog cuts and/or test data of hardware proposed, to the formwork Shop Drawings and submit the falsework and formwork Shop Drawings and calculations for review per Section 6-02.3(16). In situations where catalog cuts and/or test data are not available, testing shall be performed in accordance with Section 6-02.3(17)H.

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 weight and concrete pressures only
Form anchor	3.0	Formwork supporting weights 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

¹Safety factors are based on ultimate strength of the formwork accessory.

The bearing area of external holding devices shall be adequate to prevent excessive bearing stress on form lumber. Form ties and form hangers shall be arranged symmetrically on the supporting members to minimize twisting or rotation of the members. Form tie elongation shall not exceed the allowable deflection of the wale or member that it supports. Inserts, bolts, coil rods, and other fasteners shall be analyzed and designed for appropriately combined bending, shear, torsion, and tension stresses. The formwork shall not be attached to Contract Drawing rebar or rebar cages. However, the Contractor may install additional reinforcing steel for formwork anchorage.

Frictional resistance shall not be 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 shall be designed considering concrete strength at time of loading, available embedment, location in the member, and any other factors affecting their working strength, and shall be installed in concrete per the manufacturer's published requirements. Form anchors and anchoring inserts embedded in previous concrete placements shall not be loaded until the concrete has reached the required design strength. The required design strength of concrete for loading of an anchor shall be shown in the formwork Shop Drawing if it is assumed that the anchor is to 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, shall permit removal of all metal to at least 1/2-inch below the concrete surface. Holes shall be patched in accordance with Section 6-02.3(14). During removal of the outer unit, the bond between the concrete and the inner unit or rod shall not be broken.

6-02.3(17)J TIMBER CONNECTIONS

Timber connections shall be designed in accordance with the methods, stresses, and loads allowed in the Timber Construction Manual, Third Edition by the American Institute of Timber Construction (AITC). Timber falsework and formwork connections shall 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 shall not be considered as contributing to the stability of any timber connection.

Bolted Connections:

Tabulated values in the AITC Timber Construction Manual-Third Edition are based on square posts. For a round post or pile, the main member thickness shall 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 shall be obtained from the Hankinson formula shown in the AITC manual.

Design values in the AITC Table 6.20 apply only to three 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 two member joints (single shear bolt condition), the AITC Table 6.20 values shall be adjusted by a single shear load factor as follows:

1. 0.75 for installations East of the Cascade Range crest line, except as shown in following item 3;
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 shall be bolted using 5/8-inch diameter or larger through bolts.

Bolt holes shall 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 shall 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. In lieu 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 shown 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-inches 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 shall be as shown in the following. All distances are measured from the end or side of the wood member to the center of the bolt hole. For members which are subject to load reversals, the larger controlling distances shall be used for design. For parallel-to-grain loading, the minimum distances for full design load:

- (1) In tension, minimum end distance shall be 7 times the bolt diameter;
- (2) In compression, minimum end distance shall be 4 times the bolt diameter; and
- (3) In tension or compression, the minimum edge distance shall be 1.5 times the bolt diameter.

For perpendicular-to-grain loading, the minimum distance for full design load:

- a. Minimum end distance shall be 4 times the bolt diameter;
- b. Edge distance toward which the load is acting shall be at least 4 times the bolt diameter; and
- c. Distance on the opposite edge shall be at least 1.5 bolt diameters.

Minimum clearance (spacing) between adjacent bolts in a row shall be 4 times the bolt diameter, measured center-to-center of the bolt holes.

When more than two bolts are used in a line parallel to the axis of the side member, additional requirements shall be followed as shown in the AITC manual.

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 shall 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 given screw shall 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 shall be 75 percent of the corresponding value for withdrawal from the side grain.

Values in the Group II wood species column shall be used for Douglas Fir-Larch and the Group III wood species column shall be used for Hem-Fir. When the load is applied at an angle to the grain, as is the case with falsework bracing, the design value shall be obtained from the Hankinson formula shown 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 shall be determined separately. The withdrawal component of the applied load shall not exceed the allowable value in withdrawal. The lateral component of the applied load shall not exceed the allowable lateral load value.

Lag screws shall be inserted in lead holes as follows:

1. The clearance hole for the shank shall 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 shall 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 shall apply to screws of the greater diameters used in Group II wood species;
3. The threaded portion of the screw shall be inserted in its lead hole by turning with a wrench, not by driving with a hammer; and
4. To facilitate insertion, soap or other lubricant shall be used on the screws or in the lead hole.

Drift Pin and Drift Bolt Connections:

When drift pins or drift bolts are used, the required length and penetration shall be determined using the following criteria:

The lateral load-carrying capacity of drift pins and drift bolts driven into the side grain of a wood member shall 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 shall be increased to compensate for the absence of a bolthead and nut. For drift bolts or pins driven into the end grain of a member, the lateral load-carrying capacity shall 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 shall penetrate at least 12 diameters into the end grain. To fully develop the allowable load of the drift bolts or pins, they shall be driven into pre-drilled holes, 1/16-inch less in diameter than the drift pin or bolt diameter.

The criteria shown in the AITC Timber Construction Manual-Third Edition shall apply to drift bolt or pin connection allowable loads for the following conditions:

- 1) Withdrawal resistance; and
- 2) When there are more than two drift bolts or pins in a joint, allowable loads shall be further reduced by applying applicable modification factors shown in the AITC Table 6.3.

Nailed and Spiked Joints:

Joints using nails or spikes shall conform to the provisions of AITC. For side grain withdrawal, 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 shall be used. End grain withdrawal shall not be used. For lateral loading, the values in AITC Table 6.36 for wood species Group II for Douglas Fir-Larch and wood species Group III for Hem-Fir shall be used. Diameters listed in the tables apply to fasteners before application of any protective coating.

When more than one nail or spike is used in a joint, the total design value for the joint in withdrawal or lateral resistance shall 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 that the values are maximum values for the type and size of fastener shown. The tabulated values shall 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, the design value shall be determined by straight-line interpolation between zero and the tabulated load, except that penetration shall 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 penny weight. They have less penetration into the main member and therefore their load-carrying capacity shall be adjusted accordingly.

Nail and spike minimum spacing in timber connections shall be as follows:

1. The average center-to-center distance between adjacent nails, measured in any direction, shall not be less than the required penetration into the main member for the size of nail being used; and
2. The minimum end distance in the side member, and the minimum edge distance in both the side member and the main member, shall not be less than 1/2 of the required penetration.

Allowable values for withdrawal and lateral load resistance are reduced when toe nails are used in accordance with the following:

- a. For withdrawal loading, the design load shall not exceed 2/3 of the value shown in the applicable design table; and
- b. For lateral loading, the design load shall not exceed 5/6 of the value shown 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.

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 shall not be 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)C, are maximums and thus shall not be increased.

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 (three percent or greater of the dead load); |
| (2) | 1.33 | for falsework design governed by wind load; and |
| (3) | 2.00 | for falsework design governed by impact loading. |

6-02.3(17)K FACE LUMBER, STUDS, WALES, AND METAL FORMS

Elements of this section shall be designed for the loads, allowable stresses, deflections, and conditions which pertain from other subsections of Section 6-02.3(17).

Forms battered or inclined over the concrete tend to uplift as concrete is placed and shall have positive anchorage or counterweights designed to resist uplift and shall be shown in the formwork Shop Drawing submittal. 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 shall be designed Capable of resisting the imbalance of horizontal thrust, and prevent the dislocation and sliding of the entire form unit.

Wooden forms shall be faced with smooth sanded, exterior plywood. This plywood shall meet 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 shall bear the APA stamp. The Contractor shall list in the formwork Shop Drawing submittal the grade and class of plywood. The Contractor may use plywood that does not carry the APA stamp if the plywood manufacturer submits a Manufacturer's Certificate of Compliance stating the plywood meets or exceeds the requirements of these Specifications for plywood. Plywood panels stamped "shop" or "shop cutting" shall not be used.

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 shall be as follows:

1. **Traffic and Pedestrian Barriers** (except those that receive an architectural surface treatment) - Plywood used for these surfaces shall be 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 shall provide for the Engineer's review a 4-foot square test panel of concrete formed with the same plywood and coating as proposed in the form Shop Drawings. This panel shall include one form joint

along its centerline. The Contractor shall 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) – Plywood used to form these surfaces shall meet or exceed the requirements of APA grades B-B Plyform Class I or B-C (Group I series). If one face is less than B quality, the B (or better) face shall contact the concrete; and
3. **Unexposed Surfaces** (such as the undersides of roadway slabs between girders, the interiors of box girders, etc., and traffic and pedestrian barriers where surfaces are to receive an architectural treatment) - Plywood used to form these surfaces may be APA grade CDX, provided the Contractor complies with stress and deflection requirements stated elsewhere in these Specifications.

Form joints on an exposed surface shall be in a horizontal or vertical plane. But in wingwalls and box girders, side form joints shall be placed at right angles and parallel to the roadway grade. Joints parallel to studs or joists shall be backed by a stud or joist. Joints at right angles to studs and joists shall be backed by a stud or other equal performance backing. Perpendicular backing is not required if studs or joists are spaced:

- a. Nine inches or less on center and covered with 1/2-inch plywood; or
- b. Twelve inches or less on center and covered with 3/4-inch plywood.

The face grain of plywood shall run perpendicular to studs or joists unless shown otherwise on the reviewed Contractor's formwork Shop Drawings. Proposals to deviate from the perpendicular orientation shall be accompanied by supporting calculations of the stresses and deflections.

Forming for all exposed curved surfaces shall follow the shape of the curve shown on the Drawings and shall 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;
- 2) The chords do not vary from a true curve by more than 1/2 inch at any point; and
- 3) All panel points are on the true curve.

Where architectural treatment is required, the angle point for chords in wall stems shall fall at vertical rustication joints.

For exposed surfaces of abutments, wingwalls, piers, retaining walls, and columns, the Contractor shall build forms of plywood at least 3/4-inch thick with studs no more than 12 inches on center. Deflection of the plywood, studs, or wales shall never exceed 1/500 of the span (or 1/360 of the span for unexposed surfaces, including the bottom of the deck slab between girders).

All form plywood shall be at least 1/2-inch thick except on sharply curved surfaces. There, the Contractor may use 1/4-inch plywood if it is backed firmly with heavier material.

Round columns or rounded pier shafts shall 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 shall not be used elsewhere unless an acceptable surface can be demonstrated to the Engineer. Failure to provide an acceptable surface at any time will result in the Engineer requiring the Contractor to not use metal forms. If permitted to use a combination of wood and metal in forms, the Contractor shall coat the forms so that the texture produced by the wood matches that of the metal. Aluminum shall not be used for metal forms.

For design purposes, the Contractor shall assume that on vertical surfaces concrete exerts 150 pounds of pressure per square foot 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. Horizontal surfaces shall support a pressure of 160 pounds per square foot for each foot of concrete height.

All exposed corners shall be beveled 3/4-inch. However, traffic barriers, footings, footing pedestals and seals need not be beveled unless the Contract requires it.

All forms shall be as mortartight as possible with no water standing in them as the concrete is placed.

The Contractor shall apply a parting compound on forms for exposed concrete surfaces. This compound shall be a chemical release agent that permits the forms to separate cleanly from the concrete. The compound shall not penetrate or stain the surface and shall not attract dirt or other foreign matter. After the forms are removed, the concrete surface shall be dust-free and have a uniform appearance. The Contractor shall 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 is to be sealed, the release agent shall not contain silicone resin. Before applying the agent, the Contractor shall submit to the Engineer a Manufacturer's Certificate of Compliance stating whether the resin in the base material is silicone or non-silicone.

The Contractor shall submit to the Engineer a sample and catalog cut of the parting compound at least 10 Working Days before its use. Approval or nonapproval shall be based on laboratory tests results.

The Engineer may reject any forms that are not able to produce an acceptable surface.

6-02.3(17)L FORMS ON STEEL SPANS

Forms for concrete placement on all steel structures shall be removable and shall not remain in place. Where needed, the forms shall have openings for truss or girder members. Each opening shall 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.

Any form support for a roadway slab that rests on a plate girder flange shall apply the load within 6 inches of the girder web centerline. The Contractor shall not weld any part of the form to any steel member.

If the Engineer permits bolt holes in the web to support form brackets, the holes shall be shop-drilled. The Contractor shall fill the holes with fully torqued AASHTO M 164 bolts per Section 6-03.3(33). Each bolt head shall be placed on the exterior side of the web. There shall be no holes made in the flanges.

6-02.3(17)M FINISHING MACHINE SUPPORT SYSTEM

Before using any finishing machine, the Contractor shall submit to the Engineer for review, detailed Shop Drawings that show the system proposed to support it. The Contractor shall not attach this (or any other) equipment support system to the sides or suspend it from any girder. The Engineer will not permit such a method if it unduly alters stress patterns or creates too much stress in the girder.

6-02.3(17)N RESTRICTED OVERHEAD CLEARANCE SIGN

The Contractor shall 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 reduce clearances available to the public traffic. Falsework openings shall not be more restrictive to traffic than shown on the Drawings.

Where the height of vehicular openings through falsework is less than 15 feet 0 inches, a W 12-2 "Low Clearance Symbol Sign" shall be erected on the shoulder in advance of the falsework, and two or more W 12-301 and/or W 12-302 signs shall be attached to the falsework to provide accurate usable clearance information over the entire falsework opening. The posted low clearance shall 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. W 12-302 signs shall be used to designate prominent clearance restrictions and limits of usable clearance. In addition, where the clearance is less than the legal height limit (14 feet 0 inches), a W 12-2 sign shall 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 shall be installed below the advance sign. The Engineer will furnish the above noted signs and the Contractor shall erect and maintain them, all in accordance with Sections 1-07.23 and 1-10, and the Contract.

When erecting falsework that restricts overhead clearance above a railroad track, the Contractor shall place restricted overhead clearance signs as soon as the restriction occurs. Sign details are shown in WSDOT Standard Plan no.G-1.

6-02.3(17)O REMOVAL OF FALSEWORK AND FORMS

The Contractor shall obtain the Engineer's written approval for the removal of forms or falsework. The Engineer will determine, on the basis of post-placement curing conditions, the exact number of curing days that shall elapse before form removal. The Contractor may request the removal of forms (from the time of the last pour the forms support) as indicated in the table that follows. Both compressive strength and curing days criteria shall be met if both are listed:

Concrete Placed In	% of Specified Minimum Compressive Strength	Number of Curing Days
Columns, wall faces, mass piers and abutments (except pier caps), traffic and pedestrian barriers, and any other side form not supporting the concrete weight. ¹	---	3
Pier caps continuously supported. ²	60	3
Sidewalks not supported on bridge roadway slabs. ²	70	---
Crossbeams, caps, pier caps not continuously supported, struts and top slabs on concrete box culverts, inclined columns and inclined walls. ^{2,3}	80	5
Roadway slabs supported on wood or steel stringers or on steel or prestressed concrete girders. ²	80	10
Box girders, T-beam girders, and flat-slab superstructure. ^{2,3}	80	14
Arches. ^{2,3}	---	21

NOTES ¹Where forms do not support the load of concrete.

²Where forms support the load of concrete.

³Where 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 shall remove forms from columns to enable the Engineer to inspect the column concrete.

The Contractor may remove the side forms of footings 24 hours after concrete placement if a curing compound is applied immediately. But this compound shall not be applied to the area of the construction joint between the footing and the column or wall.

The Contractor may remove side forms, traffic barrier forms, and pedestrian barrier forms after 24 hours if these forms are made of steel or dense plywood, an approved water reducing admixture is used, and the concrete reaches a compressive strength of 1,400 psi before form removal. This strength shall be proved by test cylinders made from the last concrete placed into the form. The cylinders shall be cured according to Field Operating Procedure for AASHTO T 23, Method 2.

Wet curing shall comply with the requirements of Section 6-02.3(11). The concrete surface shall not become dry during form removal or during the entire curing period.

Before placing forms for traffic and pedestrian barriers, the Contractor shall completely release all falsework under spans.

Before releasing forms under concrete cured at temperatures colder than 50°F, the Contractor shall 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 are indicated as showing in the finished Structure.

All cells of a box girder structure having permanent access shall have all forms completely removed, including the roadway deck forms. All debris and all projections into the cells shall be removed. Unless otherwise indicated in the Contract, the roadway slab interior forms in all other cells where no permanent access is available, may be left in place.

Falsework and forms supporting sloping exterior webs shall not be released until the roadway deck and deck overhang concrete has obtained its removal strength and time of cure. Stern reshoring shall not be used.

Open joints shown on the Drawings shall 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 shall submit a falsework and formwork removal plan and calculations in accordance with Section 1-05.3(12) for review. The falsework and formwork removal plan shall include the following:

1. The location and size of any cast-in-place falsework lowering holes and how the holes are to be filled;
2. 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;
3. The type, capacity and factor of safety, weight, and spacing of points of reaction of lowering equipment; and
4. The weight at each support point of the falsework and formwork being lowered.

All other forms shall be removed, whether they are above or below the level of the ground or water. Sections 6-02.3(6) and 6-02.3(7) govern form removal for concrete exposed to sea water or to alkaline water or soil. The forms inside of hollow piers, girders, abutments, etc. shall be removed through openings provided for that purpose as indicated on the Drawings.

6-02.3(17)P EARLY CONCRETE TEST CYLINDER BREAKS

The fabrication, curing and testing of the early cylinders shall be the responsibility of the Contractor. 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 prior to applying loads or stresses. The Contractor shall retain an accredited independent testing laboratory, to be approved by the Engineer, to perform this work. The Contractor shall submit the independent testing laboratory's credentials and experience for doing testing as indicated in this Section to the Engineer at least 5 Working in advance of performing any testing.

The concrete cylinders shall be molded in accordance with Field Operating Procedure for AASHTO T 23 from concrete last placed in the forms and representative of the quality of concrete placed in that pour.

The cylinders shall be cured in accordance with Field Operating Procedure for AASHTO T 23, Method 2. The Engineer may approve the use of cure boxes meeting the requirements of this test method. Special cure boxes to enhance cylinder strength will not be allowed.

The concrete cylinders shall be tested for compressive strength in accordance with AASHTO T 22. The number of early cylinder breaks shall be in accordance with the Contractor's need and as approved by the Engineer.

The Contractor shall furnish the Engineer with all test results. The test results will be reviewed and approved before any forms are removed. The Contractor shall not remove forms without the approval of the Engineer.

Test laboratories used for this work shall be ASTM or AASHTO accredited, and shall be approved by the Engineer.

6-02.3(18) PLACING ANCHOR BOLTS

The Contractor shall comply with the following requirements in setting anchor bolts in piers, abutments, or pedestals:

- 1) If set in the wet concrete, the bolts shall be accurately placed before the concrete is placed;
- 2) If the bolts are set in drilled holes, hole diameter shall exceed bolt diameter by at least 1 inch. Grouting shall comply with Section 6-02.3(20);
- 3) If the bolts are set in pipe, grouting shall comply with the requirements for grouting shoes in Section 6-02.3(20); and
- 4) If freezing weather occurs before bolts can be grouted into sleeves or holes, they shall be filled with an approved antifreeze solution (non-evaporating).

6-02.3(19) BRIDGE BEARINGS**6-02.3(19)A ELASTOMERIC BEARING PADS**

The Contractor shall use rubber cement to bond the lower contact surface of elastomeric bearing pads to the structure.

6-02.3(19)B BRIDGE BEARING ASSEMBLIES

For all fixed, sliding, or rolling bearings, the Contractor shall:

- (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) Coat all sliding surfaces thoroughly with oil and graphite just before placing them into position; and
- (5) 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 shall comply with Section 6-02.3(20).

6-02.3(20) GROUT FOR ANCHOR BOLTS AND BRIDGE BEARINGS

Grout shall be a prepackaged grout, mixed, placed, and cured as recommended by the manufacturer, or the grout shall be produced using Type I or Type II Portland cement, fine aggregate Class 1 (see Section 9-03.1(2)C), and water, in accordance with these Specifications.

Grout shall meet the following requirements:

Requirement	Compressive Strength
Test Method	AASHTO T 106
Values	4,000 psi @ 7 days

Grout shall be a workable mix with flowability suitable for the intended application.

If the Contractor elects to use a prepackaged grout, a material sample and laboratory test data from an independent testing laboratory shall be submitted to the Engineer for approval with the request for approval of Material sources (see Section 1-06.1).

If the Contractor elects to use a grout consisting of Type II Portland cement, fine aggregate Class 1, admixture, and water, the mix proportions and laboratory test data from an independent ASTM accredited test laboratory shall be submitted to the Engineer for approval with the request for approval of Material sources.

The Contractor shall first obtain approval of the grout from the Engineer before using the grout.

Field grout cubes shall be made in accordance with WSDOT Test Method 813 for either prepackaged grout or a Contractor provided mix when requested by the Engineer, but not less than per bridge pier or one per day.

The concrete receiving the grout shall first be thoroughly cleaned, roughened, and wetted with water to ensure proper bonding. The grout pad shall be cured as recommended by the manufacturer or kept continuously wet with water for three days.

Before placing grout into anchor bolt sleeves or holes, the cavity shall be thoroughly cleaned and wetted to ensure proper bonding.

To grout bridge bearing plates, the Contractor shall:

1. Build a form approximately 4 inches high, with sides 4 inches outside the base of each steel bearing plate;
2. Fill each form with grout to the depth indicated on the Drawings;
3. Work grout under all parts of each bearing plate;
4. Remove each form after the grout has hardened;
5. Remove the grout outside each bearing plate to the base of the bearing plate;
6. Bevel off the grout neatly to the top of the masonry; and
7. Place no additional load on the bearing plate until the grout has set at least 72 hours.

After all grout under the bearing plate and in the anchor bolt cavities has attained a minimum strength of 4,000 psi, the anchor bolt nuts shall be tightened to snug-tight. "Snug-tight" means either the tightness reached by (1) a few blows from an impact wrench, or (2) the full effort of a man using a spud wrench. Once the nut is snug-tight the anchor bolt threads shall 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 shall provide and install, according to details on the Drawings, short lengths of nonmetallic pipe in the bottom slab at the low point of each cell. The pipe shall have a minimum inside diameter of 4 inches. If the difference in plan elevation is 2 inches or less, the Contractor shall install pipe in each end of the box girder cell.

6-02.3(22) DRAINAGE OF SUBSTRUCTURE

The Contractor shall use weep holes and gravel backfill that complies with Section 9-03.12(2) to drain fill material behind retaining walls, abutments, tunnels, and wingwalls. To maintain thorough drainage, weep holes shall be placed as low as possible. Gravel backfill shall be placed and compacted as required in Section 2-09.3(1)E. Tiling, French or rock drains, or other drainage devices shall also be installed if indicated on the Drawings.

If underdrains are not installed behind the wall or abutment, all backfill within 18 inches of weep holes shall comply with Section 9-03.12(4). Unless the Contract requires otherwise, all other backfill behind the wall or abutment shall be gravel backfill for walls.

6-02.3(23) OPENING TO TRAFFIC

Bridges with a roadway slab made of Portland cement concrete shall remain closed to all traffic, including construction equipment, until the concrete has reached the 28-day specified compressive strength. This strength shall be determined by testing cylinders made of the same concrete as the roadway and cured under the same conditions. A concrete deck bridge shall never be opened to traffic earlier than 10 days after the deck concrete was placed and never without written approval of the Engineer.

See Section 6-01.6 for load restrictions on bridges under construction.

6-02.3(24) REINFORCEMENT

6-02.3(24)A GENERAL

The Contractor shall submit Shop Drawings showing the rebar list and bending diagram to the Engineer for review prior to fabrication in accordance with Section 1-05.3. The submittal shall include information on welding as specified in Section 6-02.3(24)F.

Various steel reinforcing bars, including those in crossbeams, may be shown as straight in the bar list. The Contractor shall bend these bars as required to conform to the configuration of the structure and as detailed on the Drawings.

6-02.3(24)B FIELD BENDING

If the Drawings call for field bending of steel reinforcing bars, the Contractor shall bend them in keeping with the structural configuration indicated in, and in accordance with, the Contract.

Bending steel reinforcing bars partly embedded in concrete shall be done as follows:

Field bending shall not be done:

1. On bars size No. 14 or No. 18;
2. When air temperature is lower than 45°F;
3. By means of hammer blows or pipe sleeves; or
4. While the bar temperature is in the range of 400°F to 700°F.

In field-bending steel reinforcing bars, the Contractor shall:

- 1) Make the bend gradually;
- 2) 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;
- 3) Use a bending tool equipped with a bending diameter as listed in Table 1;

- 4) Limit any bend to these maximums -- 135 degrees for bars smaller than size No. 9, and 90 degrees for bars size No. 9 through 11; and
- 5) Straighten by moving a hickey bar (if used) progressively around the bend.

In applying heat for field-bending steel reinforcing bars, the Contractor shall:

- (1) Use methods that avoid damage 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 shown in the following Table 2;
- (4) Maintain the steel temperature within the required range shown in the following Table 2 during the entire bending process;
- (5) Apply two 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 two 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 the following Table 3 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.

TABLE 1		
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
The minimum bending diameters for stirrups and ties for No. 4 and No. 5 bars when heat is not applied shall be specified in Section 9-07.		

TABLE 2		
Preheating Temperatures for Field-Bending Reinforcing Bars		
Bar Size	Temperature (°F)	
	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

TABLE 3			
Minimum Bar Length to be Heated (d = nominal diameter of bar)			
Bar Size	Bend Angle		
	45°	90°	135°
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)C PROTECTION OF MATERIALS

The Contractor shall protect reinforcing steel from all damage. When placed into the structure, the steel shall 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 shall 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 shall be flushed with fresh water prior to concrete placement.

When the Engineer requires protection for reinforcing steel that is to remain exposed for a length of time, the Contractor shall protect the reinforcing steel:

1. By cleaning and applying a coat of paint Formula No. A-9-73 over all exposed surfaces of steel; or
2. By cleaning and painting paint Formula No. 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 shall have a minimum dry film thickness of 1 mil.

6-02.3(24)D PLACING AND FASTENING

The Contractor shall position reinforcing steel as the Drawings require and shall ensure that the steel is not displaced as the concrete is placed.

When spacing between bars is 1 foot or more, they shall be tied at all intersections. When spacing is less than 1 foot, every other intersection shall be tied. Bundled bars shall be tied together with wires at least every 6 feet. Wire ties used for tying epoxy-coated reinforcing steel shall 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 shall pass around main reinforcement or be firmly attached to it.

For slip-formed concrete, the reinforcing steel bars shall be tied at all intersections and crossbraced to keep the cage from moving during concrete placement. Crossbracing shall consist of additional reinforcing steel placed both longitudinally and transversely.

For slip-formed concrete barriers, the vertical dowels protruding from the supporting concrete structure shall be diagonally braced against bending induced by the advancing slip-form. The bracing bars shall be no smaller than No. 5 and shall be extended diagonally from the top of one expansion joint to the bottom of the next expansion joint and shall be securely tied to all intervening dowels. A horizontal top bar shall also be tied to all the dowels.

After reinforcing steel bars are placed in a traffic or pedestrian barrier and prior to slip-form concrete placement, the Contractor shall check clearances and reinforcing steel bar placement. This check shall 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 shall be corrected by the Contractor before slip-form concrete placement.

Mortar blocks (or other approved devices) shall be used to maintain the concrete coverage required by the Drawings. The mortar blocks shall:

1. Have a bearing surface measuring not greater than 2 inches in either dimension; and
2. Have a compressive strength equal to that of the concrete in which they are embedded.

In slabs, each mortar cube shall have either: (1) a grooved top that holds it in place, or (2) an embedded wire that protrudes and is tied to the reinforcing steel. Plastic coated ties shall be used around epoxy-coated bars.

Acceptance of mortar blocks shall be based on testing a set of two specimens. Each pair of specimens shall represent 2,500 or fewer mortar blocks and shall be made of the same mortar as the blocks and cured under the same conditions. The Contractor may either:

- 1) Submit the blocks to the Engineer for pre-use testing, or
- 2) Submit Manufacturer's Certificate of Compliance as specified in Section 1-06.3.

In lieu of mortar blocks, the Contractor may use metal or plastic chair supports to hold uncoated bars. Any surface of a metal chair support that is not to be covered by at least 1/2-inch of concrete shall be either:

- (1) Hot-dip galvanized after fabrication in keeping with AASHTO M 232, Class D;
- (2) Coated with plastic firmly bonded to the metal. This plastic shall be at least 3/32 inch thick where it touches the form and shall not react chemically with the concrete when tested in the SPU Materials Laboratory. The plastic shall not shatter or crack at or above - 5°F and shall not deform enough to expose the metal at or below 200°F; or
- (3) Stainless steel that meet the requirements of ASTM A 493, Type 302. Stainless steel chair supports are not required to be galvanized or plastic coated.

In lieu of mortar blocks, epoxy-coated reinforcing bars may be supported by either:

- A. Metal chair supports coated entirely with a dielectric material such as epoxy or plastic;
- B. Other epoxy-coated reinforcing bars; or
- C. Plastic chair supports.

Plastic chair supports shall be lightweight, non-porous, and chemically inert in concrete. Plastic chair supports shall have rounded seatings, shall not deform under load at normal temperatures, and shall not shatter or crack under impact loading in cold weather. Plastic chair supports shall be placed at spacings greater than 1 foot along the bar and shall have at least 25% of their gross place area perforated to compensate for the difference in coefficient of thermal expansion between plastic and concrete. The shape and configuration of plastic supports shall permit complete concrete consolidation in and around the support.

In roadway and sidewalk slabs, the Contractor shall place reinforcing steel mats carefully to provide the required concrete cover. A "mat" is 2 layers of steel. Top and bottom mats shall 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 shall be blocked at not more than 3-foot intervals (or 4-foot intervals for bars No. 5 and larger). Wire ties to girder stirrups shall not be considered as blocking. The Contractor shall add other supports and tie wires to the top mat as needed to provide a rigid mat.

If a bar is indicated as interfering with a bridge drain, it shall be bent in the field to bypass the drain.

Clearances shall be at least:

- A) **4 inches between:** Main bars and the top of any concrete masonry exposed to the action of salt or alkaline water.
- B) **2-1/2 inches between:** Adjacent bars in a layer. Slab bars and the top of the roadway slab. Main bars and the surface of concrete deposited against earth (without intervening forms).
- C) **2 inches between:** Adjacent layers. Main bars and the surface of concrete (except in walls and slabs). Reinforcing bars and the faces of forms for exposed aggregate finish.
- D) **1-1/2 inches between:** Main bars and the surface of concrete in retaining walls. Slab bars and the top of the slab (except roadway slabs). Stirrups and ties and the surface of the concrete.
- E) **1 inch between:** Slab bars and the bottom of the slab. Curb or sidewalk bars and the surface of the concrete.

Reinforcing steel bars shall not vary more than the following tolerances from their position shown on the Drawings:

Members 10 inches or less in thickness	±1/4 in.
Members more than 10 inches in thickness	±3/8 in.
Except:	
The distance between the nearest reinforcing steel bar surface and the top surface of the roadway deck slab	+1/4 in.
Longitudinal spacing of bends and ends of bars	±1 in.
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 dia.

Before placing any concrete, the Contractor shall:

- (A) Clean all mortar from reinforcement; and
- (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 shall be removed.)

6-02.3(24)E SPLICING

The Contractor shall supply steel reinforcing bars in the full lengths the Drawings require. Unless the Engineer approves otherwise in writing, the Contractor shall not change the number, type, or location of splices.

The Engineer may permit the Contractor to use thermal or mechanical splices in place of the method shown on the Drawings if they are of a Contractor submitted and Engineer reviewed design. Use of a new design may be granted by the Engineer if:

1. The Contractor provides technical data and proof from the manufacturer that the design shall perform as well as or better than the method shown on the Drawings, and
2. Sample splices and materials from the manufacturer pass the Engineer's tests.

After a new design has been reviewed, any further changes in detail or material shall require a new submittal for review.

The Contractor shall:

- 1) Not lap-splice reinforcing bars Nos. 14 or 18,
- 2) Not permit any welded or mechanical splice to deviate in alignment more than 1/4 inch per 3-1/2 feet of bar,
- 3) Distribute splices evenly, grouping them together only at points of low tensile stress,
- 4) Ensure at least 2 inches clearance between any splice and the nearest bar or the surface of the concrete (or 1-1/2 inches for the length of the sleeve on mechanical splices),
- 5) Rigidly clamp or wire all splices in a manner acceptable to the Engineer,
- 6) Place lap-spliced bars in contact for the length of the splice and tie them together near each end, and
- 7) Securely fasten the ends and edges of welded-wire-fabric reinforcement, overlapping them enough to maintain even strength.

6-02.3(24)F WELDING REINFORCING STEEL

Welding of steel reinforcing bars shall conform to the requirements of the Contract.

When welding is required, steel reinforcing bars shall be supplied that are suitable for welding. Steel which is to be welded shall have a maximum carbon equivalent of 0.65 percent. The carbon equivalent shall be determined by the following formula:

$$CE = \frac{\% C}{1} + \frac{\% Mn}{6} + \frac{\% Cu}{10} + \frac{\% Ni}{20} + \frac{\% Cr}{10} - \frac{\% Mo}{50} - \frac{\% V}{10}$$

In addition, carbon shall not exceed 0.45 % and manganese shall not exceed 1.30 %.

Before any welding begins, the Contractor shall submit it to the Engineer's for review, a written welding procedure for each type of welded splice to be used, including the procedure specifications and joint details. The procedure specifications shall specify:

1. material specification;
2. manual or machine;
3. position of weld;
4. filler metal specification and classification;
5. shielding gas;
6. single or multiple pass;
7. single or multiple arc;
8. either shielded metal arc, flux cored arc, or gas metal arc welding process;
9. preheat and interpass temperature;
10. welding current;
11. polarity; and
12. root treatment.

The welding procedure shall specify:

- 1) welding sequence,
- 2) pass number,
- 3) electrode size,
- 4) welding current amperes, and
- 5) voltage for each joint detail.

All the aforementioned information shall be contained on a form that specifies the procedure number, revision number, and the Contractor. The form shall be signed and dated by the Contractor.

Electrodes for manual shielded metal arc welding (SMAW) of Grade 60 steel reinforcing bars shall conform to the requirements of AWS A5.5 of the low hydrogen E90 series.

Solid and composite electrodes for gas metal arc welding (GMAW) and flux-cored arc welding (FCAW) of Grade 60 steel reinforcing bar shall conform to the requirements of AWS A5.28, ER90S and AWS A5.29, E90T respectively. The Contractor shall demonstrate that each combination of electrode and shielding proposed for use produces the following mechanical properties:

FCAW Grade E90T	
Tensile Strength	90,000 psi
Yield Strength	78,000 psi
Elongation in 2 inches	17%

Compliance may be verified from manufacturer's certified test reports, or from actual testing of weld specimens.

All welding shall 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 will not be allowed. Slugging of welds will not be allowed. No field welding of reinforcing bars will be permitted when the ambient temperature is below 32°F.

The minimum preheat and interpass temperature for welding Grade 60 reinforcing bars shall be 400°F. Preheating shall 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, postheating of welded splices is only required for direct butt welded splices of Grade 60 bars size No. 9 or larger. Postheating shall be done immediately after welding before the splice has cooled to 700°F. Postheating shall 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.

Weld joint and welder qualifications shall be made by the following procedures. The joint qualification and welder qualification shall be according to the following tests.

In the presence of the Engineer's Materials and Fabrication Inspector, the welder shall weld three test joints of the largest size reinforcing bar to be weld spliced. Two of the test welds shall be test loaded to no less than 125 percent of the minimum specified yield strength of the bar. The remaining test weld shall be mechanically cut perpendicular to the direction of welding and macroetched. Indirect butt splices shall be cut mechanically at two locations to provide a transverse cross section of each of the bars spliced in the test assembly. The sections shall show the full cross-section of the weldment, the root of the weld, and any reinforcement. The etched cross-section shall have complete penetration and complete fusion with the base metal and between successive passes in the weld. Groove welds of direct butt splices and flare-groove welds shall not have reinforcement exceeding 1/8-inch in height

measured from the main body of the bar and shall have a gradual transition to the base metal surface. No cracks will be allowed in either the weld metal or heat-affected zone. All craters shall be filled to the full cross-section of the weld. Weld metal shall be free from overlap. Undercutting deeper than 1/32-inch will not be allowed except at points where welds intersect the raised pattern of deformations where undercutting less than 1/16-inch deep will be acceptable. The sum of diameters of piping porosity in groove welds shall not exceed 1/8-inch in any linear inch of weld or exceed 9/16 inch in any 6 inch length of weld. The Contractor shall first obtain approval of the Engineer for proposed corrections to welds with shielded metal arc, gas metal arc, or flux-cored arc welding processes.

A welder qualified in the vertical position shall then be qualified for the horizontal and flat positions. A welder qualified for the horizontal position shall then be qualified for the flat position but not the vertical position. A welder qualified in the flat position shall be qualified for the flat position only.

Welders qualified for direct butt splice groove welds are qualified for indirect butt splice groove welds and fillet welds. A welder qualified for indirect butt splice grooved welds is not qualified for direct butt splice welds. The welder qualifications shall remain in effect indefinitely unless:

- 1 the welder is not engaged in a given process of welding for which he/she is qualified for a period exceeding six months, or
- 2 there is some specific reason to question a welder's ability.

Weld joint geometry shall be as shown on the Drawings and in compliance with the Specifications. Welding machines shall be DC current, be reverse polarity, and be Capable of placing welds as specified.

The Contractor is responsible for using a welding sequence that limits 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 shall be burned or sawed off a minimum of 1/2-inch to completely remove the ruptured portion of the steel shear area prior to welding butt splices. Surfaces to be welded shall be smooth, uniform, and free from fins, tears, cracks, and other defects. Surfaces to be welded and surfaces adjacent to a weld shall also be free from loose or thick scale, slag, rust, moisture, grease, paint, epoxy covering, or other foreign materials. All tack welds shall 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 shall be upward. The ground wire from the welding machine shall be clamped to the bar being welded.

Should the Contractor elect to use a procedure which differs in any way from the procedure recommended above, the Contractor shall submit the differing procedure with reasons for the changes to the Engineer for review. Engineer reviewed weld procedures shall be strictly followed.

6-02.3(24)G MECHANICAL SPLICES

The Contractor shall form mechanical splices with an Engineer-reviewed system using sleeve filler metal, threaded coupling, or another method that complies with this Section.

The Contractor shall adjust, relocate, or add stirrups, ties, and bars as needed to maintain required clearances after the splices are in place.

The Contractor shall provide the Engineer with the following information for each shipment of splice material before performing splicing:

1. The type or series identification (and heat treatment lot number for threaded-sleeve splices);
2. The grade and size of bars to be spliced;
3. A manufacturer's catalog with complete data on material and procedures;
4. A written statement from the manufacturer that the material is identical to that used earlier by the Engineer in testing and reviewing the system design; and
5. A written statement from the Contractor that the system and materials shall be used according to the manufacturer's instructions and all requirements of this Section.

All splices shall meet these criteria:

- 1) Tension splices shall develop at least 130 percent of the yield tensile strength specified for the unspliced bar. The ultimate tensile strength of the sleeve shall exceed that of the other parts of the completed splice;
- 2) AASHTO M 31 bars within a splice sleeve shall not slip more than 0.03 inch for Grade 40 bars, nor more than 0.045 inch for Grade 60 bars. This slippage shall be measured between gage points clear of the splice sleeve. Measurements shall be taken at an initial load of 3,000 psi and again after loading to 90 percent of the minimum specified yield strength for the unspliced bar and then relaxed to 3,000 psi; and
- 3) Maximum allowable bar size:

a.	Mechanical butt splice	No. 14 bar
b.	Mechanical lap splice	No. 6 bar

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 review. If the Engineer considers any splice defective, it shall be removed and replaced at the Contractor's sole expense.

In preparing sleeve-filler metal splices, the Contractor shall:

- (1) Clean the bar surfaces by:
 - (a) oxyacetylene torch followed by power wire brushing, or
 - (b) abrasive blasting;
- (2) Remove all slag, mill scale, rust, and other foreign matter from all surfaces within and 2 inches beyond the sleeve;
- (3) Grind down any projection on the bar that would prevent placing the sleeve;
- (4) Prepare the ends of the bars as the splice manufacturer recommends and as the Engineer reviewed procedure requires; and
- (5) 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 shall 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 shall qualify in the following way under the supervision of the Engineer. The operator shall 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 shall be 42 inches long and shall consist of two 21-inch bars joined end-to-end by the splice. The bar alignment shall not deviate more than 1/8 inch from a straight line over the whole length of the sample. All 6 samples must meet both the tensile strength and the slip criteria specified in this Section.

The Contractor shall provide labor, materials, and equipment for making these test samples at no additional cost to the Owner. The Owner will test the samples at no cost to the Contractor.

6-02.3(24)H JOB CONTROL TESTS

As the work progresses, the Engineer may require the Contractor to provide a sample splice (thermal or mechanical or both) to be used in a job control test. The operator shall 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 shall 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 two acceptable samples that conform to the specified splicing procedures on any project with fewer than 200 splices and no more than one acceptable sample per 100 splices on any project with more than 200 splices.

6-02.3(24)I EPOXY-COATED STEEL REINFORCING BAR

This work is furnishing, fabricating, coating, and placing epoxy-coated steel reinforcing bars as shown in the Contract. Coating material shall be applied electrostatically, by spraying, or by the fluidized-bed method.

All epoxy-coated bars shall comply with the requirements of Section 9-07. Fabrication may occur before or after coating.

The Contractor shall protect epoxy-coated bars from damage using padded or nonmetallic slings and straps free of dirt or grit. The Contractor shall lift bundled bars with a strong-back, multiple supports, or a platform bridge to prevent abrasion from bending or sagging. Bundled bars shall not be dropped or dragged. Bars shall rest on wooden or padded cribbing during shop or field storage. The Contractor may substitute other methods for protecting the bars if the Engineer approves. Coated bars that have significant damage (significant damage defined in this Specification Section) will be rejected.

Metal chairs and supports shall be coated with epoxy or other inert coating approved in writing by the Engineer. The Contractor may use other support devices with prior written approval of the Engineer. Plastic coated tie wires, approved in writing by the Engineer, shall be used to protect the coated bars from being damaged during placement.

The bars shall be placed as indicated on the Drawings. The bars shall be secured firmly in place during placing and setting of the concrete. All epoxy-coated bars in the top mat of the roadway slab, and epoxy-coated bars with spacing intervals of 1 foot or greater, shall be tied at all intersections. Epoxy-coated bars not in the top mat of the roadway slab, and with bar spacing intervals of less than 1 foot, shall be tied at alternate intersections.

The Contractor shall protect the epoxy-coating from damage that might result from other construction work in the interval between installing coated bars and concreting the deck.

The Engineer will inspect the coated bars after they are placed and again before the deck concrete is placed. The Contractor shall patch any areas that show significant damage defined as follows.

Significant damage means the Engineer has determined any opening in the coating that exposes the steel in an area that exceeds:

1. 0.05 square inch (approximately 1/4 inch square or 1/4 inch in diameter or the equivalent);
2. 0.012 square inch (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; or
4. 0.50 square inch aggregate area in any 1-foot length of bar.

The Contractor shall patch significantly damaged areas with a patching material obtained from the epoxy resin manufacturer which has been submitted to and reviewed by the Engineer. This patching material shall be compatible with the coating and inert in concrete. Areas to be patched shall be clean and free of surface contaminants. Patching shall be done before oxidation occurs and according to the resin manufacturer's instructions.

6-02.3(25) PRESTRESSED CONCRETE GIRDERS

6-02.3(25)A GENERAL

The manufacturing plant of prestressed concrete girders shall be certified by the Precast/Prestressed Concrete Institute's Plant Certification Program for the type of prestress member to be produced and shall be approved by WSDOT as a

Certified Prestress Concrete Fabricator prior to the start of production as part of WSDOT's annual plant review and approval process. Proof of plant certification by P/PCI and by WSDOT shall be submitted along with the Shop Drawings by the Contractor to the Engineer.

The Contractor shall provide the Engineer at least 3 Working Days advance notice of the girder production schedule. The Contractor shall give the Engineer safe and unencumbered access to the work. If non-Specification work or unacceptable quality control practices are observed, the Engineer will advise the plant manager with written notice. The proposed corrective action shall be acceptable to the Engineer. Failure to provide acceptable corrective action will be cause for rejection of the girder(s).

All reinforcement, from manufacture to encasement in concrete, used in girders shall be protected against contamination such as dirt, oil, grease, damage, rust, all corrosives, and any other material deleterious for its intended use. The proposed protection method requires the Engineer's advance written approval. Reinforcement will be rejected if found contaminated.

The various types of girders are:

Prestressed Concrete Girder - Refers to prestressed concrete girders including Series W42G, W50G, W58G, and W74G girders, bulb tee girders, and deck bulb tee girders.

Bulb Tee Girder - Refers to a bulb tee girder or a deck bulb tee girder.

Deck Bulb Tee Girder - Refers to a bulb tee girder with a top flange designed to support traffic loads (i.e., without a cast-in-place deck). This type of bulb tee girder is mechanically connected to adjacent girders at the Project Site.

6-02.3(25)B SHOP DRAWINGS

The Drawings show design conditions and details for prestressed girders. Deviations will not be permitted, except as specifically allowed by these Specifications and by manufacturing processes approved by the annual plant approval process.

Shop Drawings shall show the size and location of all cast-in holes for installation of deck formwork hangers and/or temporary bracing. Holes for formwork hangers shall match Engineer reviewed deck formwork Shop Drawings designed in accordance with Section 6-02.3(16). There shall be no field-drilled holes in prestressed girders.

The Contractor shall have the option to furnish Series W74G prestressed concrete girders with minor dimensional differences from those shown on the Drawings. The 2-5/8-inch top flange taper may be reduced to 1-5/8-inch and the bottom flange width may be increased to 2feet 2-inches. Other dimensions of the girder shall be adjusted as necessary to accommodate the above mentioned changes. Reinforcing steel shall be adjusted as necessary. The overall height and top flange width shall remain unchanged.

If the Contractor elects to provide a Series W74G girder with an increased web thickness, Shop Drawings along with supporting design calculations in accordance with Section 1-05.3(12) shall be submitted to the Engineer for review prior to girder fabrication. The girder shall be designed for at least the same load carrying capacity as the girder shown on the Drawings. The load carrying capacity of the mild steel reinforcement shall be the same as that shown on the Drawings.

The Contractor may alter bulb tee girder dimensions as indicated from that shown on the Drawings if:

1. The girder has the same or higher load carrying capacity (using current AASHTO Design Specification);
2. The Engineer reviews, before the girder is made, complete design calculations for 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;
5. The web thickness is not increased by more than 1 inch and is not decreased;
6. The top flange minimum thickness of the girder is not increased by more than 2 inches, providing the top flange taper section is decreased a corresponding amount;
7. The top flange taper depth is not increased by more than 1 inch; and
8. The bottom flange width is not increased by more than 2 inches.

The Contractor shall provide four copies of the Shop Drawings to the Engineer. Only steel side forms are acceptable, except plywood forms are acceptable on the end bulkheads.

6-02.3(25)C CASTING

Before casting girders, the Contractor shall have possession of the Engineer reviewed set of Shop Drawings.

All concrete mixes to be used shall be submitted in accordance with the requirements of Section 9-19.1. The temperature of the concrete when placed shall be between 50°F and 90°F.

Slump shall not exceed 4 inches for normal concrete nor 7 inches with the use of a high range water reducing admixture. The high range water reducer shall meet the requirements of Section 9-23.6, 9-23.7, and 9-23.8. When the slump exceeds the maximum slump specified, the acceptability of the concrete shall be subject to the provisions of Section 6-02.3(4).

Air-entrainment is not required in the concrete placed into prestressed precast concrete girders unless otherwise specified in the Contract. The Contractor shall use air-entrained concrete in the entire roadway deck flange of deck bulb-tee girders. Maximum and minimum air content shall be as specified in Section 6-02.3(2)B.

No welds will be permitted on steel within prestressed girders. Once the prestressing steel has been installed, no welds or grounds for welders shall 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 shall:

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 and W58G girders, and 6 inches or more for Series W74G girders; and
4. Be located within 15 inches of the web centerline for bulb tee girder.

The Contractor may form circular block-outs in the girder webs to support brackets for roadway slab falsework. These block-outs shall:

- 1) Not exceed 1 inch in diameter;
- 2) Be spaced no more than 72 inches apart longitudinally on the girder; and
- 3) Be positioned so as to clear the girder reinforcing and prestressing steel.

6-02.3(25)D PRESTRESSING

Each stressing system shall have a pressure gauge or load cell that measures jacking force. Any gauge shall display pressure accurately and readably with a dial at least 6 inches in diameter or with a digital display. Each jack and its gauge shall be calibrated as a unit and shall be accompanied by a certified calibration curve allowing tension stress to be determined. The calibration and certification shall be obtained from an AASHTO certified testing laboratory acceptable to the Engineer. The Contractor shall provide one copy of this certified calibration curve to the Engineer. The cylinder extension during calibration shall be in the approximate position it occupies at final jacking force.

Jacks and gauges shall be recalibrated and recertified:

1. Annually;
2. After any repair or adjustment; and
3. Anytime there are indications that the jack calibration is in error.

The Engineer may engage an independent testing laboratory to check jacks, gauges, and calibration charts before and during tensioning.

All load cells or pressure gauges shall be calibrated as specified above in this Section and shall have an indicator that shows prestressing force in the strand. The range of the load cell shall be broad enough that the lowest 10 percent of the manufacturer's rated capacity shall not be used to measure jacking force.

See Section 6-02.3(25)A for protection of reinforcement.

6-02.3(25)E CURING

During curing, the Contractor shall keep the girder in a saturated curing atmosphere until the girder concrete has reached the required release strength. The Contractor with advance notification to the Engineer for review, 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 shall envelop the entire surface with saturated steam. The Engineer will not permit hot air curing until after reviewing 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 shall never allow dry heat to touch the girder surface at any point.

Under heat curing methods, the Contractor shall:

1. Keep all unformed girder surfaces in a saturated atmosphere throughout the curing time;
2. Embed a thermocouple (linked with a thermometer accurate to $\pm 5F^\circ$) 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 $\pm 5F^\circ$) arranged and calibrated to continuously record, date, and identify concrete temperature throughout the heating cycle;
4. Make this temperature record available to the Engineer;
5. Heat concrete to no more than 100°F during the first two hours after placing the concrete, and then increase no more than 25°F per hour to a maximum of 175°F;
6. Cool the concrete, after curing is complete, at a rate not to exceed 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 once the concrete has reached a minimum compressive strength of 3,000 psi. All damage from stripping is the Contractor's responsibility and shall be repaired in a manner acceptable to the Engineer at no additional cost to the Owner.

6-02.3(25)F CONTRACTORS CONTROL STRENGTH

Concrete strength shall be measured using test cylinders cast from the same concrete as that in the girder. These cylinders shall 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 shall remain in the coolest zone throughout curing. If forms are heated another way, the Contractor shall provide a record of the curing time-temperature relationship for the cylinders for each girder to the Engineer. When two 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 acceptable uniformity of casting and curing to the Engineer.

The Contractor shall mold, cure, and test enough of these cylinders to comply with specification requirements for measuring concrete strength. The Contractor may use 4 inch by 8 inch or 6 inch by 12 inch cylinders. If heat is used to shorten curing time, the Contractor shall let cylinders cool for at least 1/2 hour before testing.

Test cylinders may be cured in a moist room or water tank in accordance with AASHTO T 23 after the girder concrete has obtained the required release strength. If, however, the Contractor intends to ship the girder prior to the standard 28 day strength test, the design strength for shipping shall be determined from cylinders placed with the girder and cured under the same conditions as the girder. These cylinders may be placed in a noninsulated, moisture-proof envelope.

To measure concrete strength in the girder, the Contractor shall randomly select two test cylinders and average their compressive strengths. The compressive strength in either cylinder shall not fall more than 5 percent below the specified strength. If the first set of two cylinders do not pass the test, a second set of two other cylinders shall be selected and tested.

If too few cylinders were molded to carry out all required tests on the girder, the Contractor shall remove and test cores from the girder. The collection and testing of these girder test cores shall be performed in the presence of the Engineer. If the Contractor casts cylinders to represent more than one girder, all girders represented by the cast cylinders shall be cored and tested. A test shall consist of three cores from a girder measuring 4 inches in diameter by the thickness of the web and shall be removed from just below the top flange. One core shall be taken at the midpoint of the girder's length and the other two cores shall be taken approximately 3 feet to the left and approximately 3 feet to the right of the midpoint core. The cores shall be taken in accordance with AASHTO T 24 and shall be tested in accordance with AASHTO T 22. The Engineer may accept a girder if the average compressive strength of three cores from that 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 shall be done prior to shipment. If there are more than three holes or if they are not in a neutral location, the prestress steel shall 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 4000 psi, whichever is less.

The Contractor shall coat cored holes with a Type II, Grade 2 epoxy and patch the holes using the same type concrete as that in the girder, or a concrete mix approved during WSDOT's annual plant review and approval process. The girder shall not be shipped until tests show the patch material has attained a minimum compressive strength of 4000 psi.

6-02.3(25)G PRESTRESS RELEASE

Side and flange forms that restrain deflection shall be removed before release of the prestressing reinforcement.

All harped and straight strands shall be released in a way that produces the least possible tension in the concrete. This release shall not occur until test results show each girder has reached the minimum Contract specified strength.

6-02.3(25)H PROTECTION OF EXPOSED REINFORCEMENT

See Section 6-02.3(25)A for protection of reinforcement requirements. When a girder is removed from its casting bed, all bars and strands projecting from the girder shall be cleaned and painted with a minimum dry film thickness of 1 mil of paint Formula No. A-9-73 (Section 9-08). During handling and shipping, projecting reinforcement shall be protected from bending or breaking. The Contractor shall remove all dirt, oil, and other contaminants from the painted projected reinforcing before placing concrete.

6-02.3(25)I FINISHING

The Contractor shall apply a Class 2 finish, as defined in Section 6-02.3(14), to:

1. The vertical exterior surfaces of the outside girders;
2. The bottoms, sides, and tops of the lower flanges on all girders; and
3. The bottom of the outside roadway flange of each outside bulb tee girder section.

All other girder surfaces shall receive a Class 3 finish.

The interface on I-girders and other girders that contact the cast-in-place deck shall have a finish of dense, screeded concrete. The finished surface shall not have a smooth sheen or laitance. The Contractor shall texture the interface after vibrating and screeding, but just before the concrete reaches initial set. This surface texture shall be transverse 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, the Contractor shall test the roadway deck surface portion for flatness. This test shall occur after floating but while the concrete remains plastic. Testing shall be done with a 10-foot-straightedge parallel to the girder centerline and with a flange width straightedge at right angles to the girder centerline. The Contractor shall fill depressions, cut down high spots, and refinish to correct any deviation of more than 1/4 inch within the straightedge length. This section of the roadway surface shall be finished to meet the requirements for finishing roadway slabs, as defined in Section 6-02.3(10).

The Contractor may repair rock pockets and other defects in the girder provided the repair is covered in WSDOT's annual plant approval package. All other repairs and repair procedures shall be documented and reviewed by the Engineer prior to acceptance of the girder.

6-02.3(25)J TOLERANCES

The girders shall be fabricated as indicated on the Drawings, and shall meet the following dimensional tolerances unless specified otherwise in the Contract. Actual acceptance or rejection will depend on whether a defect outside these tolerances affects the structure's specified strength or specified appearance:

1. Length (overall): $\pm 1/4$ inch per 25 feet of beam length, up to a maximum of ± 1 inch.
2. Width (flanges): $+ 3/8$ inch, $- 1/4$ inch.
3. Width (narrow web section): $+ 3/8$ inch, $- 1/4$ inch.
4. Girder Depth (overall): $\pm 1/4$ inch.
5. Flange Depth: $+ 1/4$, $- 1/8$ inch.
6. Strand Position: $\pm 1/4$ inch from center of gravity of the strand group and individual strands.
7. Longitudinal Position of Harping Points: ± 18 inches.
8. Bearing Recess (center recess to end beam): $\pm 1/4$ inch.
9. Beam Ends (deviation from square or designated skew)

- Horizontal: $\pm 1/2$ inch from web centerline to flange edge
 Vertical: $\pm 1/8$ inch per foot of beam depth.
10. Bearing Area Deviation from Plane (in length or width of bearing): 1/16 inch.
 11. Stirrup Reinforcing Spacing: ± 1 inch.
 12. Stirrup Projection from Top of Beam: $\pm 3/4$ inch.
 13. Mild Steel Concrete Cover: - 1/8 inch, + 3/8 inch.
 14. Offset at Form Joints (deviation from a straight line extending 5 feet on each side of joint): $\pm 1/4$ inch.
 15. Differential Camber Between Girders in a Span (measured in place at the job site)
 - a. For I-girders: 1/8 inch per 10 feet of beam length (series W42G, W50G, W58G, and W74G)
 - b. For bulb tee girders: Cambers shall be equalized by a method submitted to and reviewed by the Engineer when the difference in cambers between adjacent girders or stages measured at mid-span exceeds 1/4 inch.
 16. Position of Inserts for Structural Connections: $\pm 1/2$ inch.
 17. Position of Lifting Loops: ± 3 inches longitudinal, ± 1 inch transverse.
 18. Weld plates for bulb tee girders shall be placed $\pm 1/2$ inch longitudinal, and $\pm 1/8$ inch vertical.

6-02.3(25)K HORIZONTAL ALIGNMENT

The Contractor shall check and record the horizontal alignment of both top and bottom flanges of each girder upon removal from the casting bed. The Contractor shall also check and record the horizontal alignment within a two week period prior to shipment, but no less than three days prior to shipment. If the girder remains in storage for a period exceeding 120 days, the Contractor shall check and record the horizontal alignment at approximately 120 days. Each check shall be made by measuring the distance between each flange and a chord that extends the full length of the girder. The Contractor shall 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 shall be available for the Engineer's review and shall be included in the Contractor's Prestressed Concrete Certificate of Compliance.

Immediately after the girder is removed from the casting bed, neither flange shall be offset more than 1/8 inch for each 10 feet of girder length. During storage and prior to shipping, the offset (with girder ends plumb and upright and with no external force) shall not exceed 1/4 inch per 10 feet of girder length. Any girder within this tolerance may be shipped, but shall 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 permit the use of external force to correct girder alignment at the plant or at the Project Site if the Contractor submits to the Engineer for review stress calculations and a proposed procedure indicating the expected girder correction. If external force is permitted, it shall not be released until after the roadway slab has been placed and cured ten days.

The Engineer may reject any girder that does not meet the requirements of this Specification Section.

6-02.3(25)L GIRDER DEFLECTION

The Contractor shall check and record the vertical deflection (camber) of the girder upon removal of the girder from the casting bed. If the girder remains in storage for a period exceeding 120 days, the Contractor shall check and record the vertical deflection (camber) within a two week period prior to shipment, but no less than three days prior to shipment. The Contractor shall 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 shall be available for the Engineer's inspection, and in the case of girders older than 120 days, shall be transmitted to the Engineer as soon as practical for evaluation of the effect of long term storage on the "D" dimension. These records shall also be included in the Contractor's Prestressed Concrete Certificate of Compliance.

The "D" dimensions shown on the Drawings are computed girder deflections at midspan based on a time elapse of 120 days after release of the prestressing strands. A positive (+) "D" dimension indicates upward deflection.

The Contractor shall control the deflection of prestressed concrete girders that are to receive a cast-in-place slab by scheduling fabrication within 120 days of girder erection. If it is anticipated that the girders are to be older than 120 days at the time of erection, the Contractor shall submit calculations to the Engineer showing estimated girder deflection at midspan for the age anticipated for erection. This submittal shall also include the Contractor's proposal for accommodating any excess camber in the construction. The Contractor shall not proceed with girder fabrication until the submittal is reviewed and returned by the Engineer. The actual girder deflection at the midspan may vary from the "D" dimension at the time of 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 any additional Owner engineering expenses, in connection with accommodating excess girder deflection shall be at the Contractor's sole expense with no additional cost to the Owner.

6-02.3(25)M HANDLING AND STORAGE

Each girder shall be kept plumb and upright during handling and storage. It shall be lifted only by the lifting strands at either end. Series W42G, W50G and W58G girders can be lifted at an angle not to exceed 30 degrees to the vertical as measured in the longitudinal plane of the girder. All other prestressed girders shall be picked up vertically. Girders shall be braced laterally to prevent tipping or buckling as specified on the Drawings.

Before moving a long girder, the Contractor shall check it for any tendency to buckle. Each girder that may buckle shall be braced on the sides to prevent buckling. This bracing shall be attached securely to the top flange of the girder. The

lateral bracing shall be in place during all lifting or handling necessary for transportation from the manufacturing plant to the Project Site and erection of the girder. The Contractor is cautioned that for some delivery routes more conservative guidelines for lateral bracing may be required. The Contractor shall ensure all girders are fastened in-place before removing the bracing to cast diaphragms.

If the Contractor wishes to deviate from these handling and bracing requirements, the vertical pickup, or the pickup location, the proposed method shall be analyzed by the Contractor's engineer and submitted with the supporting calculations to the Engineer for review. The Contractor's analysis shall conform to Articles 5.2 and 5.3 of the P.C.I. Design Handbook, Precast and Prestressed Concrete, Third Edition, or other approved methods. The Contractor's calculations shall verify that the concrete stresses in the prestressed girder do not exceed those listed in Section 6-02.3(25)N. All costs associated with the Contractor's deviation shall be at no additional cost to the Owner.

If girders are to be stored, the Contractor shall place them on a stable foundation that keeps them in a vertical position. Stored girders shall be supported at the bearing recesses, or approximately 18 inches from the girder ends if there are no recesses. 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 shall have the proposed method analyzed by the Contractor's engineer to ensure against damaging the girder.

6-02.3(25)N SHIPPING

After the girder has reached its 28 day design strength, the Contractor shall obtain girder certification and then request the Engineer to accept the girder for approval to ship the girder. This approval will take the form of the Engineer stamping the girder "Approved for Shipment". To obtain girder certification, the fabricator shall present to the Engineer for inspection either:

- 1) a completed Manufacturer's Certificate of Compliance signed by a Prestressed Concrete Institute Certified Technician, certifying the girder complies with the Contract, or
- 2) certification from a professional engineer registered as a structural engineer in the State of Washington under Title 18 RCW who is acceptable to the Engineer, certifying the girder complies with the Contract.

If the Engineer finds the girder certification and the girder to be acceptable, the Engineer will stamp the girder "Approved for Shipment".

No prestressed girders shall be shipped that are not stamped "Approved for Shipment".

No bulb tee girder shall be shipped for at least seven days after concrete placement. No other girder shall be shipped for at least ten days after concrete placement.

Girder support during shipping shall meet these requirements unless otherwise specified in the Contract:

Type of Girder	Centerline Support Within This Distance From Either End
Series W42G and W50G, and all bulb tee girders	3 feet
Series W58G	4 feet
Series W74G	5 feet
Series W83G and W95G	8 feet

If the Contractor wishes to use other support locations, they shall be submitted to the Engineer for review. The Contractor's proposal shall comply with Section 6-02.3(25)M and shall include calculations showing concrete stresses in the girders shall not exceed the following:

Criteria for Checking Girder Stresses at the Time of Lifting or Transporting and Erecting

Stresses at both support and harping points shall be calculated based on the following:

1. Allowable compression stress, $f_c = 0.60 f'_{cm}$.
 - a. f'_{cm} = compressive strength at time of lifting or transporting verified by test but shall not 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 the square root of f'_{cm} .
 - b. With bonded reinforcement to resist total tension force in the concrete computed on the basis of an uncracked section = 7.5 times the square root of f'_{cm} . The allowable tensile stress in reinforcement is 30 ksi (ASSHTO M 31, Gr. 60).
3. Prestress losses
 - a. 1 day to 1 month = 20,000 psi
 - b. 1 month to 1 year = 35,000 psi
 - c. 1 year or more = 45,000 psi (max.)
4. Impact on dead load
 - a. Lifting from casting beds = 0%
 - b. Transporting and erecting = 20%

6-02.3(25)O PRESTRESS CONCRETE GIRDER ERECTION

The Contractor shall submit an erection plan to the Engineer for review. Before beginning to erect any prestressed concrete girders, the Contractor shall have received the Engineer reviewed erection plan and procedure submittal. The erection plan and procedure shall provide complete details of the erection process and methods 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, and lifting devices, spreaders, and angle of lifting cables in accordance with Section 6-02.3(25)M, etc.;
5. Crane(s) make and model, mass, geometry, lift capacity, outrigger size and reactions;
6. Girder launcher or trolley details and capacity (if intended for use); and
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 shall include Shop 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 shall also be included. The erection plan shall be prepared by a professional engineer in accordance with Section 1-05.3(12).

The Contractor shall submit the erection Shop Drawings, calculations, and procedure directly to the Engineer, in accordance with Section 6-02.3(16). After the Shop Drawings is reviewed and returned to the Contractor, all subsequent changes that the Contractor proposes to the Engineer reviewed and returned submittal shall be resubmitted to the Engineer for additional review. The resubmitted Shop Drawings shall clearly note the changes from the reviewed and returned Shop Drawings along with supporting calculations.

When prestressed girders arrive on the Project Site, the Engineer will confirm that they are stamped "Approved for Shipment" and that they have not been damaged in shipment before accepting them.

The concrete in piers and crossbeams shall reach at least 80 percent of design strength before girders are placed on them. The Contractor shall hoist girders only by the lifting strands at the ends, always keeping the girders plumb and upright.

Instead of the oak block wedges shown on the Drawings, the Contractor may use Douglas fir blocks if the grain is vertical.

Before the grout pads are placed, the receiving concrete shall be thoroughly cleaned, roughened, and wetted with water to ensure proper bonding. Grout pad requirements will be specified on the Drawings. Grout pads shall reach the specified strength before placing girders on them. The Materials Laboratory will determine grout compressive strength by fabricating cubes in accordance with WSDOT Test Method 813 and testing in accordance with AASHTO T 106. The Contractor shall provide the Engineer at least 2 Working Days advance notice.

The Contractor shall check the horizontal alignment of both the top and bottom flanges of each girder, as described in Section 6-02.3(25)K, before placing concrete in the bridge diaphragms.

The Contractor shall completely fill all block-out holes and restore any area damaged by the Contractor's operation to its original or better condition with an approved grout mix at no additional cost to the Owner.

6-02.3(25)P DECK BULB TEE GIRDER FLANGE CONNECTION

The Contractor shall submit a method of equalizing deck bulb tee girder deflections to the Engineer for review. This submittal shall be prepared by a professional engineer in accordance with Section 1-05.3(12) and shall be made a minimum of 60 days prior to field erection of the deck bulb tee girder. On deck bulb tee girders, girder camber shall be equalized utilizing the submitted and reviewed method before girders are weld-tied and before keyways are filled. Keyways between tee girders shall be filled flush with the surrounding surfaces with non-shrink grout. This non-shrink grout shall have a compressive strength of 4,000 psi before the equalizing equipment is removed. The SPU Materials Laboratory will determine grout compressive strength by fabricating cubes in accordance with WSDOT Test Method 813 and testing in accordance with AASHTO T 106. The Contractor shall provide the Engineer at least 2 Working Days advance notice.

Welding grounds shall be attached directly to the steel plates being welded when welding the weld-ties on bulb tee girders.

No construction equipment shall be placed on the Structure, other than equalizing equipment, until the girders have been weld-tied and the keyway grout has attained a compressive strength of 4,000 psi.

6-02.3(26) CAST-IN-PLACE PRESTRESSED CONCRETE**6-02.3(26)A GENERAL**

Cast-in-place prestressed concrete shall be Class 4000D, unless the Contract specifies otherwise. It shall be air-entrained, but shall not contain air-entraining cement.

The Contractor shall construct supporting falsework in a way that leaves the superstructure free to contract and lift off the falsework during post-tensioning. Forms that remain inside box girders to support the roadway slab shall, by design, resist girder contraction as little as possible.

Before tensioning, the Contractor shall remove all side forms from girders. From this point until 48 hours after grouting the tendons, the Contractor shall keep all construction and other live loads off the superstructure and shall keep the falsework supporting the superstructure in place.

Once the prestressing steel is installed, no welds or welding grounds shall be attached to metal forms, structural steel, or reinforcing bars of the structural member.

The Contractor shall 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 shall 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 shall be completed before sidewalks and barriers are placed.

6-02.3(26)B SHOP DRAWINGS

Before casting the structural elements, the Contractor shall submit for review, in accordance with Section 6-02.3(16), complete details of the method, materials, and equipment he proposes to use in the prestressing operations.

In addition, the Shop Drawings shall show:

1. The method and sequence of stressing;
2. Technical data on tendons and steel reinforcement, anchoring devices, anchoring stresses, types of tendon conduit, and all other data on prestressing operations;
3. Separate stress and elongation calculations shall be submitted for each tendon if the difference in tendon elongations exceeds 2 percent;
4. That tendons in the bridge shall 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; and
6. Procedures and lift-off forces at both ends of the tendon for performing a force verification lift-off in the event of discrepancies between measured and calculated elongations.

Review of these Shop Drawings will mean only that the Engineer considers them to show a reasonable approach in enough detail. Review will not indicate a check on dimensions.

Couplings or splices will not be permitted in prestressing strands. The Contractor shall submit sketches and calculations of couplings or splices in bar tendons for the Engineer's review.

Friction losses used to calculate forces of the post-tensioning steel shall 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 revise the assumed anchor set value provided all of the stress and force limits listed in Section 6-02.3(26)F are met.

The Contractor shall determine all points of interference between the mild steel reinforcement and the paths of the post-tensioning tendons. Details to resolve interferences shall be submitted with the Shop Drawings for review. Where reinforcing bar placement conflicts with post-tensioning tendon placement, the tendon profile shown on the Drawings shall be maintained. Mild steel reinforcement for post-tensioning anchorage zones shall not be fabricated until after the post-tensioning Shop Drawings have been reviewed by the Engineer.

The Contractor may deviate from the Engineer's reviewed Shop Drawings only after submitting a written request that describes the proposed changes and obtains the Engineer's written notice of review of the proposed changes. The Engineer's review of a change in method, material, or equipment shall not relieve the Contractor of any responsibility for successfully completing the work.

Before physical completion of the project, the Contractor shall provide the Engineer with reproducible originals of the Shop Drawings (and any Engineer reviewed changes). These shall be legible, clear, suitable for microfilming, and on permanent sheets of sizes specified in Section 1-05.3(10).

6-02.3(26)C ANCHORAGES

Post-tensioning reinforcement shall be secured at each end by means of an anchorage device which shall be of such a nature that it does not kink, neck down, or otherwise damage the post-tensioning reinforcement. The anchorage assembly shall be securely grouted.

The structure shall be reinforced with steel reinforcing bars in the vicinity of the anchorage device. This reinforcement is categorized into two zones. The first or local zone is the anchorage region that closely surrounds the specific anchorage device. The second or general zone is the portion of the anchorage region more remote from the anchorage device.

The steel reinforcing bars required locally for the concrete confinement immediately around the anchorage device (first or local zone) shall be calculated by the post-tensioning system Supplier and shall be shown in the Shop Drawings. The calculations shall be submitted with the Shop Drawings. The first or local zone steel reinforcing bars shall 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 second or general zone shall be as shown on the Drawings and are included in the appropriate Bid items.

The Contractor shall submit details, certified tests reports, and/or supporting calculations specified in the following, which verify the structural adequacy of the anchorage devices for review by the Engineer. This requirement does not apply where the anchorage devices have been previously approved by the Engineer for the same structure configuration. The Contractor shall also submit any necessary changes to the Contract. The test report shall specify all pertinent test data. Dead ended anchorages will not be permitted. Dead ended anchorages are defined as anchorages that cannot be accessed during the stressing operations.

The Contractor's proposed anchorage devices shall meet the requirements listed either in 1, bearing type anchorage, or 2, other anchorage assemblies, as follows:

1. **Bearing Type Anchorage:**
 - a. The computed average bearing stress on the concrete directly beneath bearing plates shall not exceed either of the following:
 - (1) At service load (after all losses)

$$f_{cp} = 0.6 f'_c (A'b/Ab)^{1/2}$$
 but not greater than $1.25 f'_c$.
 - (2) At jacking load (before seating)

$$f_{cp} = 0.8 f'_{ci} (A'b/Ab - 0.2)^{1/2}$$
 but not greater than $1.25 f'_{ci}$ for longitudinal tendons anchored in the webs and not greater than $1.00 f'_{ci}$ for transverse tendons anchored in the deck slab, where:
 - f_{cp} = permissible compressive concrete stress,
 - f'_c = compressive strength of concrete,
 - f'_{ci} = compressive strength of concrete at time of initial prestress,
 - $A'b$ = Maximum area of the portion of the concrete anchorage surface that is geometrically similar to and concentric with the area of the anchorage (excluding openings),
 - Ab = bearing area of the anchorage excluding openings.
 - b. For anchorages where $A'b$ and Ab are equal, and in transverse post-tensioning of roadway slabs, the bearing stress shall not exceed $0.9f'_c$ at jacking load (before seating) or 3000 psi at service load after all losses.
 - c. The computed bending stresses in the distribution plate induced by the pull of the prestressing steel shall not exceed 90 percent of the yield point of the material when 95 percent of the ultimate strength of the post-tensioning reinforcement is applied. The bending stresses in the distribution plate shall be computed in accordance with the procedure described in the article titled, "Simplified Bearing Plate Computations for Post-Tensioning Anchorages" published in the July-August 1975 edition of the PCI Journal. These calculations shall be submitted with the Shop Drawings for review.
 - d. Materials and workmanship shall conform to the applicable requirements of Sections 6-03 and 9-06.
2. **Other Anchorage Assemblies:**

Other anchorage assemblies shall be defined as any assembly that does not meet the requirements of item 1.a. above for bearing-type anchorages. The adequacy of other anchorage assemblies shall be demonstrated by tests representing actual job site conditions. The tests shall be certified and meet the following requirements:

 - a. The concrete test block shall have a cross-section equal to twice the minimum edge distance of center line of tendon to the face of concrete in the actual structure in one direction and equal to the minimum spacing of the anchorages plus 3 inches in the other direction. The length of the concrete test block shall be at least three times the largest cross-sectional dimension.
 - b. The reinforcement in the test block behind the anchorage for a distance equal to the largest of the two cross-sectional dimensions of the anchorage shall simulate the actual reinforcement used in the structure. For the remaining length of the test block, the reinforcement may be increased as required to prevent failure in that portion.
 - c. Concrete strength at the time of testing shall not exceed 85 percent of the minimum concrete strength at the time of post-tensioning as specified in the Contract. The concrete strength shall be determined in accordance with procedures outlined in ASTM C 1074, Estimating Concrete Strength by the Maturity Method.
 - d. The test shall be comprised of three anchorages separately tested or tested together in one test block.
 - e. Anchorages shall be Capable of developing 95 percent of the ultimate strength of the post-tensioning reinforcement without measurable permanent distortion of the assembly and without concrete failure in the test block. Measurable permanent distortion is defined as a distortion across the face of the assembly of 0.01 inch or more using the original plane as a reference and is measured after the test loading is released. Test blocks that comply with the following criteria shall be acceptable with regard to concrete failure:
 - (1) No concrete cracks with a load of 40 percent of the ultimate strength of the post-tensioning reinforcement.
 - (2) Width of concrete cracks with a test load of 70 percent of the ultimate strength of the post-tensioning reinforcement does not exceed 0.005 inch.
 - (3) After loading to 95 percent of the ultimate strength of the post-tensioning reinforcement and releasing the test load, the width of concrete cracks does not exceed 0.015 inch.
 - f. Materials and workmanship shall conform to the applicable requirements of Sections 6-03 and 9-06.

The Contractor shall submit a Manufacturer's Certificate of Compliance for the anchorage device in accordance with Section 1-06.3 before installing the anchorage device.

6-02.3(26)D METAL DUCTS

The Contractor shall encase each tendon in a galvanized, rigid, spiral, ferrous metal duct. This duct shall maintain the required profile within a placement tolerance of $\pm 1/4$ -inch for longitudinal tendons and $\pm 1/8$ -inch for transverse slab tendons, during all phases of the work. The conduit shall be completely sealed to keep out all mortar.

Each conduit shall be located to place the tendon at the center of gravity as indicated on the Drawings. To keep friction losses to a minimum, the Contractor shall install duct to the exact lines and grades shown on the Drawings. Once in place, the duct shall be tied firmly in position before they are covered with concrete. During concrete placement, the duct shall not be displaced or damaged.

The ends of the duct shall:

1. Permit free movement of anchorage devices, and
2. Remain covered after installation in the forms to keep out all water or debris.

The Contractor shall install vents at high points and drains at low points of the tendon profile and at other places as indicated on the Drawings. Vents and drains shall be 1/2-inch minimum diameter standard steel or polyethylene pipe. Vents shall point upward and remain closed until grouting begins. Drains shall point downward and remain open until grouting begins. Ends of steel vents and drains shall be removed to a depth of 1 inch inside the concrete surface after grouting has been completed. Polyethylene vents and drains may be left flush to the surface unless the Contract indicates otherwise. Duct vents are not required for transverse post-tensioning ducts in the roadway slab unless otherwise specified in the Contract.

Immediately after any concrete placement, the Contractor shall force blasts of oil-free, compressed air through the duct to break up and remove any concrete inside before it hardens. Before deck concrete is placed, the Contractor shall first verify that the ducts are unobstructed and contain nothing that could interfere with grouting or harm the tendons, and second, provide written verification to the Engineer before placing concrete that this inspection has taken place. If the tendons are in place, the Contractor shall show that they are free in the duct.

Ducts shall be kept free from water.

6-02.3(26)E PRESTRESSING REINFORCEMENT

All prestressing reinforcement shall comply with Section 9-07.10. They shall not be coupled or spliced. Tendon locations shown on the Drawings indicate final positions after stressing (unless the Contract specifies otherwise). No tendon made of 7-wire strands shall contain more than 31 strands of 1/2-inch diameter, or more than 22 strands of 0.6-inch diameter.

From the time prestressing reinforcement is made until it is grouted or encased in concrete, the Contractor shall protect it from contaminants including but not limited to dirt, grease, rust, corrosives, and any physical damage. The Engineer will reject prestressing reinforcement that is damaged or contaminated. If the prestressing reinforcement is not to be stressed and grouted within 10 calendar days after it is placed in the conduits, the Contractor shall place an approved corrosion inhibitor in the conduits.

The feeding ends of the strands shall be equipped with a bullet nosing or similar apparatus to facilitate strand installation.

6-02.3(26)F TENSIONING

The Contractor shall not begin to tension the tendons until:

1. All concrete has reached a minimum compressive strength of 4,000 psi or the strength indicated in the Contract as demonstrated on test cylinders made of the same concrete and cured under the same conditions as that in the bridge; and
2. The strands and ducts comply with specified requirements.

Tendons shall be tensioned to the values shown in the Contract using hydraulic jacks unless the Shop Drawings clearly indicate a different tension value with explanation and supporting calculations for the Engineer's Shop Drawing review. When stressing from both ends of a tendon is specified, it need not be simultaneous unless indicated otherwise in the Contract. The jacking sequence shall comply with the reviewed Shop Drawings.

Each jack shall have a pressure gauge that indicates the load applied to the tendon. The gauge shall display pressure accurately and readably with a dial at least 6 inches in diameter or with a digital display. Each jack and its gauge shall be calibrated as a unit and shall be accompanied by a certified calibration chart. The calibration and certification shall be obtained from an AASHTO certified testing laboratory acceptable to the Engineer. The Contractor shall provide one copy of this chart to the Engineer for use in monitoring. The cylinder extension during calibration shall be in approximately the position it is to occupy at final jacking force.

All jacks and gauges shall 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 Contract specifies other limits:

- | | | |
|----|--|---|
| 1) | Maximum service load after all losses: | 80 percent of the specified yield stress of the steel. |
| 2) | Maximum tensile strength during jacking: | 79 percent of the specified minimum ultimate tensile strength of the steel. |
| 3) | Maximum initial stress at anchoring after seating: | 70 percent of the specified minimum ultimate |

tensile strength of the steel.

Tendons shall be anchored at initial stresses that ultimately maintain service loads at least as great as indicated on the Drawings.

As tensioning proceeds, in the presence of the Engineer the Contractor shall record the applied load, tendon elongation, and anchorage seating values.

As stated in Section 6-02.3(26)B, the assumed design friction coefficient “ μ ” and wobble coefficient “ k ” specified in the Contract shall be used to calculate the stressing elongation. These coefficients may be revised by the post-tensioning Supplier by the following method provided the Contractor submits this revision in advance to the Engineer for review:

- (1) Before fabrication and in the presence of the Engineer, the post-tensioning Supplier shall test, in place, two representative tendons of each size and type shown on the Drawings, for the purpose of accurately determining the friction loss in the strand and/or bar tendon.
- (2) The test procedure shall consist of stressing the tendon at an anchor assembly with load cells at the dead end and jacking end. The test specimen shall be tensioned to 79 percent of ultimate strength in ten increments. For each increment, the gauge pressure, elongation, and load cell force shall be recorded and the data furnished to the Engineer. The theoretical elongations and post-tensioning forces shown on the post-tensioning Shop Drawings shall be re-evaluated by the post-tensioning Supplier using the results of the tests and corrected as necessary. Revisions to the theoretical elongations shall be submitted to the Engineer for evaluation and review. Details of the apparatus and methods used to perform the tests shall be proposed by the post-tensioning Supplier and shall be submitted through the Contractor to the Engineer.

As tensioning proceeds and in the presence of the Engineer, the Contractor shall record the applied load, tendon elongation, and anchorage seating values.

Elongation measurements shall 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 submitted and reviewed calculated elongation, the stressed tendon represented by the elongation measurements is acceptable to the Engineer.

In the event discrepancies greater than 7 percent exist between the measured and calculated elongations, the jack calibration shall 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 shall be performed to verify the force in the tendon. The post-tensioning Supplier force verification lift-off procedure shall provide access for visual verification of anchor plate lift-off. The jacking equipment shall 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 submitted and reviewed calculated force nor more than 70 percent of the specified minimum ultimate tensile strength of the prestressing steel unless the Contract specifies otherwise.

Elongation measurements shall 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 submitted and reviewed calculated force unless the Contract specifies otherwise.

When removing the jacks, the Contractor shall relieve stresses gradually before cutting the prestressing reinforcement. The prestressing strands shall be cut a minimum of 1 inch from the face of the anchorage device.

6-02.3(26)G GROUTING

After tensioning the tendons, the Contractor shall again blow oil-free, compressed air through each duct. All drains shall then be closed and the vents opened. After completely filling the duct with grout, the Contractor shall 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 shall not exceed 100 psig. Grout shall be continuously wasted through the vent until no more air or water pockets show. At this point, all vents shall 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 shall be held between 50 and 75 psig for at least 10 seconds. The Contractor shall leave all plugs, caps, and valves in place and closed for at least 24 hours after grouting.

Grouting equipment shall:

1. Include a pressure gauge with an upper end readout in the range of 275 to 325 psig;
2. Screen the grout before it enters the pump with an easily reached screen that has clear openings of no more than 0.125 inches;
3. Be gravity fed from an attached, overhead hopper kept partly full during pumping; and
4. Be able to complete the largest tendon on the project in no more than 20 minutes of continuous grouting.

In addition, the Contractor shall take steps necessary to ensure a continuous, one-way flow of grout is maintained. These steps may include but are not limited to having standby equipment able to pump at 250 psig, having a separate power source, and being readily available for flushing when the regular equipment cannot maintain a one-way flow of grout.

The grout shall consist of Portland cement, water, and a water reducing admixture and shall be mixed in the following proportions:

Portland Cement Type II	1 Sack
Water	4.5 Gallons Maximum
Water Reducing Admixture	Manufacturer's Recommendation
Fly Ash (Optional)	20 Pounds Maximum

The water reducing admixture shall be limited to AASHTO M 194, Type A or Type D, and shall not contain ingredients that may corrode steel, such as chlorides, fluorides, sulfates, or nitrates. Fly ash may be used at the option of the Contractor.

The Contractor shall proportion the mix to produce a grout with a minimum flow time of 15 seconds to a maximum flow time of 20 seconds as determined by ASTM C 939, Flow of Grout for Preplaced Aggregate Concrete (Flow Cone Method).

The grout mix shall be injected within 30 minutes after the water is added to the cement. The Contractor shall take steps to ensure the temperature of the surrounding concrete is maintained at least 35°F from the time the grout injecting begins until at least 2 of the 2 inch cube samples of the grout indicates a compressive strength of 800 psi. Cubes shall be samples in accordance with WSDOT Test Method 813 and stored in accordance with method 2 of WSDOT Test Method 809. If the surrounding concrete temperature may fall below 35°F, the Contractor shall be prepared to provide a heat source and protective covering to maintain the temperature of the surrounding concrete above 35°F. Grout temperature shall 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 shall 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.

6-02.3(27) CONCRETE FOR PRECAST UNITS

Precast units shall 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 in accordance with ASTM C 805.

Precast units shall 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 shall be made, handled, and stored in accordance with Field Operating Procedure for AASHTO T 23, Method 2, and compression tested in accordance with AASHTO T 22 and AASHTO T 231.

6-02.3(28) PRECAST CONCRETE PANELS

6-02.3(28)A GENERAL

The Contractor shall perform quality control inspection. The manufacturing plant for precast concrete units shall be certified by the Precast/Prestressed Concrete Institute's (P/PCI) Plant Certification Program for the type of precast member to be produced. Proof of plant certification by P/PCI shall be submitted along with the Shop Drawings by the Contractor to the Engineer. Products that 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.

Prior to the start of production of the precast concrete units, the Contractor shall give the Engineer advance notice of the production schedule. The Contractor shall give the Inspector safe and free access to the work. If the Inspector observes any nonspecification work or unacceptable quality control practices, the Inspector will inform the plant manager. If the corrective action is not acceptable to the Engineer, the unit(s) will be rejected.

The Engineer intends to perform Quality Assurance inspection. By its inspection, the Engineer intends only to facilitate the work and verify the quality of that work. This inspection shall not relieve the Contractor of any responsibility for identifying and replacing defective material and workmanship.

If products are prestressed, all prestressing materials and methods shall be in accordance with Section 6-02.3(25).

6-02.3(28)B SHOP DRAWINGS

The Contractor shall submit Shop Drawings of Precast/Prestressed Panels as specified in Section 1-05.3(10).

Shop Drawings shall show complete details of the methods, materials, and equipment the Contractor proposes to use in prestressing/precasting work. The Shop Drawings shall follow the design conditions shown on the Drawings unless variations are submitted and reviewed by the Engineer.

The Shop Drawings shall contain as a minimum:

1. Unit shapes (elevations and sections), and dimensions;
2. Finishes and method of constructing the finish (i.e., forming, rolling, etc.);
3. Reinforcing, joint and connection details;
4. Lifting, bracing and erection inserts;
5. Locations and details of hardware attached to the structure; and
6. Relationship to adjacent material.

The Contractor may deviate from the submitted and reviewed Shop Drawings only after obtaining the Engineer's review of a written notice that describes the proposed changes to the prior reviewed Shop Drawings.

Before physical completion can be established, the Contractor shall provide the Engineer with reproducible originals of the Shop Drawings (and any changes which were submitted to the Engineer for review). These shall be clear, suitable for microfilming, and on permanent sheets of sizes specified in Section 1-05.3(10).

6-02.3(28)C CASTING

The Contractor and Fabrication Inspector shall have in their possession, an Engineer reviewed set of Shop Drawings before casting precast concrete units.

Precast units shall not be removed from forms until the concrete has attained a minimum compressive strength of 70 percent of the specified design strength.

Forms may be either steel or plywood faced provided they impart the required finish to the concrete.

6-02.3(28)D CURING

Concrete in the precast units shall be cured by either moist or accelerated curing methods. The method to be used shall be preapproved in the annual WSDOT plant certification process.

1. For moist curing, the surface of the concrete shall be kept covered or moist until such time as the compressive strength of the concrete reaches the strength specified for stripping. Exposed surfaces shall be kept continually moist by fogging, spraying or covering with moist burlap or cotton mats. Moist curing shall commence as soon as possible following completion of surface finishing.
2. For accelerated curing, heat shall 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 two hours after placing the concrete, and then increase the temperature at a rate not to exceed 25°F per hour to a maximum of 175°F. After curing is complete, cool the concrete at a rate not to exceed 25°F per hour to 100°F. Maintain the concrete temperature above 60°F until the unit reaches stripping strength.

Concrete temperature shall be monitored by means of a thermocouple embedded in the concrete (linked with a thermometer accurate to ± 5 F°). The recording sensor (accurate to ± 5 F°) shall be arranged and calibrated to continuously record, date, and identify concrete temperature throughout the heating cycle. This temperature record shall be made available to the Engineer and become a part of the documentation required.

The Contractor shall never allow dry heat to make direct contact with exposed concrete surfaces at any point.

6-02.3(28)E CONTRACTORS CONTROL STRENGTH

The concrete strength at stripping shall be determined by testing cylinders made from the same concrete as the precast units. The cylinders shall be made, handled, and stored in accordance with Field Operating Procedure AASHTO T 23, Method 2, and compression tested in accordance with AASHTO T 22 and AASHTO T 231.

For accelerated cure units, concrete strength shall be measured on test cylinders cast from the same concrete as that in the unit. These cylinders shall be cured under time-temperature relationships and conditions that simulate those of the unit. If the forms are heated by steam or hot air, test cylinders shall remain in the coolest zone throughout curing. If forms are heated another way, the Contractor shall provide a record of the curing time-temperature relationship for the cylinders for each unit to the Engineer. When two or more units are cast in a continuous line and in a continuous pour, a single set of test cylinders may represent all units provided the Contractor demonstrates acceptable uniformity of casting and curing to the Engineer.

The Contractor shall mold, cure, and test enough of these cylinders to comply with specification requirements for measuring concrete strength. The Contractor may use 4-inch by 8-inch or 6-inch by 12-inch cylinders. The required design strength shall be increased 5 percent when using 4-inch by 8-inch cylinders. This 5 percent increase shall not be applied for the determination of the stripping strength. The Contractor shall let cylinders cool for at least one-half hour before testing for release strength.

Test cylinders may be cured in a moist room or water tank in accordance with AASHTO T 23 after the unit concrete has obtained the required release strength. If, however, the Contractor intends to ship the unit prior to the standard 28-day strength test, the design strength for shipping shall be determined from cylinders placed with the unit and cured under the same conditions as the unit. These cylinders may be placed in a noninsulated, moisture-proof envelope.

To measure concrete strength in the precast unit, the Contractor shall randomly select two test cylinders and average their compressive strengths. The compressive strength in either cylinder shall not fall more than 5 percent below the specified strength. If these two cylinders do not pass the test, two other cylinders shall be selected and tested.

6-02.3(28)F FINISHING

The Contractor shall 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)G TOLERANCES

The units shall be fabricated as shown in the Contract, and shall meet the dimensional tolerances listed in P/PCI MNL-116-85, unless otherwise indicated in the Contract.

6-02.3(28)H HANDLING AND STORAGE

The Contractor shall lift all units only by adequate devices at locations designated on the Shop Drawings. Section 6-02.3(25)M shall apply when these devices and locations are not shown on the Drawings.

Precast unit shall be stored off the ground on foundations suitable to prevent differential settlement or twisting of the units. Stacked units shall be separated by dunnage of uniform thickness Capable of supporting the units. Dunnage shall be arranged in vertical planes. The upper units of a stacked tier shall not be used as storage areas for shorter units unless substantiated by engineering analysis and submitted to the Engineer for review.

6-02.3(28)I SHIPPING

Precast units shall not be shipped until the concrete has reached the design strength specified in the Contract. The units shall be supported in such a manner that they shall not be damaged by anticipated impact on their dead load during shipment. Tie chains and cables shall be padded to prevent chipping or spalling of the concrete.

6-02.3(28)J ERECTION

When the precast units arrive on the Project Site, the Engineer will confirm that they are stamped "Approved for Shipment". The Engineer will inspect the units for damage before accepting them.

The Contractor shall lift all units by suitable devices at locations designated on the Shop Drawings. Temporary shoring or bracing shall be provided, if necessary. Units shall be properly aligned and leveled as required by the Drawings. Variations between adjacent units shall be leveled out by a method submitted to and reviewed by the Engineer.

6-02.3(29) DOWNSPOUTS

The Contractor shall furnish and install standard weight steel pipe downspouts no less than 6 inch inside diameter at the locations shown and as detailed in the Contract.

The downspouts shall be full length pipe sections in all straight runs. The Contractor may propose types of couplings and fittings other than grooved couplings and fittings, provided they are equal performance and are included in the submittal specified in the last paragraph of this Section.

The portion of downspouts and/or drain pipe constructed within concrete shall be fully encased in a sponge rubber compound 1/2 inch thick and meeting the requirements of ASTM D 1752, Type No. 1, except the color requirement is waived.

All pipe bends, whether encased in concrete or not, shall have a bend radius of not less than 4 feet. All straight run pipe shall have a minimum slope of 10%. The Contractor shall verify all downspout lengths by field measurements prior to fabrication and shall determine the exact lengths of pipe and the hangers required for each bridge drain location.

The Contractor shall submit to the Engineer for approval at least 5 Working Days in advance of this work, Shop Drawings showing each downspout pipe layout including size of pipe(s), spacing and type of pipe hangers and concrete inserts, radius of bends, details of pipe connections including connection to receiving pipe or drainage Structure, slopes of straight run pipe, and connection to bridge drain details.

See Section 6-02.3(36) regarding bridge drains and clean outs.

6-02.3(30) DRILLING HOLES IN CONCRETE

The Contractor shall drill holes in the existing concrete facilities as located on the Drawings. The diameter of the hole shall be sized as recommended by the manufacturer of the bonding agent used for anchoring a new member in that hole.

The Contractor shall submit to the Engineer for approval, the bonding agent manufacturer's name, and recommendations for the bonding agent, instructions for use, recommended hole size for size bar to be epoxied, the method of drilling the hole, controls to prevent drilling beyond required penetration, and such other information as necessary at least 5 Working Days in advance of this work. If the bonding agent manufacturer has no recommended hole diameter for each diameter bar or rod, the manufacturer shall include a statement in the submittal certifying that the bonding agent bonds the bars or rods to the required hole diameters recommended as follows:

Diameter of Bar or Rod	Hole Diameter Required
Diameter Holes for #18 Bars	2-1/2"
Diameter Holes for #14 Bars	2"
Diameter Holes for #11 Bars	1-5/8"
Diameter Holes for #10 Bars	1-1/2"
Diameter Holes for # 9 Bars	1-3/8"
Diameter Holes for # 8 Bars	1-1/4"
Diameter Holes for # 7 Bars	1-1/8"
Diameter Holes for # 6 Bars	1"
Diameter Holes for # 5 Bars	3/4"
Diameter Holes for # 4 Bars	5/8"
Diameter Holes for # 3 Bars	1/2"
For threaded rod	1/4" larger than the outside diameter of the rod.

The holes to be drilled in the existing concrete shall be drilled with equipment that shall not fracture or damage the existing concrete which is to remain, or fracture the aggregate that surrounds the hole. Jackhammers shall not be used to drill holes. The method used to drill the holes shall provide a fracture free surface in which to epoxy bond the bars and/or threaded rods. The hole shall be roughened and cleaned prior to bonding bar or rod.

The Contractor shall not begin hole drilling operations until the method submitted is approved by the Engineer. Prior to drilling the hole, the Contractor shall locate reinforcement by a non destructive testing method. If existing steel reinforcing is hit during drilling, the drilling shall be immediately stopped and the Engineer shall be immediately notified. The rejected hole shall be cleaned and then filled completely with non-shrink grout per Section 9-04.3(2). After again locating reinforcement as described immediately above, a new hole shall be drilled adjacent to the rejected hole.

6-02.3(31) EPOXY IN DRILLED HOLES

Reinforcing bars or threaded rods shall be secured in holes drilled into existing concrete where indicated on the Drawings using a high strength, creep resistant epoxy resin meeting the requirements of Section 9-26. The epoxy system shall meet the requirements of ASTM C 881, Type 4, or approved equal performance. For products other than epoxy resins,

the Contractor shall submit a Manufacturer's Certificate of Compliance including a test report from an independent testing laboratory, which complies with the requirements of ASTM E 1595, verifying that the application temperature range, cure time, heat deflection temperature (ASTM D 648), and slant shear strength (AASHTO T 237) are equal to or better than the above specified epoxy resin systems.

The Contractor shall place the reinforcing steel and/or threaded rods in existing concrete in the following manner:

1. Core drilled or other smooth surface holes shall be sandblasted full depth to roughen sides of hole;
2. Sandblast the section of reinforcing steel and/or threaded rod scheduled to be embedded in the existing concrete to white metal;
3. All holes shall be thoroughly cleaned and prepared in accordance with the epoxy manufacturer's instructions. If compressed air is used, the air shall be filtered to prevent oil or other contamination from entering the hole adversely impacting bonding;
4. Place the epoxy in the drilled hole in accordance with the manufacturer's instructions;
5. Clean the reinforcing bar and/or threaded rod in accordance with the manufacturer's instructions; and
6. Insert the reinforcing bar and/or threaded rod into the drilled hole. In the horizontal drilled holes, caulk the annular space between the entrance of the hole and the bar and/or threaded rod with lead wool or approved equal.

NOTE: For factory coated epoxy bars, item 2 immediately above shall be omitted.

6-02.3(32) REPAIR OF SPALLED AND DELAMINATED CONCRETE

6-02.3(32)A DESCRIPTION

This work shall consist of cleaning and repairing loose, spalled, and delaminated concrete at locations indicated on the Drawings and in accordance with the following subsections.

6-02.3(32)B CLEANING AND PREPARATION

The Contractor shall remove all loose, defective and delaminated concrete by chipping or with high pressure water jets. All cracks and cavities shall be chipped so that their sides are approximately perpendicular to the exposed surface and form a mechanical shoulder at least 1/2-inch in depth. The final depth of concrete removal shall be as indicated in the Contract. In addition to chipping, all concrete to be repaired shall be cleaned of all dirt, grease, oil, moss, scale, rust, and loose particles.

Care shall be taken in removing concrete to prevent overbreakage. Concrete shall be carefully broken away from reinforcing bars where applicable, to prevent damage to steel reinforcement.

6-02.3(32)C REPAIRS

Two proposed methods of repairing concrete are available to the Contractor:

1. Hand placed sand and cement grout with approved epoxy bonding agent; and
2. Quick-set concrete.

Hand placed sand and cement grout shall be used only on the smaller spalled areas with a depth of 1/2-inch or less. All repairs shall be finished to the original size and contour of the member being repaired.

Spall depths over 1-inch shall be reinforced with 4 X 4 WO.5. welded wire fabric secured to the existing concrete with 1/4-inch tie wire anchors and 16 gauge wire ties. Welded wire fabric shall have a minimum 1/2-inch cover, preferably 3/4-inch. Location, spacing and type of anchor shall be sufficient to permanently retain the concrete patch in-place.

6-02.3(33) EPOXY INJECTION OF CONCRETE CRACK

6-02.3(33)A GENERAL

Cracks in existing concrete shall be repaired by epoxy injection where indicated on the Drawings in accordance with the following Specifications.

The Contractor shall submit the epoxy manufacturer's recommended instructions for the step by step total epoxy injection process including but not limited to crack preparation; preliminary surface sealing; entry port insertion and spacing detail; epoxy injection process including how identify "the crack is filled"; sequencing and timing of injections; curing requirements; the epoxy applicator's qualifications including at least 2 recent projects with dates, locations, owner contacts and the contact's telephone number for successful epoxy resin repairs on concrete structures; a Manufacturer's Certificate of Compliance and certified laboratory test reports of the epoxy crack repair results; any necessary requirements related to initial set and obtaining design strength; and any other descriptive information about the complete process to the Engineer for approval at least 10 Working Days prior to performing this work.

The material used as a surface seal shall have adequate strength and adhesion to hold injection ports firmly in place and to resist injection pressures adequately to prevent leakage during injection.

The epoxy resin system for crack injection shall be a Type I, Grade 1 system conforming to ASTM C881 except for the following requirements:

Gel Time ¹	20 Minutes Minimum
Viscosity	700 Centipoise Maximum
Shrinkage	Not Required
Heat Deflection Temperature	130 °F. Minimum

¹Gel time shall not apply if continuous flow nozzle mixing injection equipment is used.

The injection equipment shall have the Capability of discharging the mixed adhesive at pressures indicated in the manufacturer's application instructions.

6-02.3(33)B GUIDELINES

Epoxy injection repair of concrete cracks over 0.006 inch wide, as designated and marked by the Engineer, shall include as a minimum:

1. Before repair work begins, cracks shall be prepared to accept epoxy in accordance with the epoxy manufacturer's instructions;
2. Entry ports shall be provided, placed, and spaced in the crack in accordance with the epoxy manufacturer's instructions;
3. Unless required otherwise by the epoxy manufacturer's written instructions, prior to injection of the crack, the surface sealing system shall be applied to the face of the crack and areas around entry ports to attain a seal Capable of withstanding the applied injection pressures. For through cracks, the surface seal shall be applied to all accessible faces;
4. Unless required otherwise by the epoxy manufacturer's written instructions, the surface seal shall be allowed to gain adequate strength before proceeding with the injection. However, prior to epoxy injection, the crack should be air injected to determine if the crack is Capable of epoxy injection (air detected coming out of adjacent ports means that the crack can be injected). If the crack is not Capable of being injected, the entry port should be temporarily abandoned and procedure repeated at adjacent ports. At a later time, previously non-injectable cracks should be given a second air injection test;
5. Unless required otherwise by the epoxy manufacturer's written instructions, the injection of the adhesive into each crack shall begin at the entry port at the lowest elevation. Injection of deck cracks shall be done from the top side; through cracks may require sealing the crack on the bottom surface. Injection shall continue at the first port until the injection adhesive begins to flow out of the port at the next higher elevation. The first port shall be plugged and injection started at the second port until adhesive flows from the next port. The entire crack shall be injected with the same sequence. If port to port travel of epoxy adhesive is not indicated, the work shall immediately be stopped and the Engineer notified. On wide cracks where resin travel between ports is expected to be rapid, two or more ports may be pumped simultaneously. On exceptionally large cracks, a formulation (dependent upon crack width, ambient temperature, modulus requirements and other variables) of epoxy resin and fine sands shall be used as recommended by the epoxy manufacturer and approved by the Engineer;
6. After the injection adhesive has cured, the surface seal shall be removed. The face of the crack shall be finished flush with the adjacent concrete. There shall be no indentations or protrusions caused by placement of entry ports;
7. Supervision of this process by the manufacturer's representative shall be required until the Contractor is familiar with the products and the operations; and
8. The Engineer may evaluate the crack repair by requiring a core or cores of the repaired crack be taken at locations designated by the Engineer and evaluating the cores as specified in the following paragraph.

The Contractor shall obtain three core samples in the first 100 linear feet of crack repaired and one core sample for each 100 linear feet thereafter at no additional cost to the Owner. The core diameter shall be no less than 2 inches. The core length shall be for the full crack depth and taken from locations selected by the Engineer. If less than 90% of the visible crack is filled with epoxy adhesive, the crack from which the cores were taken shall be deemed not to have been repaired in accordance with this Specification and no payment will be made until acceptable repairs are completed by the Contractor. The Contractor shall re-inject the crack, and the repair will again be subject to the approval of the Engineer. Cores determined by the Engineer to be at least 90% filled, shall be trimmed square to a length to diameter ratio of 2 to 1. When tested in compression to failure. If failure does not occur along the repaired crack, the crack repair shall be considered acceptable.

Upon acceptance of the repair by the Engineer, the Contractor shall fill the core holes using an epoxy bonding agent and Portland cement mortar ($f'_c = 4,000$ psi minimum) and finish the surface smooth with the adjacent concrete.

6-02.3(34) REMOVAL OF CONCRETE / BONDING NEW CONCRETE TO EXISTING CONCRETE

6-02.3(34)A REMOVAL OF CONCRETE - GENERAL

The Contractor shall remove existing concrete as noted, and to the limits indicated, on the Drawings. The Contractor shall submit to the Engineer for review, a demolition plan with working Shop Drawings showing the method of removing portions of the existing concrete structure. The Contractor shall demonstrate to the Engineer that the method and equipment for removing portions of existing concrete are adequate for the intended purpose and provide acceptable results. The removal shall not begin until authorized in writing by the Engineer. Explosives shall not be used in the demolition.

Exposed reinforcing steel shall be cut a minimum of one (1) inch behind the final surface. The void left by removal of the reinforcing steel shall be coated with an approved epoxy resin. Care shall be taken in removing concrete to prevent

overbreakage or damage to portions of the existing structure which are to remain. Any damage, due to the Contractor's operations, to the existing structure which is to remain shall be repaired by the Contractor, as approved by the Engineer, at no additional cost to the Owner.

Loose particles, dust, dirt, oil, moss, and other deleterious material shall be removed. The remaining concrete surface shall be acceptable for one or both of the following finishes as indicated in the Contract.

6-02.3(34)A1 CONCRETE REMOVAL WITHOUT REPLACEMENT

The remaining concrete surface shall be patched with grout to a smooth finished surface. The grout shall consist of cement and fine aggregate mixed in the proportions to match the existing work as nearly as practicable. The Contractor shall submit to the Engineer at least 10 Working Days in advance of this work, a grout mixture including admixture if recommended by the grout manufacturer, bonding agent as necessary, and bonding agent manufacturer's final concrete surface preparation indicating the finished surface material provides a strong bond with existing concrete and is durable.

6-02.3(34)A2 BONDING NEW CONCRETE TO EXISTING CONCRETE

Unless the concrete bonding manufacturer's recommended preparation procedure states otherwise, the existing concrete surface shall be prepared as necessary in accordance with the general removal requirements specified above. The concrete surface to which new concrete is to be bonded shall have a rough and jagged texture. Unless indicated otherwise in the Contract, the minimum amplitude of concrete roughening shall be 1/4 inch as defined in ACI "Concrete Repair Basics" Course Manual SCM-24(91). This texture will be measured under a straight board four (4) foot in length where surface peaks to adjacent valleys shall average 1/4 inch depth minimum displacement along the board's length. The Contractor shall make every reasonable effort to obtain valleys not exceeding 1/2 inch maximum from the original surface and peaks not greater than 1/8 inch from the original surface. Each peak shall be jagged. Along the four foot board length, the number of peaks shall be a minimum 30, and the number of valleys shall be a minimum 30. At each test location, the Engineer will place the board in three (3) directions to verify roughness.

Steel reinforcing bars, extending from the existing concrete surface which are to remain as indicated on the Drawings, shall be carefully cleaned of all existing concrete, oil, rust, scale, and other deleterious material. New reinforcing steel shall be spliced to the existing bar unless otherwise specified in the Contract.

The Contractor shall submit to the Engineer at least 10 Working Days in advance of this work, a concrete bonding agent suitable for the conditions anticipated including time to place concrete forms, a surface preparation procedure if different, and a Manufacturer's Certificate of Compliance stating the bonding agent manufacturer's recommended procedure produces an acceptable bond between new concrete and existing concrete.

6-02.3(35) SUPERSTRUCTURE

The superstructure for bridges shall include the following materials (except those noted in the following) above the top of the cross beams or pedestals as the case may be, and between the abutment expansion joints, including concrete Class 4000, reinforcing steel, prestressed concrete girders, deck slab, diaphragms, sidewalks, curb/parapets, earthquake restrainers, railing anchorage, concrete for precast and prestressed components, prestressing steel, expansion joints, inserts, compression seals, elastomeric pads and bridge drains with reducers.

Exceptions: Items excluded under "superstructure" are the following:

1. Metal traffic and pedestrian railings and posts;
2. Steel bridge bearings;
3. Girders;
4. Downspouts;
5. Painting;
6. Light poles (standards) luminaires and other electrical-related items specified elsewhere herein; and
7. Electrical conduit/expansion fittings, junction boxes and condulets.

6-02.3(36) BRIDGE DRAINS

The Contractor shall furnish and install bridge drains of the type specified on Standard Plan no. 290, unless the Contract specifies otherwise. Bridge drains shall be located and installed as shown on the Drawings. Downspout pipe weld connected to bridge drains shall be a minimum inside diameter of 6 inch and all bends shall have a radius not less than 4 feet.

Bridge drains shall be furnished with vaned grates as shown in Standard Plan no. 265. The grate cover shall be fitted to the casting and shall be ground to rest evenly and without rocking on the frame.

When the Contract requires clean outs, they shall be of the size and type specified, and shall be installed as indicated at the specified locations.

Standard weight galvanized steel pipe shall be shop welded to the bridge drain casting. Galvanizing of the pipe shall be in accordance with ASTM A 53, "Black and Hot-Dipped Zinc-Coated Welded and Seamless Steel Pipe for Ordinary Uses". Galvanizing the pipe shall be done after all pipe fabrication including but not limited to cutting to length, grooving, or threading.

After welding, the drain castings and grating covers shall be coated inside and outside with an asphaltic base, black dipping paint. This asphaltic coating shall extend over that portion of the galvanized steel pipe adjacent to the casting far enough to cover the welds.

The Contractor shall submit to the Engineer at least 5 Working Days in advance of this work, a Shop Drawing with product information of the casting, grate, pipe connection, pipe diameter(s) and bend radii as applicable, and asphaltic base black dipping paint. When clean outs are indicated in the Contract, the submittal shall also include information on the clean out(s) such as size, location, installation features, pipe layout, and details of connection to bridge drain or downspout.

See Section 6-02.3(29) regarding downspouts.

6-02.3(37) ELECTRICAL CONDUIT AS-BUILT DRAWINGS

For electrical conduit runs to be confined within concrete Structures such as floor slabs, retaining walls, abutments, or bridge superstructures, the Contractor shall provide as-built drawings of the conduits at least 5 Working Days prior to placing concrete. See Section 8-33.3(2)A.

6-02.4 MEASUREMENT

Bid items of work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Concrete (Class) (Designation)" will be by the cubic yard in place. Measurements will be to the neat lines of the Structure as shown in the Contract with the exception of concrete in cofferdam seals. No measurement will be made for concrete below the established elevation of the bottom of the footing or seal. No deduction will be made for pile heads, reinforcing steel, structural steel, bolts, weep holes, rustications, chamfers, edgers, bridge drains, joint filler, junction boxes, miscellaneous hardware, and for conduit and drain pipe less than 6 inches diameter.

Concrete, when used in the seals of underwater cofferdams, will be paid for on the basis of the actual volume deposited as determined by the average cross-sectional area of the inside of the cofferdam except that no measurement will be made for the volume so determined which is outside of an area bounded by vertical planes 1 foot outside of the neat lines of the seal. The limiting vertical planes shall be parallel to the location of the neat lines based upon the traverse and longitudinal centerlines of the seal as shown on the Drawings.

Measurement for "Steel Reinforcing Bar, (Grade)" will be by the pound in place as calculated from the Drawings, unless the Contract indicates otherwise. No allowance will be made for spreaders, form blocks, wire clips or other fastenings, which shall be furnished by the Contractor. When splices are made other than those shown on the Drawings, no allowance will be made for the extra steel required. When shear steel is required at construction joints which are not shown on the Drawings, and which are permitted for the Contractor's convenience, no allowance will be made for the additional steel required.

Measurement for "Steel Reinforcing Bar, (Grade), Epoxy Coated" will be by the pound before epoxy coating is applied, as set forth in the paragraph immediately above for uncoated steel reinforcing bars.

Measurement for "Wire Mesh, (Gage), (Mesh Size)" will be by the square yard for the area covered as calculated from the Drawings. No measurement will be made for required overlap of mesh.

Measurement for "Expansion Joint (Type)" or "Compression Seal (Type)" will not be made at or between the abutment expansion joints when there is a Bid item for "Superstructure". Otherwise, measurement for "Expansion Joint (Type)" or "Compression Seal (Type)" will be per linear foot along the outside of the horizontal and vertical faces.

Measurement for "Downspout, Galvanized Steel Pipe, (Diameter)" will be by the linear foot along the center line of the pipe through fittings.

Measurement for "Superstructure" will be by lump sum. Separate measurement will not be made for those material items described in Section 6-02.3(35), or for those additional items identified in the Contract, as these materials are included with the "superstructure".

When a Bid item for "Superstructure" is included on the Bid Form, no measurement will be made for concrete or reinforcing steel placed in the area defined as superstructure.

When the Bid Form includes the Bid item "Superstructure", no separate measurement will be made for "Bridge Drain" that are to be installed within the area defined as superstructure.

Measurement for gravel backfill for drains will be by the cubic yard as Mineral Aggregate (Type).

6-02.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 6-02 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "Concrete, (Class), (Designation)", per cubic yard.

The Bid item price for "Concrete, (Class), (Designation)" shall include all costs for the work required to furnish and install structural concrete in place including falsework, forms, expansion joint material, and construction of weep holes including gravel backfill for drains surrounding the weep holes. The Bid item price for "Concrete (Class) (Use)" shall exclude concrete in the superstructure when "Superstructure" is a separate Bid item.

2. "Superstructure", per lump sum.

The Bid item price for "Superstructure" shall include all costs for the work required to furnish and install the superstructure complete not including the excluded items.

All costs for furnishing and placing the date numerals as specified in Section 6-02.3(15) shall be included in the Bid item price for the Bid item "Superstructure".

All costs related to the work for the overhead clearance signs as specified in Section 6-02.3(17)N shall be considered incidental to the Bid item "Superstructure".

All costs in connection with lifting, transporting, and erecting girders including inserts, shims for leveling, grout, field cutting and bending, rebar for drains, welding, blockouts in girders and slabs, and special construction features shall be included in the Bid item price for "Superstructure".

3. **“Steel Reinforcing Bar, (Grade)”**, per pound.
4. **“Steel Reinforcing Bar, (Grade), Epoxy Coated”**, per pound.

The Bid item prices for “Steel Reinforcing Bar, (Grade)” and for “Steel Reinforcing Bar, (Grade), Epoxy Coated” shall include all costs for the work required to furnish, fabricate, coat, and place the steel reinforcement as specified, and to provide a bar list and bending diagram. The Bid item prices shall also include all costs for any required threading of reinforcing bars. 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 Bid item prices for reinforcing steel unless the Contract specifies otherwise. When a Bid item for “Superstructure” is included in the Bid Form, all costs for reinforcing steel in the superstructure shall be considered included in the Bid item price for “Superstructure”.

All costs related to test weld as required in Section 6-02.3(24)F shall be included in the Bid item price for “Steel Reinforcing Bar, (Grade)” and shall be at no additional or separate cost to the Owner.

5. **“Wire Mesh, (Gage), (Mesh Size)”**, per square yard.

The Bid item price for “Wire Mesh, (Gage), (Mesh Size)” shall include all costs required to furnish and place the mesh as specified.

6. **“Expansion Joint (Type)”**, per linear foot.

The Bid item price for “Expansion Joint (Type)” shall include all costs for the work required to furnish and install the complete expansion joint system for bridge roadway slabs as specified, including hardware and miter joints. When the project contains a Bid item for “Superstructure”, expansion joints within the superstructure shall be considered incidental to the Bid item “Superstructure”.

7. **“Compression Seal (Type)”**, per linear foot.

The Bid item price for “Compression Seal (Type)” shall include all costs for the work required to furnish and install the compression seal in place. All costs in connection with the compression seals in the deck, sidewalk slabs, concrete overlay, curbs and abutment backwalls, including miter joints, lubricant adhesive, samples and all necessary items to make a complete installation shall be included in the Bid item price for “Compression Seal (Type)”. Refer to Section 6-02.4 for measurement clarification.

8. **“Downspout, Galvanized Steel Pipe, (Diameter)”**, per linear foot.

The Bid item price for “Downspout, Galvanized Steel Pipe, (Diameter)” shall include all costs for the work required in connection with furnishing and installing the downspouts, including field measuring, galvanizing, and other items necessary to make a complete construction as specified.

9. **“Drill Hole (Size)”**, per linear foot.

The Bid item price for “Drill Hole (Size)” shall include all costs for the work required to perform the drilling as specified.

10. **“Repair Spalled and Delaminated Concrete”**, per square foot.

The Bid item price for “Repair Spalled and Delaminated Concrete” shall include all costs for the work required to repair spalled and delaminated concrete.

11. **“Epoxy Injection of Concrete Crack”**, per linear foot.

The Bid item price for “Epoxy Injection of Concrete Crack” shall include all costs for the work required to perform the epoxy injection repair.

12. **“Bridge Drain”**, per each.

The Bid item price for “Bridge Drain” shall include all costs for the work required to furnish and install drain, reducer, and grate to structure complete. All costs in connection with maintaining and cleaning of bridge drains shall be considered incidental to the construction of the bridge drain.

13. **Other payment information.**

All necessary items not specifically listed as a Bid item in the Bid Form, and payment is not otherwise provided, shall be in accordance with Section 1-04.1(2).

Structure excavation, shoring, cribbing, and cofferdams will be paid in accordance with Section 2-09.5.

Gravel backfill for walls and gravel backfill for drains will be paid as Mineral Aggregate, (Type) in accordance with Section 4-01.5.

Structural removals will be paid in accordance with Section 2-02.5.

See Section 1-05.7 regarding any concrete placed that is not in compliance with the Contract.

Concrete that is placed in water for foundation seals, and that upon testing as required by the Engineer reveals void(s) or joint(s), the Contractor shall repair the void(s) or joint(s), or replace the seal at the Contractor's sole expense and at no additional cost to the Owner.

All costs for curing and finishing concrete shall be considered incidental to the various Bid items comprising the Work.

When testing indicates leakage in the expansion joint system(s) on the bridge deck, the Contractor shall make good the system(s) and all costs incurred thereof shall be borne by only the Contractor and at no additional or separate expense to the Owner.

All costs related to the provision for openings as specified in Section 6-02.3(17)L shall be considered incidental to the various Bid items comprising the Contract and shall be at no additional or separate expense to the Owner.

All costs for the Contractor providing labor, materials, and equipment for making the test sample splices as specified in Section 6-02.3(24)G shall be at the Contractor's sole expense and at no additional or separate cost to the Owner. The Owner will test the Contractor made sample splices at no cost to the Contractor.

All costs in connection with the provision and installation of special anchorage reinforcement as specified in Section 6-02.3(26)C shall be borne by the Contractor and shall be at no additional or separate expense to the Owner.

All costs, including any additional Owner's engineering expenses, in connection with controlling the girder deflection as specified in Section 6-02.3(25)L shall be borne solely by the Contractor.

All costs associated with furnishing and installing Date Numerals, where indicated on the Drawings, shall be incidental to the various Bid Items and shall be at no additional or separate expense to the Owner.

All costs in connection with using air-entraining and/or water-reducing admixture(s) in concrete for the bridge decks, traffic barrier, and pedestrian barrier shall be included in the Bid item prices for the various Bid items involved and shall be at no additional or separate cost to the Owner.

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 shall be included in the Bid item prices for the various Bid items involved and shall be at no additional or separate expense to the Owner.

All costs in connection with replacing Portland cement with pozzolan shall be included in the Bid item price for the various classes of concrete involved and shall be at no additional or separate cost to the Owner. If the concrete is to be paid for other than by class of concrete, all costs involved with replacing Portland cement with pozzolan shall be included in the Bid item price for the applicable Bid item or Bid items of concrete work and shall be at no additional or separate expense to the Owner.

All costs associated with removing concrete and preparing and finishing the concrete surface as specified in Section 6-02.3(34) shall be included in the concrete removal Bid Item in Section 2-02.5 and shall be at no additional or separate expense to the Owner.

All costs associated with preparing a concrete surface for new concrete shall be included in "Concrete (Class) (Use)" and shall be at no additional or separate expense to the Owner.

All costs for placing anchor bolts as specified in Section 6-02.3(18) shall be incidental to the applicable Bid items unless the Contract specifies otherwise. All costs in connection with furnishing cylinder molds, fabrication, curing, and testing of early concrete test cylinders per Section 6-02.3(17)P shall be included in the Bid item prices for the various Bid items of Work involved and shall be at no additional or separate expense to the Owner.

All costs associated with tension testing and evaluating test data per Section 6-02.3(26)F shall be included in the Bid item prices for the applicable Bid items of Work involved and shall be at no additional or separate cost to the Owner.

In Section 6-02.3(35), the superstructure contains the approximate quantities of materials as listed in the Contract. The quantities listed are for major items only and are not intended to be a complete list of all items required for construction of the superstructure. The quantities are approximate and are for the convenience of the Contractor in determining the volume of work involved and are not guaranteed to be accurate. The prospective Bidders shall verify these quantities before submitting a Bid. No adjustments other than for approved changes will be made in the Bid item lump sum price for "Superstructure" even though the actual quantities required may deviate from those listed.

All cost for Contractor requested changes in concrete accepted by the Engineer as specified in Section 6-02.3(1) shall be at the sole expense of the Contractor and no separate or additional payment will be made therefore.

SECTION 6-03 STEEL STRUCTURES

6-03.1 DESCRIPTION

Section 6-03 addresses the work of furnishing, fabricating, erecting, cleaning, and painting steel structures and the structural steel parts of nonsteel Structures.

Any part of a steel Structure made of nonsteel Materials shall comply with the Sections of the Standard Specifications governing those Materials.

6-03.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Structural Steel and Related Materials	9-06
Paints	9-08

Structural steel shall be classified as:

1. Structural carbon steel (to be used whenever the Contract does not specify another classification);
2. Structural low alloy steel; and
3. Structural high strength steel.

Unless the Contract states otherwise, the following shall be 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 shall meet 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 shall meet 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 shall be as specified in the Contract. Filler metals for welding shall meet the toughness requirements of the applicable welding code specified in Section 6-03.3(25).

The Contractor shall submit for the Engineer's approval a written plan for visibly marking the material so that it can be traced. These marks shall remain visible at least through the fit-up of the main load-carrying tension members. The marking method shall include the following information:

- (1) material specification designation,
- (2) heat number, and
- (3) material test reports to meet any special requirements.

As-built drawings: for steel in main load-carrying tension members and in tension components of flexural members, the Contractor shall 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, floorbeams, truss members, and stringers, for permanent steel bridges, shall 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 shall also have an endorsement F, Fracture Critical, under the AISC Quality Certification Program.

6-03.3(1) NOTICE OF ROLLING

Before rolling work begins, the Contractor shall provide enough advance notice that the Engineer may arrange to observe it. The Contractor shall inform the Engineer of who is to do the work and where it is to be done. No material shall be rolled until the Engineer gives written notice to Proceed.

6-03.3(2) FACILITIES FOR INSPECTION

See Sections 1-05.6 and 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 Sections 1-05 and 1-06.

6-03.3(5) MILL ORDERS AND SHIPPING STATEMENTS

The Contractor shall 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 shall furnish 4 copies of the calculations or weight slips unless the Contract specifies another quantity. If scale weights are used, the Contractor shall record separately the weights of all tools, erection material, and dunnage.

6-03.3(7) SUBMITTALS

6-03.3(7)A SHOP DRAWINGS AND AS-BUILT RECORDS

The Contractor shall submit to the Engineer for review all Shop Drawings, and certified mill test reports, for fabricating the steel. Prints of the Shop Drawings shall be supplied in these quantities:

Ten sets to the Engineer (four more 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 shall correct and resubmit them in the quantities required above. No material shall be fabricated until:

- (1) the Engineer has reviewed all Shop Drawings; and
- (2) the SPU Materials Laboratory has approved the Material source(s) and the fabricator(s).

See Section 1-05.3 regarding Shop Drawings.

As-built records: Before the Physical Completion Date can be established, the Contractor shall furnish the Engineer one set of reproducible copies of the as-built Shop Drawings (see Sections 1-05.3(11) and 1-05.3(13)). 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 shall be 22 inches by 34 inches and shall meet the requirements of Section 1-05.3(10).

6-03.3(7)B ERECTION METHODS

The Contractor shall submit a steel erection plan and procedure describing the methods the Contractor intends to use to the Engineer for review. The Contractor shall have received the Engineer's returned submittal for the erection plan and procedure before doing this work. The Contractor's erection plan and procedure shall first be reviewed by the steel fabricator

prior to being submitted to the Engineer. The Contractor's submittal shall include evidence that the fabricator has reviewed the erection Shop Drawings and procedures; and shall submit the fabricator's review comments with the erection plan submittal.

The erection plan and procedure shall 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, glommers, etc.;
5. Crane(s) make and model, masses, geometry, lift capacity, outrigger size and reactions;
6. Girder launcher or trolley details and capacity (if intended for use); and
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 shall 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 erection plan shall be prepared by a professional engineer in accordance with Section 1-05.3(12).

The Contractor shall submit the erection Shop Drawings, calculations, procedure, and fabricator's comments directly to the Engineer, in accordance with 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 shall be in accordance with Section 1-05.3(5).

6-03.3(8) SUBSTITUTIONS

The Contractor shall 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 shall be at no additional cost to the Owner. Also see the requirements of Sections 1-05.3(5).

6-03.3(9) HANDLING, STORING, AND SHIPPING OF MATERIALS

Markings applied at the mill shall distinguish structural low alloy steel from structural carbon steel. The fabricator shall keep the two classes of steel carefully separated.

Before fabrication, all material stored at the fabricating plant shall be protected from rust, dirt, oil, and other foreign matter. The Owner will not accept rust-pitted material.

After fabrication, all material awaiting shipment shall be subject to the same storage requirements as unfabricated material.

All structural steel shall arrive at the Project Site in a condition meeting or exceeding the specified requirements. Steel damaged by salt water shipment shall 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 shall be stored to prevent rust and loss of small parts. Piled material shall rest on skids or platforms, and shall not make contact with the ground or with water.

The loading, transporting, unloading, and stockpiling of the structural steel material shall be so conducted that the metal is kept clean and free from injury from rough handling.

In field assembly of structural parts, the Contractor shall use methods and equipment that shall not twist, bend, deform, or otherwise injure the metal. Any bent or twisted member shall be corrected before it is placed. The Owner will not accept any member with damage.

Girder sections shall be handled to prevent damage to the girders. The Contractor shall provide temporary stiffeners to prevent buckling during erection as necessary.

6-03.3(10) CORRECTING BENT MATERIAL

Plates, angles, other shapes, and built-up members may be straightened if authorized in writing by the Engineer. Straightening methods shall not fracture or injure the metal. Distorted members shall be straightened mechanically. A limited amount 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 shall be free from all stress and external forces except those that result from the mechanical pressure used with the heat.

After straightening, the Contractor shall inspect the member for fractures using a method specified in the Contract.

The Engineer will reject metal showing sharp kinks and bends.

The procedure for heat straightening of universal mill (UM) plates by the mill or the fabricator shall be submitted to the Engineer for review prior to doing this work.

6-03.3(11) WORKMANSHIP AND FINISH

Workmanship and finish shall be first-class, equaling the best practice in modern bridge fabrication shops. Welding, shearing, burning, chipping, and grinding shall be done neatly and accurately. All parts of the work exposed to view shall be neatly finished.

Wherever the Drawings show a surface finish symbol, the surface shall be machined.

6-03.3(12) FALSEWORK

All falsework shall 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 shall be:

1. Blast cleaned entirely or blast cleaned on all areas within 2 inches of welds to SSPC-SP6, Commercial Blast Cleaning; and
2. Fabricated from plate stock with the primary rolling direction of the stock parallel to the length of the member.

6-03.3(14) EDGE FINISHING

All rolled, sheared, and flame-cut edges shall be true to line and free of rough corners and projections. Corners along exposed edges shall be rounded to a minimum radius of 1/16-inch.

Sheared edges on plates more than 5/8 inch thick shall be planed, milled, ground, or flame-cut to a depth of at least 1/8 inch.

Re-entrant corners or cuts shall be filleted to a minimum radius of 3/4 inch.

Exposed edges of main load-carrying tension members or tension components of flexural members shall 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 shall have surface roughness no greater than 1,000 micro-inches.

The hardness of flame-cut edges of structural low alloy plates, as specified in Section 9-06.2, for main load-carrying tension members or tension components of flexural members shall meet the requirements outlined in Appendix A, "Testing Rockwell Hardness of Flame-cut Edges" to be found in the appendix of the Project Manual. The Contractor shall prevent excessive hardening of plate edges through preheating, postheating, or control of the burning process as recommended by the steel manufacturer and approved by the Engineer.

6-03.3(15) PLANING OF BEARING SURFACES

Ends of columns that bear on base and cap plates shall be milled to true surfaces and accurate bevels.

When assembled, caps and base plates of columns and the sole plates of girders and trusses shall have full contact. If warped or deformed, the plates shall be heat straightened, planed, or corrected in some other way to produce accurate, even contact. If necessary for proper contact, bearing surfaces that are to be in contact with other metal surfaces shall be planed or milled. Surfaces of warped or deformed base and sole plates that are to be in contact with masonry shall be rough finished.

On the surface of expansion bearings, the cut of the planer shall be in the direction of expansion.

6-03.3(16) ABUTTING JOINTS

Abutting ends of compression members shall be faced accurately so that they bear evenly when in the Structure. On built-up members, the ends shall be faced or milled after fabrication.

Ends of tension members at splices shall be rough finished to produce neat, close joints. A contact fit is not required.

6-03.3(17) END CONNECTION ANGLES

On floorbeams and stringers, end connection angles shall be flush with each other and set accurately in relationship to the position and length of the member. End connection angles shall not be finished unless specified otherwise in the Contract. If, however, faulty assembly requires them to be milled, milling shall not reduce thickness by more than 1/16 inch.

6-03.3(18) BUILT-UP MEMBERS

The various pieces forming one built-up member shall 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 the use of mechanical force shall 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, shall be true to sizes and shapes shown on the Drawings. Edges shall be true to line and ground smooth.

6-03.3(20) LACING BARS

Unless the Contract states otherwise, ends of lacing bars shall 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 shall not exceed 3/8 inch.

6-03.3(21)B RESERVED**6-03.3(21)C WEB SPLICES AND FILLERS**

Web splice plates and fillers under stiffeners shall fit within 1/8 inch at each end.

6-03.3(22) EYEBARS

Eyebars shall 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 shall 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 shall not overrun by more than 1/16 inch. Welds shall not be made in the body or head of any bar.

Each eyebar shall be properly annealed and carefully straightened before it is bored. Pinholes shall be located on the centerline of each bar and in the center of its head. Holes in bar ends shall 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 shall be interchangeable.

6-03.3(23) ANNEALING

All eyebars shall 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 shall 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**6-03.3(24)A GENERAL**

Pins and rollers shall be made of the class of forged steel as specified on the Drawings. They shall be turned accurately to detailed dimensions, smooth, straight, and flawless. The final surface shall 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 shall have holes at least 2 inches in diameter bored longitudinally through their centers. Pins with inner defects will be rejected.

The Contractor shall provide pilot and driving nuts for each size of pin unless the Contract specifies otherwise.

6-03.3(24)B BORING PIN HOLES

Pin holes shall be bored true to detailed dimensions, smooth and straight, and at right angles to the axis of the member. Holes shall be parallel with each other unless the Contract specifies otherwise. A finishing cut shall always be made.

The distance between holes shall not vary from detailed dimensions by more than 1/32 inch. In tension members, this distance shall be measured from outside to outside of holes. In compression members, this distance shall be measured from inside to inside of holes.

6-03.3(24)C PIN CLEARANCES

Each pin shall be 1/50-inch smaller in diameter than its hole. All pins shall be numbered after being fitted into their holes in the assembled member.

6-03.3(25) WELDING AND REPAIR WELDING**6-03.3(25)A GENERAL**

Welding and repair welding of all steel bridges shall comply with the ANSI / AASHTO / AWS D1.5-96, Bridge Welding Code. Welding and repair welding for all other steel fabrication shall comply with AWS D1.1, latest edition, Structural Welding Code. The requirements described in the remainder of this Section shall 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, shall 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 shall be submitted with the Shop Drawings. The procedures shall 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 shall be included in the submittal.

Welding shall not begin until after the Contractor has received the Engineer's review of Shop Drawings as required in Section 603.3(7). These Shop Drawings shall include procedures for welding, assembly, and any heat-straightening or heat-curving.

Any welded shear connector longer than 8 inches may be made of two shorter shear connectors joined with full-penetration welds.

In shielded metal-arc welding, the Contractor shall use low-hydrogen electrodes.

In submerged-arc welding, flux shall 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 shall be redried before use.

Preheat and interpass temperatures shall conform to the applicable welding code as specified in this Section. When welding main members of steel bridges, the minimum preheat shall 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 shall 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 shall terminate groove welds in a way that ensures the soundness of each weld to its ends. The bars and plates shall be removed after the weld is finished and cooled. The weld ends shall then be ground smooth and flush with the edges of abutting parts.

The Contractor shall 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)B WELDING INSPECTION

The Contractor's inspection procedures, techniques, methods, acceptance criteria and inspector qualifications for welding of steel bridges shall be in accordance with the ANSI / AASHTO / AWS D1.5-96, Bridge Welding Code. The Contractor's inspection procedures, techniques, methods, acceptance criteria and inspector qualifications for welding of all steel Structures other than steel bridges shall be per AWS D1.1, latest edition, Structural Welding Code. The requirements described in the remainder of this section shall prevail whenever they differ from either of the above welding codes.

Nondestructive testing, in addition to visual inspection, shall be performed by the Contractor. Unless otherwise specified in the Contract, the extent of inspection shall be as specified in this Section. Testing and inspection shall apply to welding performed in the shop and in the field.

1. **Visual Inspection**
All welds shall be 100 percent visually inspected. Visual inspection shall be performed before, during, and after the completion of welding.
2. **Radiographic Inspection**
Complete penetration tension groove welds in highway bridges shall be 100 percent radiographically inspected. These welds include those in the tension area of webs where inspection shall cover the greater of these two distances:
 - a. 15 inches from the tension flange or
 - b. one third of the web depth.

In addition, edge blocks conforming to the requirements of AWS D1.1-96 Structural Welding Code Section 6.17.13 shall be used for radiographic inspection.
3. **Ultrasonic Inspection**
Complete penetration groove welds on plates thicker than 5/16 inch in the following welded assemblies or structures shall be 100 percent ultrasonically inspected:
 - a. Welded connections and splices in highway bridges and earth retaining Structures, excluding longitudinal butt welds in beam or girder webs;
 - b. Bridge bearings and modular expansion joints;
 - c. Sign bridges, cantilever sign Structures, and bridge mounted sign brackets excluding longitudinal butt joint welds in beams;
 - d. Light, signal, and strain pole standards; and
 - e. Steel Casing for concrete columns.

The testing procedure and acceptance criteria for tubular members shall conform with Section 10 of the latest edition of the AWS Structural Welding Code D1.1 - Steel.
4. **Magnetic Particle Inspection**
 - a. Fillet and partial penetration groove welds: At least 30 percent of each size and type of fillet welds (excluding intermittent fillet welds) and partial penetration groove welds in the following welded assemblies or Structures shall be tested by the magnetic particle method:
 - (1) Flange-to-web connections in highway bridges;
 - (2) End and intermediate pier diaphragms in highway bridges;
 - (3) Stiffeners and connection plates in highway bridges;
 - (4) Welded connections and splices in earth retaining Structures;
 - (5) Boxed members of trusses;
 - (6) Bridge bearings and modular expansion joints;
 - (7) Sign bridges, cantilever sign Structures, and bridge mounted sign brackets; and
 - (8) Light, signal, and strain pole standards.
 - b. Longitudinal butt welds in beam and girder webs: At least 30 percent of each longitudinal butt weld in the beam and girder webs shall be tested by the magnetic particle method.
 - c. Complete penetration groove welds on plates 5/16 inch or thinner shall be 100 percent tested by the magnetic particle method. Testing shall apply to both sides of the weld, if backing plate is not used.
 - d. The ends of each complete penetration groove weld at plate edges shall be tested by the magnetic particle method.

The Contractor shall have all welds of structural members inspected by 100% radiographic or ultrasonic inspection, or by a combination of both, in accordance with the applicable specification in 2. and 3. above and in compliance with the last paragraph of this section.

Where 100 percent testing is not required, the Engineer reserves the right to select the location(s) for testing.

If rejectable flaws are found in any test length of weld in item 4. Magnetic Particle Inspection, subitems (a) or (b) in this Section, the full length of the weld or 5 feet on each side of the test length, whichever is less, shall be tested.

After repairs of defects have been made, additional nondestructive testing shall be performed to ensure that the repairs are acceptable. This testing shall include the repaired area plus at least 2 inches on each side of the repaired area.

After the Contractor has completed his welding inspection, the Contractor shall allow the Engineer sufficient time to perform quality assurance ultrasonic welding inspection.

The Contractor shall 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 shall mail the film and video record together with 2 copies each of the radiographic and ultrasonic inspection reports to the Engineer.

6-03.3(26) SCREW THREADS

Screw threads shall be U.S. Standard and shall fit closely in the nuts.

6-03.3(27) HIGH STRENGTH BOLT HOLES

6-03.3(27)A GENERAL

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 shall be 1/16-inch larger than the nominal diameter of the bolt.

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 shall 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 shall be made full size using steel templates;
 - b. A minimum of 30 percent of the holes in the second side shall be made full size assembled in the shop; and
 - c. All remaining holes may be made full size in unassembled members using steel templates; and
3. Drill bolt holes in crossframes, gussets, lateral braces, and other secondary members full size using steel templates.

The Contractor shall 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)B PUNCHED HOLES

For punched holes, die diameter shall not exceed punch diameter by more than 1/16 inch. Any hole requiring enlargement to admit the bolt shall be reamed. All holes shall be cut clean with no torn or ragged edges. The Owner will reject components having poorly matched holes.

6-03.3(27)C REAMED AND DRILLED HOLES

Reaming and drilling shall be done with twist drills, or with short taper reamers, producing cylindrical holes perpendicular to the member. Reamers and drills shall be directed mechanically, not hand-held. Connecting parts that require reamed or drilled holes shall be assembled and held securely as the holes are formed, then match-marked before disassembly. The Contractor shall provide the Engineer with a diagram showing these match-marks. The Owner will reject components having poorly matched holes.

Burrs on outside surfaces shall be removed. The Contractor shall disassemble parts to remove burrs as applicable.

If templates are used to ream or drill full-size connection holes, the templates shall be positioned and angled with accuracy and bolted securely in place. Templates for reaming or drilling matching members, or the opposite face of one member, shall be duplicates. All splice components shall be match-marked.

6-03.3(27)D 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 shall submit for review, a detailed outline of proposed N/C procedures. This outline shall:

1. Cover all steps from initial drilling or punching through check assembly; and
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 shall demonstrate that the N/C procedures consistently produces holes and connections meeting the requirements of these Specifications.

6-03.3(27)E ACCURACY OF PUNCHED, SUBPUNCHED AND SUBDRILLED HOLES

After shop assembly and before reaming, all punched, subpunched, and subdrilled holes shall meet the following standard of accuracy. At least 75 percent of the holes in each connection shall permit the passage of a cylindrical pin 1/8-inch smaller in diameter than nominal hole size. This pin shall pass through at right angles to the face of the member without drifting. All holes shall permit passage of a pin 3/16-inch smaller in diameter than nominal hole size. The Owner will reject any pieces that fail to meet these standards.

6-03.3(27)F ACCURACY OF REAMED AND DRILLED HOLES

At least 85 percent of all holes in a connection of reamed or drilled holes shall show no offset greater than 1/32-inch between adjacent thicknesses of metal. No hole shall have an offset greater than 1/16-inch.

Centerlines from the connection shall be inscribed on the template, and holes shall be located from these centerlines. Centerlines shall also be used for accurately locating the template relative to the milled or scribed ends of the members.

Templates shall 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 shall be at least 1/2-inch thick. If necessary, thicker templates shall be used to prevent buckling and misalignment as the holes are formed.

6-03.3(27)G FITTING FOR BOLTING

Before drilling, reaming, and bolting begins, all parts of a member shall be assembled, well pinned, and drawn firmly together. If necessary, assembled pieces shall be taken apart to permit removal of any burrs or shavings produced as the holes are formed. The member shall be free from twists, bends, and other deformation.

In shop-bolted connections, contacting metal surfaces shall be sandblasted clean before assembly. Sandblasting shall meet the requirements of the SSPC Specifications for Commercial Blast Cleaning (SSPC-SP 6).

Any drifting done during assembly shall be no more than enough to bring the parts into place. Drifting shall 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 shall choose from the following 5 described shop assembly methods, the method that best fits the proposed erection method. The Contractor shall submit and obtain review from the Engineer, both the shop assembly and the erection methods before this work begins.

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 shall include at least three adjacent truss panels. Each truss panel shall include all of the 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 shall include at least three 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 shall be assembled to include: two truss panels or girder shop sections of the previous stage and one or more truss panels or girder shop sections added at the advancing end. The previous stages shall be repositioned if necessary, and pinned to ensure accurate alignment.

For girders on tangents without skews or tapers, the Contractor may assemble subsequent stages which include one girder shop section of the previous stage and two or more girder shop sections at the advancing end.

If the bridge is longer than 150 feet, each longitudinal stage shall be at least 150 feet long, regardless of the length of individual continuous truss panels or girder shop sections.

The Contractor may begin the assembly sequence at any point on the bridge and proceed in either or both directions from that point.

No assembly shall have less than three 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/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 one end of each web member shall be milled or scribed at right angles to its long axis. The templates at both ends of the member shall 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 shall check each assembly for alignment, accuracy of holes, fit of milled joints, and other assembly techniques. Drilling or reaming shall not begin until the Engineer has given written approval. If the Contractor uses N/C drilling, this written approval from the Engineer shall be obtained before the assembly or stage is dismantled.

6-03.3(29) SANDBLASTING

After fabrication, the Contractor shall sandblast all structural steel (except machine-finished surfaces) in accordance with the SSPC-SP10 specification for near-white blast cleaning. After sandblasting and before painting, the Contractor shall remove all loose dust and dirt that remains on the steel. Acid shall not be used to remove scale or stains in the field.

6-03.3(30) SHOP PAINTING**6-03.3(30)A GENERAL**

Within 8 hours after the sandblasting required in Section 6-03.3(29), all structural steel shall be painted with one shop coat as the Drawings specify. The Contractor shall not add more volatile thinner to the paint than the formula permits.

The Contractor shall not load structural steel for shipment until the shop coat of paint has dried thoroughly. No painting shall be done after the steel has been loaded for shipment.

Contact surfaces of field bolted connections shall be:

1. Painted with the shop coat when the structure is to be coated with inorganic zinc silicate paint; or
2. Painted with one shop coat of vinyl pretreatment, Formula No. A5-61, when the structure is to be coated with a paint other than inorganic zinc silicate.

If the contact surfaces of a bolted connection coated with inorganic zinc silicate paint has been kept free from dirt, oil, grease, and other foreign matter, it may be field bolted without further preparation. If it is contaminated, the surface shall be sandblasted no more than 8 hours before final bolting.

All contact surfaces of bolted connections coated with other than inorganic zinc silicate paint shall be cleaned by sandblasting just before final field bolting.

Any sandblasting done before final field bolting shall comply with SSPC Specifications for Commercial Blast Cleaning (SSPC-SP6).

6-03.3(30)B WEATHER CONDITIONS

The Contractor shall submit to the Engineer, the paint manufacturer's recommendations for paint application before application of the paint.

Unless the paint manufacturer recommends otherwise, the Contractor shall apply paint only when air and metal are 40°F or warmer. Major painting on a Structure shall not begin unless the weather is forecast to remain above 40°F for at least 48 hours after painting starts. Minor painting of spots and small areas may be done any time the air and metal meet temperature requirements.

In open yards or on erected structures, the metal shall not be painted while hot enough to blister the paint.

Paint shall never be applied on damp metal. Any metal painted under cover in damp or cold weather shall remain covered until dry or until weather conditions permit open exposure.

6-03.3(30)C APPLICATION

All paint shall be brushed on, unless the Contract specifies another method. Painting shall be done in a professional manner by competent painters. The paint film shall meet the minimum thickness requirements stated in Section 6-07.3(5).

6-03.3(30)D ERECTION MARKS

Erection marks to permit identification of members in the field shall be painted on previously painted surfaces.

6-03.3(30)E 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 shall be covered with grease. After erection, the steel shall be cleaned and painted as specified.

All surfaces of iron and steel castings milled to smooth the surface shall 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 shall receive the full paint system. Surfaces of pins and holes machine-finished to specific tolerances shall not be painted. However, as soon as possible and before they leave the shop, they shall be coated with grease.

6-03.3(31) ALIGNMENT AND CAMBER**6-03.3(31)A GENERAL**

Before beginning field bolting, the Contractor shall:

1. Adjust the structure to correct grade and alignment;
2. Regulate elevations of panel points (ends of floorbeams); and
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 shall be correct before the top chord joints, top lateral system, and sway braces are bolted.

6-03.3(31)B MEASURING CAMBER

The Contractor shall provide the Engineer with a diagram for each truss that shows camber at each panel point. This diagram shall display actual measurements taken as the truss is being assembled.

6-03.3(32) ASSEMBLING AND BOLTING

To begin bolting any field connection or splice, the Contractor shall install and tighten to snug-tight enough bolts to bring all parts into full contact with each other prior to 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 shall be securely drift-pinned and bolted in accordance with 1 or 2 following, before the weight of the member can be released or the next member is added. Field erection Shop Drawings shall specify pinning and bolting requirements that meet or exceed the following minimums:

1. **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 shall be filled with drift pins and bolts. 30 percent of the filled holes shall be pinned. 70 percent of the filled holes shall be bolted and tightened to snug-tight. Once all these bolts are snug-tight, each bolt shall be systematically tightened to the specified minimum tension. "Systematically tightened" means beginning 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 shall be located near the middle of a single field connection or a single splice plate.
2. **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 shall be filled with drift pins and bolts. 50 percent of the filled holes shall be pinned. 50 percent of the filled holes shall be bolted and tightened to snug-tight. Once all these bolts are snug-tight, each bolt shall be systematically tightened to the specified minimum tension. The fully tensioned bolts shall be located near the middle of a single field connection or a single splice plate.

Drift pins shall 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.

To complete a joint following the method listed above, the Contractor shall fill all remaining holes of the field connection or splice plate with bolts and tighten to snug-tight. Once all of these bolts are snug-tight, each bolt shall be systematically tightened to the specified minimum tension. After these bolts are tightened to the specified minimum tension, the Contractor shall replace the drift pins with bolts tightened to the specified minimum tension.

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 shall utilize drift pins to align the connection. The alignment drift pins shall 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 shall 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 shall systematically tighten all these bolts to the specified minimum tension. The Contractor shall then replace the drift pins with bolts. Each of these bolts shall be tightened to the specified minimum tension.

All bolts shall be placed with heads toward the outside and underside of the bridge. All high-strength bolts shall be installed and tightened before the falsework is removed.

The Contractor may erect metal railings as erection proceeds. But railings shall not be bolted or adjusted permanently until the falsework is released and the deck placed.

The Contractor shall provide the Engineer advance notice for the Engineer's inspection of field bolting before beginning painting. Where bolted connections are shown on the Drawings or specifically authorized, all bolts, nuts, and washers shall conform to the specifications for material and assembly of structural joints using high strength steel bolts as provided in Division I, Design, Article 10.32.3, and Division II, Construction, Article 11.3.

6-03.3(33) BOLTED CONNECTIONS

6-03.3(33)A GENERAL

Bolts, nuts, hardened washers, and direct tension indicators shall meet the requirements of Section 9-06(5)3.

All bolted connections are slip critical bearings. Painted Structures require Type 1 or Type 2 bolts. Unpainted Structures require Type 3 bolts. AASHTO M 253, Types 1, 2, and 3 bolts shall not be galvanized or be used in contact with galvanized material.

Hardened washers are required under turned elements for connections using AASHTO M 164 and AASHTO M 253 bolts and as required in the following:

1. Irrespective of the tightening method, hardened washers shall be used 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 1:20 with respect to a plane normal to the bolt axis, a hardened beveled washer shall be used to compensate for the lack of parallelism.

All galvanized nuts shall be lubricated with a lubricant containing a visible dye so a visual check for the lubricant can be made at the time of field installation. Black bolts shall be "oily" to the touch when installed. Weathered or rusted bolts and nuts shall be cleaned and relubricated prior to installation.

After assembly, bolted parts shall fit solidly together. Bolted parts shall not be separated by washers, gaskets, or any other material. Assembled joint surfaces, including those next to bolt heads, nuts, and washers, shall be free of loose mill scale, burrs, dirt, and other foreign material that would prevent solid seating.

Tightened bolts in a joint shall carry at least the proof load shown in the following Table 3:

Table 3		
Minimum Bolt Tension		
Bolt Size (Inches)	AASHTO M 164 (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
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

Tightening may be done by either the turn-of-nut or the Direct-Tension-Indicator Method. Preferably, the nut shall be turned tight while the bolt is prevented from rotating. However, if required because of bolt entering and/or wrench operational clearances, tightening may be done by turning the bolt while the nut is prevented from rotating. Following are descriptions of the Turn-of-Nut and Direct-Tension-Indicator Methods:

1. **Turn-of-Nut Method:**

Hardened steel washers shall be used under the turned elements. After a bolt in a connection or joint splice plate has been tightened to snug-tight and meets all specified bolting conditions, it shall be tightened to the specified minimum tension by rotating the amount specified in the following Table 4. Before final tightening, the Contractor shall match-mark with crayon or paint the outer face of each nut and the protruding part of the bolt. To ensure that this tightening method is followed, the Engineer will (1) observe as the Contractor installs and tightens all bolts, and (2) inspect each match-mark.

Table 4			
Turn-of-Nut Tightening Method			
Nut Rotational from Snug-Tight Condition			
Bolt Length	Disposition of Outer Faces of Bolted Parts		
	Condition 1	Condition 2	Condition 3
$L \leq 4D$	1/3 turn	1/2 turn	2/3 turn
$4D < L \leq 8D$	1/2 turn	2/3 turn	5/6 turn
$8D < L \leq 12D$	2/3 turn	5/6 turn	1 turn

Bolt length measured from underside of head to extreme end of point.

Condition 1: both faces at right angles to bolt axis.

Condition 2: one face at right angle to bolt axis, one face sloped no more than 1:20, without bevel washer.

Condition 3: both faces sloped no more than 1:20 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.

Tolerances 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.

D = nominal bolt diameter of bolt being tightened.

When bolt length exceeds 12D, the rotation shall be determined by actual tests in which a suitable tension device simulates actual conditions.

2. **Direct-Tension-Indicator Method:**

Direct Tension Indicators (DTIs) shall not be used under the turned element. DTIs shall be placed under the bolt head with the protrusions facing the bolt head when the nut is turned. DTIs shall be placed under the nut with the protrusions facing the nut when the bolt is turned.

DTIs shall be installed by 2 or more person crews with one individual preventing the element at the DTI from turning the measuring the gap of the DTI to determine the proper tension of the bolt.

Three DTIs, per lot, shall be tested in a WSDOT approved bolt tension calibrator. The bolts shall be tensioned to 105 percent of the tension shown in Table 3. The test bolts shall not be tightened such that all of the DTI protrusions are completely crushed (all five openings with zero gap). The DTI gap between all protrusions shall be measured with a tapered feeler gauge to the nearest 0.001 inch. All of the non-zero DTI gap measurements for the three test bolts shall be averaged. This average shall be used in the tightening of all the production bolts except as provided in the following:

All bolts in a connection shall be snug tightened prior to bringing any DTIs in the connection to full load. The maximum gap of the production bolt DTIs shall not be greater than the average test gap established above or 0.005 inch, whichever is less. The minimum gap of the production bolts DTIs may be zero (all five openings with zero gap).

The Contractor shall tension all bolts, inspecting all DTIs with a feeler gage, in the presence of the Engineer. The Contractor shall ensure the DTI does not rotate during bolt tightening.

If a bolt, that has had its DTI brought to full load, loosens during the course of bolting the connection, the bolt shall have a new DTI installed and be retensioned. Reuse of the bolt and nut are subject to the provisions of this Section.

AASHTO M 253 bolts and galvanized AASHTO M 164 bolts shall not be reused. Ungalvanized AASHTO M 164 bolts may be reused if the used nut on the used bolt can be turned for the full length of the bolt threads by hand. Bolts to be reused shall be relubricated. Used bolts shall be subject to a rotational capacity test as specified in Section 6-03.3(33)B Pre-Erection Testing. Touching up or retightening previously tightened bolts which may have been loosened by the tightening of adjacent bolts shall not be considered reused, provided the snugging up continues from the initial position and does not require greater rotation, including the tolerance, than that required by Table 4 in this Specification Section.

6-03.3(33)B PRE-ERECTION TESTING

High strength bolt assemblies (bolt, nut, and washer), black and galvanized, new and used as described in Section 6-03.3(33)A, shall be subjected to a rotational capacity test (AASHTO M 164, Section 8.5) prior to any erection activity. Each combination of bolt production lot, nut lot, and washer lot shall be tested as an assembly. All tests shall be performed by the Contractor in the presence of the Engineer. Two new specimens and two used specimens per lot shall be tested at the erection site immediately prior to installation or at a time during installation determined by the Engineer. The bolt assemblies shall meet the following requirements:

1. Go through two times the required number of turns from snug tight condition as indicated in Table 4 of Section 6-03.3(33)A without stripping, tensile, or shear failure. Rotation-capacity test shall be performed in a WSDOT approved bolt tension calibrator.
2. The maximum recorded tension shall be equal to or greater than 1:15 times the minimum bolt tension listed in Table 3 of Section 6-03.3(33)A.
3. The measured torque to produce the minimum bolt tension shall not exceed the value obtained by the following equation.

$$\text{Torque} = 0.25 PD$$

Where:	Torque	= Calculated Torque (foot-pounds)
	P	= Measured Bolt Tension (pounds)
	D	= Normal Bolt Diameter (feet)

4. Disassemble the torqued bolt and inspect for signs of failure. Failure is defined as any shear damage to the threads of the bolt or the nut or cracks in the body of the bolt. If either specimen fails, the lot of bolts will be rejected. Elongation of the bolt between the bolt head and the nut is not considered to be a failure.

6-03.3(33)C BOLTING INSPECTION

The Contractor, in the presence of the Engineer, shall inspect the tightened bolt using a calibrated inspection torque wrench. Torque wrench calibration shall be within the last six months.

If the bolts to be installed are not long enough to fit in the Owner furnished tension calibrator, five bolts of the same grade, size and condition as those under inspection shall be selected by the Contractor in the presence of the Engineer and shall be tested using Direct-Tension-Indicators (DTI) to measure bolt tension. This tension measurement test shall be done at least once each inspection day. The Contractor shall supply the necessary DTIs. The DTI shall be placed under the bolt head. A washer shall be placed under the nut, which shall be the element turned during the performance of this tension measurement test. Each bolt shall be tightened by any convenient means to the specified minimum tension as indicated by the DTI. The inspecting wrench shall 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 shall be tested five times. The high and low values shall be discarded and the job-inspection torque shall be the average of the remaining three middle values.

Five bolts selected by the Contractor in the presence of the Engineer of the same grade, size, and condition as those under inspection shall be placed individually in an Owner furnished tension calibrator to measure bolt tension. This calibration operation shall be done at least once each inspection day. There shall be a washer under the part turned in tightening each bolt if washers are used on the structure. In the calibrated device, each bolt shall be tightened by any convenient means to the specified tension. The inspecting wrench shall 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

shall be tested five times. The high and low values shall be discarded and the job-inspection torque shall be the average of the remaining three middle values.

Ten percent (minimum 2 bolts) of the tightened bolts on the structure represented by the test bolts shall be selected at random in each connection. The job-inspection torque shall then be applied to each with the inspecting wrench turned in the tightening direction. The connection will be considered acceptable tightened if this job-inspection torque turns no bolt head or nut. However, if the torque turns one or more bolt heads or nuts, the job-inspection torque shall then be applied to all bolts in the connection. Any bolt whose head or nut turns at this stage shall be tightened and reinspected. The Contractor may, however, retighten all the bolts in the connection and resubmit it for inspection.

6-03.3(34) ADJUSTING PIN NUTS

All pin nuts shall be tightened thoroughly. The pins shall be placed so that members bear fully and evenly on the nuts. The pins shall have enough thread to allow burring after the nuts are tightened.

6-03.3(35) SETTING ANCHOR BOLTS

Anchor bolts shall be set in masonry as required in Section 6-02.3(18). Anchor bolts shall be grouted in after the shoes, bearing 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 BEARING PLATES

The following procedure applies to steel bearing plates for all steel spans, including shoes, keeper plates and turning racks on movable bridges.

To set bearing plates, the Contractor shall:

1. Set bearing plates on the anchor bolts;
2. Place steel shims under the bearing plates to position pin centers to line and grade and in relationship to each other. Steel shims shall be no more than 2-1/2 inches square and placed under bearing plates;
3. Level the bases of all bearing plates;
4. Draw anchor bolt nuts down tight;
5. Recheck pin centers or bearings for alignment; and
6. Leave at least 3/4 inch of space under each bearing plate for grout.

After the bearing plates have been set and the span or series of continuous spans are completely erected and swung free, the space between the bottom of the bearing plate and the top of the concrete bearing seat shall be filled with grout. Main bearing plates for cantilever spans shall be set and grouted in before any steel work is erected.

Grout mixture and placement shall be as required in Section 6-02.3(20).

6-03.3(37) SETTING STEEL BRIDGE BEARINGS

Bearing plates, shoes, and keeper plates of expansion bearings shall be set and adjusted to center the expansion shoe at a normal temperature of 64°F. Adjustment for any inaccuracy in fabricated length shall be made after dead-load camber is out.

6-03.3(38) PLACING SUPERSTRUCTURE

The Contractor shall place no superstructure load on finished piers or abutments until the Engineer allows. Normally, this concrete-hardening interval requires at least 12 days.

6-03.3(39) SWINGING THE SPAN

No forms, steel reinforcing bars, or concrete roadway slabs shall 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. Forms, reinforcing steel, or concrete roadway slabs shall not be placed on any simple or continuous span steel girder bridge until all its spans are adjusted and its bearing plates, shoes, and keeper plates grouted. For this Specification, the structure shall be considered to be continuous across hinged joints.

After the falsework is released (spans swung free), the bearing plates, shoes, and keeper plates are grouted, and before any load is applied, the Engineer will:

1. Measure elevations at selected points along the tops of girders or floorbeams under steel weight dead load;
2. Compare the calculated steel weight camber elevations with the elevations measured in step 1; and
3. Furnish the Contractor with new dead-load camber dimension.

The Contractor shall adjust the top-of-web to top-of-deck dimensions, varying from Drawing camber as necessary and as determined by the Engineer.

6-03.3(40) DRAINING POCKETS

The Contractor shall 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 shall not be drilled without the written review of the Engineer.

6-03.3(41) FLOORBEAM PROTECTION

Each floorbeam that supports a concrete slab joint shall be coated on its top and flange edges with a heavy mop of roofing grade asphalt applied hot. This asphalt shall conform to ASTM D 312 (not mineral stabilized). A protective covering of asphalt coated glass fiber sheet (ASTM D 4601, Type 1, non-perforated) shall be placed over the hot coat of asphalt. This

combination coating shall be applied over the shop paint. It shall take the place of the two field coats of paint specified for other parts of the structural steel. The second and third coats are acceptable exceptions and shall comply with Section 6-07.3(1)B.

6-03.3(42) SURFACE CONDITION

As the Structure is erected, the Contractor shall 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 shall be cleaned as follows:

1. Painted steel surfaces shall be cleaned by methods required for the type of staining. The method shall be submitted to the Engineer for approval; and
2. Unpainted steel surfaces shall be cleaned by sandblasting. Sandblasting to remove stains on publicly visible surfaces shall 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

6-03.3(43)A GENERAL

Castings, steel forgings, and miscellaneous metals shall be built to comply with Section 9-06.

6-03.3(43)B SHOP CONSTRUCTION, CASTINGS, STEEL FORGINGS, AND MISCELLANEOUS METALS

This Section's requirements for structural steel (including painting requirements) shall also apply to castings, steel forgings, and miscellaneous metals.

Castings shall 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; and
5. Formed with sharp and perfect arises.

Iron and steel castings and forgings shall be annealed before any machining, unless indicated otherwise in the Contract.

6-03.4 MEASUREMENT

Bid items of work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

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 of 1 percent of the weight of the member shall be deducted from the scale weights to compensate for weight of shop paint.

6-03.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 6-03 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

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" shall 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 the purpose of payment, such minor items as bearing plates, pedestals, forged steel pins, anchor bolts, field bolts, shear connectors, etc., shall not be considered as structural carbon steel even though it is made of other materials.

All costs related to inspection of structural welds shall be included in the Bid item price Bid for structural steel and shall, in each case, refer to the appropriate inspection method necessary for obtaining optimum quality assurance and shall be 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" shall include all costs for the work required to furnish and install the Material as specified.

7. **Other payment information.**

When no Bid item is included in the Bid Form and payment is not otherwise provided, the castings, forgings, and miscellaneous metal shall be considered as incidental to the construction, and all costs therefore shall be included in the Bid item prices for the Bid items involved and shall be at no additional or separate expense to the Owner.

Prospective Bidders shall verify the estimated weight of structural steel before submitting the Bid.

All costs related to filling pockets shall be included in the Bid item prices for structural or cast steel and shall be at no additional or separate expense to the Owner.

The weight of field bolts shall be based on the Engineer reviewed shipping list. No payment will be made for any weight in excess of 1-1/2 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" in accordance with Section 6-02.5.

All costs related to providing drain holes shall be included in the Bid item prices for structural or cast steel and shall be at no additional or separate expense to the Owner.

All costs related to providing drain holes per Section 6-03.3(40) shall be included in the Bid item prices for structural or cast steel and shall be at no additional or separate expense to the Owner.

SECTION 6-04 TIMBER STRUCTURES

6-04.1 DESCRIPTION

Section 6-04 addresses the work of building of any Structure or parts of Structures (except piles) made of treated timber, untreated timber, or both. The Contractor shall erect timber structures on prepared foundations. The Structures shall conform to the dimensions, lines, and grades required by the Drawings, the Engineer, and these Standard Specifications.

Any part of a timber structure made of nontimber Materials shall comply with the sections of the Standard Specifications that govern those Materials.

6-04.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Structural Steel and Related Material	9-06
Paints	9-08
Timber and Lumber	9-09

6-04.3 CONSTRUCTION REQUIREMENTS

6-04.3(1) STORING AND HANDLING MATERIAL

At the Project Site, the Contractor shall store all timber and lumber in stacked piles. Weeds and rubbish under and around these piles shall be removed before the lumber is stacked.

Untreated lumber shall be open stacked at least 12 inches above the ground and shall be piled to shed water and prevent warping.

Treated timber shall 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; and
5. Lifted and moved with rope and chain slings (without using cant dogs, peaveys, hooks, or pike poles).

6-04.3(2) WORKMANSHIP

See Section 1-05.13. Poor workmanship includes deep hammer marks in wood surfaces. Workmanship on metal parts shall comply with requirements of Section 6-03.

6-04.3(3) SHOP DRAWINGS

The Contractor shall provide the Engineer with six sets of Shop Drawings for all Structures built with treated timber. These Shop Drawings shall show dimensions for all cut, framed, or bored timbers.

The Engineer will return to the Contractor one set of reviewed Shop Drawings. No material shall be framed or bored until the Engineer has completed review of the Shop Drawings. Shop Drawings shall be drawn on sheets that conform to the sizes required in Section 1-05.3(10)B.

6-04.3(4) FIELD TREATMENT OF CUT SURFACES, BOLT HOLES, AND CONTACT SURFACES

All cut surfaces, bolt holes, and contact surfaces shall be treated in accordance with Section 9-09.3 for all timber and lumber requiring preservative treatment.

All cuts and abrasions in treated timber piles or treated timbers shall be trimmed carefully and treated again at the cut or abrasion in accordance with Section 9-09.3.

6-04.3(5) HOLES FOR BOLTS, DOWELS, RODS, AND LAG SCREWS

Holes shall 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 two 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 two thirds of the shank diameter.

6-04.3(6) BOLTS, WASHERS, AND OTHER HARDWARE

Bolts, flat-head bolts, dowels, washers, and other hardware, including nails, shall be black or galvanized as specified on the Drawings. Hardware not otherwise specified shall be galvanized when used in treated timber Structures. Flat-head bolts are detailed in the Standard Plans.

Washers of the size and type specified shall be used under all bolt heads and nuts that contact wood. Flat-head bolts require washers under the nuts only.

All bolts shall be checked by burring the threads after the nuts have been finally tightened. Vertical bolts shall have nuts on the lower ends.

Wherever bolts fasten timber to timber, timber to concrete, or timber to steel, the members shall be bolted tightly together at installation and retightened just before the Owner accepts the Work. These bolts shall have surplus threading of at least 3/8 inch per foot of timber thickness to permit future tightening.

6-04.3(7) COUNTERSINKING

Countersinking shall be done wherever smooth faces are indicated in the Contract. Each recess shall be treated in accordance with Section 9-09.3.

6-04.3(8) FRAMING

The Contractor shall cut and frame lumber and timber to produce close-fitting, full-contact joints. Each mortise shall be true to size for its full depth, and its tenon shall fit it snugly. Neither shimmed nor open joints are permitted.

6-04.3(9) FRAMED BENTS

Mudsills shall be of pressure-treated timber, firmly and evenly bedded to solid bearing, and tamped in place.

Concrete pedestals that support framed bents shall be finished so that sills bear evenly on them. To anchor the sills, the Contractor shall set dowels in the pedestals when they are cast. The dowels shall be at least 3/4 inch in diameter and protrude at least 6 inches above the pedestal tops. Pedestal concrete shall comply with Section 6-02.

Each sill shall rest squarely on mudsills, piles, or pedestals. It shall 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. The Contractor shall ensure no earth touches the sills and that free air circulation surrounds them.

Each post shall 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 shall rest uniformly across the tops of posts or piles and cap ends shall be aligned evenly. Each cap shall 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 shall be approximately in the center of the pile or post.

If the roadway grade exceeds 2 percent, each cap shall be beveled to match the grade.

6-04.3(11) BRACING

When pile bents are taller than 10 feet, each bent shall be braced transversely. Every other pair of bents shall be braced longitudinally. No single cross-bracing shall brace more than 20 feet of vertical distance on the piles. More than one cross-bracing shall be used if the vertical distance exceeds 20 feet. Each brace end shall be bolted through the pile, post, or cap with a bolt at least 3/4 inch in diameter. Other brace/pile intersections shall be bolted or boat-spiked as indicated on the Drawings. Cross-bracing shall lap both upper or lower caps and shall 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 shall be sized to an even depth at bearing points. Outside stringers shall be butt jointed and spliced.

Interior stringers shall be lapped so that each rests over the full width of the cap or floorbeam at each end. Stringers may cover two spans except on sharp horizontal and vertical curves. In this case, joints shall be staggered and the stringers either toenailed or drift bolted as indicated in the Contract. To permit air circulation on untreated timber structures, the ends of lapped stringers shall be separated. This separation shall be done by fastening across the lapping face a 1-inch by 3-inch wood strip cut 2 inches shorter than the depth of the stringer.

Any cross-bridging or solid bridging shall be neatly and accurately framed, then securely toenailed at each end (with two nails for cross-bridging and four nails for solid bridging). The Drawings show bridging size and spacing.

6-04.3(13) TIMBER WHEEL GUARDS AND TIMBER RAILINGS

Timber wheel guards and timber railings shall follow the construction requirements of Section 6-06.3(1). Construction methods not addressed in Section 6-06.3(1) shall follow the construction requirements of Section 6-04.

6-04.3(14) SINGLE-PLANK FLOORS

Single-plank floors shall be made of a single thickness of plank on stringers or joists.

The planks shall be:

1. Laid heart side down with tight joints;
2. Spiked to each joist or nailing strip with at least two 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 no adjacent planks vary in thickness by no more than 1/16 inch; and
6. Surfaced on one side and one edge (S1S1E) unless otherwise specified in the Contract.

6-04.3(15) LAMINATED FLOORS

The strips shall be placed on edge and shall be drawn down tightly against the stringer or nailing strip and the adjacent strip and, while held in place, shall be spiked. Each strip shall extend the full width of the deck, unless otherwise indicated in the Contract.

Each strip shall 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 shall be of sufficient length to pass through two strips and at least halfway through the third. In addition, unless bolting is specified in the Contract, each strip shall be toenailed to alternate stringers with 40d common nails and adjacent strips shall be nailed to every alternate stringer. The ends of all pieces shall be toenailed to the outside stringer. The ends of the strips shall 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 shall be placed at the spacing shown in the Contract, and the pieces shall be drawn down tightly to the bolting strips. The bolt heads shall be driven flush with the surface of the deck. Double nuts or single nuts and lock nuts shall be used on all bolts. The strips shall be spiked together in the same manner as specified above.

6-04.3(16) PLANK SUBFLOORS FOR CONCRETE DECKS

Any plank subfloor shall be laid surfaced side down with close joints at right angles to the centerline of the roadway. Planks shall be spiked in place as required in Section 6-04.3(14).

Floor planks shall be treated as Section 9-09.3 requires.

6-04.3(17) TRUSSES

Completed trusses shall show no irregularities of line. From end to end, chords shall be straight and true in horizontal projection. In vertical projection they shall 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 shall 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(3) for painting of timber Structures.

6-04.4 MEASUREMENT

Bid items of work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

The criteria in Section 6-03.4 will be used to determine the weight of structural metal other than hardware.

Timber and lumber (treated or untreated) will be measured by the 1,000 board feet (MBM), using nominal thicknesses and widths. Lengths will be 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 shall be the length remaining in the finished Structure.

6-04.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 6-04 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

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 proposal, full pay for furnishing and placing metal parts shall 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 605 describes work consisting of furnishing and driving piles (timber, precast concrete, cast-in-place concrete, and steel) of the sizes and types indicated in the Contract require. This work also includes cutting off or building up piles when required.

6-05.2 MATERIALS

Materials shall meet the requirements of the following sections:

Reinforcing Steel	9-07
Prestressing Steel	9-07.10
Piles	9-10

6-05.3 CONSTRUCTION REQUIREMENTS**6-05.3(1) PILE TERMS**

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. In the absence of a specified factor of safety, a value of three (3) shall be used.

Auger Cast-In-Place Piles — Auger cast-in-place piles are auger drilled soil penetrations to the limits called for 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.

Concrete Piles — Concrete piles may be precast or precast-prestressed driven to the limits called for in the Contract. Concrete piles may also be steel casings driven to limits called for in the Contract and then filled with concrete after driving.

Developed Hammer Energy — The developed hammer energy is the actual amount of gross energy produced by the hammer for a given blow. This value shall 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 shall be calculated from ram impact velocity measurements or other means approved by the Engineer. For closed-ended diesel hammers, the developed energy shall 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.

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.

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, thus protecting the hammer and the pile.

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 as uniformly as possible 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 (anvil, hammer cushion, etc.) fit. The helmet does not include the follower, if one is used. For hydraulic hammers, the helmet is sometimes referred to as the anvil.

Maximum Driving Resistance — The maximum driving resistance is either the pile ultimate bearing capacity, or ultimate bearing capacity plus overdriving to reach minimum tip elevation is specified in the Contract, whichever is greater.

Minimum Tip Elevation — The minimum tip elevation is the elevation to which the pile tip shall be driven. Driving deeper in order to obtain the required bearing capacity may be required.

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 in order to reach the minimum tip elevation specified in the Contract, or as required by the Engineer.

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.

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.

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.

Pile Driving System — The pile driving system includes, but is not necessarily limited to, the hammer, leads, helmet or cap, cushion and pile.

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.

Pile Shoe — A hard metal tip secured to the driving end of a pile for protecting the pile tip during penetration into the soil.

Pile Tip — The penetrating end of the pile opposite the pile head where end bearing may occur. Also known as tip.

Rated Hammer Energy — The rated energy represents the theoretical maximum amount of gross energy that a pile driving hammer can generate. The rated energy of a pile driving hammer shall be stated in the hammer manufacturer's catalog or specifications for that pile drive hammer.

Steel Piles — Open-ended or closed-ended pipe piles, or H-piles.

Transferred Hammer Energy — The transferred hammer energy is the amount of energy transferred to the pile for a given blow. This value shall 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 use of sensors attached to the pile. A pile driving analyzer (PDA) may be used to measure transferred energy.

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 may be required by the Contract.

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 herein to verify the Contractor's proposed pile driving system. The pile driving system includes, but is not necessarily limited to, the pile, the hammer, the helmet, and any cushion. The wave equation may also be used by the Engineer 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 shall be ordered by the Contractor. The Contractor shall 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. The Contractor shall increase the lengths, at no additional cost to the Owner, the necessary amount 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) CONCRETE PILES

6-05.3(3)A MANUFACTURE OF PRECAST CONCRETE PILES

Precast concrete piles shall 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 shall be chamfered 1 inch.

13-inch diameter precast or prestressed piles shall meet the requirements of WSDOT Standard Plan no. E-4.

16-inch and 18-inch diameter precast-prestressed piles shall meet the requirements of WSDOT Standard Plan no. E-4a.

Temporary stress in the prestressing reinforcement of prestressed piles (before loss from creep and shrinkage) shall be 70 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 70 percent of that strength.)

Prestressed concrete piles shall have a final (effective) prestress of at least 1,000 psi.

Unless the Engineer approves splices, all piles shall be full length.

The Engineer intends to perform inspection in accordance with Section 1-06.1.

6-05.3(3)B CASTING AND STRESSING

Reinforcing bars, hoops, shoes, etc. shall be placed as shown in the Contract. All parts shall be securely tied together and placed to the specified spacings. No concrete shall be placed until all reinforcement is in place and the forms are secured.

The Contractor shall perform quality control inspection. The manufacturing plant for precast concrete piles shall be certified by the Precast/Prestressed Concrete Institute's Plan Certification Program for the type of precast piles that is to be produced and shall be approved by WSDOT as a Certified Precast Concrete Fabricator prior to start of production.

Prior to the start of production of the piles, the Contractor shall provide the Engineer advance notification of the production schedule. The Engineer may inspect the fabrication of concrete piles in accordance with Sections 1-05 and 1-06.

In casting concrete piles, the Contractor shall:

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 that the reinforcement is properly embedded;
6. Use internal vibration around the reinforcement during concrete placement to prevent rock pockets from forming; and
7. Cast test cylinders with each set of piles as concrete is placed.

Forms shall be metal and shall be braced and stiffened to retain their shape under pressure of wet concrete. Forms shall 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 shall be a true plane at right angles to the pile axis.

Each pile shall contain a cage of nonprestressed reinforcing steel sized and located as indicated on the Drawings. Spiral steel reinforcing shall be secured in position and shall have a minimum 1-1/2 inch concrete cover from the outside pile surface.

Prestressing steel shall be tensioned as required in Section 6-02.3(25)D.

The Drawings specify tensioning stress for strands or wires. Tension shall be measured by jack pressure as described in Section 6-02.3(25)D. Mechanical locks or anchors shall temporarily maintain cable tension. All jacks shall have hydraulic pressure gauges (accurately calibrated and accompanied by a certified calibration curve no more than 180 days old) that permit stress calculations at all times.

All tensioned piles shall be pretensioned. Post-tensioning is not allowed.

The Contractor shall not stress any pile until test cylinders made with it reach a compressive strength of at least 3,300 psi.

6-05.3(3)C FINISHING

As soon as the forms for each precast concrete pile is removed, the Contractor shall fill all holes and irregularities in the pile with 1:2 mortar. That part of any trestle pile that is to be underground or below the low-water line and all parts of any pile to be used in salt water or alkaline soil shall receive only this mortar treatment. That part of any trestle pile that shows above the ground or water line shall be given a Class 3 finish as described in Section 6-02.3(14)D.

6-05.3(3)D CURING

Precast Concrete Piles. The Contractor:

1. Shall keep the concrete continuously wet with water after placement for at least ten days with Type I or II Portland cement or at least three days with Type III;
2. Shall remove side forms no sooner than 24 hours after concrete placement, and then only if the surrounding air remains at no less 50°F for five days with Type I or II Portland cement or three days with Type III; and
3. May cure precast piles with saturated steam or hot air, as described in Section 6-02.3(25)E, provided the piles are kept continuously wet until the concrete has reached a compressive strength of 3,300 psi.

Precast-Prestressed Concrete Piles. These piles shall be cured as required in Section 6-02.3(25)E.

6-05.3(4) MANUFACTURE OF STEEL CASINGS FOR CAST-IN-PLACE CONCRETE PILES

The diameter of steel casings shall be as specified in the Contract. Spiral welded steel pile casings are not allowed for steel pile casings 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(5) MANUFACTURE OF STEEL PILES

Steel piles shall 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 permit steel piles and steel casings for cast-in-place concrete piles to be spliced. However, the Contractor shall obtain the Engineer's advance approval on the need and the method for splicing. Welded splices shall be spaced at a minimum distance of *10 feet*. Only welded splices will be permitted.

Splice welds shall comply with Section 6-03.3(25) and AWS D1.1 Structural Welding Code. Splicing of steel piles shall be performed in accordance with an approved weld procedure. The Contractor shall submit a weld procedure to the Engineer for approval prior to welding. For ASTM A 252 Material, mill certification for each lot of pipe to be welded shall accompany the submittal.

Weld splicing of steel casings for cast-in-place concrete piles shall be the Contractor's responsibility. Casings that collapse or are not watertight, shall be replaced at no additional cost to the Owner.

Steel casing joints shall not be offset more than 1/16 inch.

6-05.3(7) STORAGE AND HANDLING

The Contractor shall store and handle piles in ways that protect them from damage.

6-05.3(7)A TIMBER PILES

Timber piles shall be stacked closely and in a manner to prevent warping. The ground beneath and around stored piles shall be cleared of weeds, brush, and rubbish. Piles shall be covered against the weather if the Engineer requires it.

The Contractor shall take special care to avoid breaking the surface of treated piles. Piles shall be lifted and moved with rope or chain slings (without the use of cant dogs, peaveys, hooks, or pike poles). If timber piles are rafted, any attachments shall be within 3 feet of the butts or tips. Any surface cut or break shall be brushed with two coats of creosote oil and covered with an approved roofing asphalt. The Engineer may reject any pile because of a cut or break.

6-05.3(7)B PRECAST CONCRETE PILES

The Contractor shall 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 shall protect piles from fractures by impact and undue bending stresses. Handling methods shall never stress the reinforcement more than 12,000 psi. An allowance of twice the calculated load shall be made for impact and shock effects. The method of lifting the piles shall be submitted to the Engineer for approval. The Contractor shall 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 shall be driven with squared ends unless subsurface conditions require attaching metal shoes. Pile tips and shoes shall be securely attached to the piles in accordance with the manufacturer's recommendations.

When required in the Contract, conical steel pile tips shall be used when driving steel casings. The tips shall 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 shall have a steel driving plate that is thick enough to keep the casing watertight and free from distortion as it is driven. The diameter of the steel driving plate shall not be greater than the outside diameter of the steel casing.

Where called for in the Contract, inside-fit cutting shoes shall be used when driving open-ended steel piles. The cutting shoes shall 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 shall be of an inside diameter at least 0.75 inch less than the nominal inside diameter of the steel pile.

The Contractor shall submit to the Engineer for approval, Shop Drawings of the proposed pile tip or shoe along with design calculations, specifications, material chemistry and installation requirements, and shall also be prepared to provide a pile driving test demonstrating suitability of the proposed pile tip. The test shall be performed in the presence of the Engineer or an acceptable to the Engineer independent AASHTO certified testing agency, and shall consist of driving a pile fitted with the proposed tip. The pile shall be located outside the proposed foundation limits if the pile cannot be visually inspected (see Section 6-05.3(11)F). The pile shall 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 shall be removed for evaluation.

6-05.3(9) PILE DRIVING EQUIPMENT**6-05.3(9)A GENERAL**

Prior to driving any piles, the Contractor shall submit to the Engineer for approval, the details of each proposed pile driving system. The pile driving system shall meet the minimum requirements for the various combinations of hammer type and pile type specified in this Section. These requirements are minimums and may need to be increased in order to ensure that the required bearing capacity can be achieved, that minimum tip elevations can be reached, and to prevent pile damage.

The Contractor shall 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 shall 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 shall be performed in accordance with the requirements of this Specification Section and the user's manual for the program. The wave equation analysis shall 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 shall be 3 times the square root of f_c' , plus prestress in tension, and $0.85f_c'$ minus prestress in compression. The wave equation shall 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. Furthermore, the wave equation analysis shall verify that at bearing, the maximum driving resistance is 100 blows per foot or less. Unless otherwise specified in the Contract, the following default values shall be used as input to the wave equation analysis program:

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	

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 approved, the Contractor shall 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 shall weigh it in the Engineer's presence or provide the Engineer with a certificate of its weight. The exact weight shall be stamped on the hammer. Drop hammers shall have a weight of not less than:

1. 3,000 pounds for piles under 50 feet long that have an ultimate bearing capacity of not more than 60 tons; and
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 shall provide the Engineer with the manufacturer's specifications and catalog. These shall 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 shall have a maximum drop of 10 feet. Drop hammers shall not be used 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 shall provide at least 13,000 foot-pounds of developed energy per blow. The ram of any diesel hammer shall have a weight of at least 2,700 pounds.

Precast concrete, and precast-prestressed concrete piles shall 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 shall not exceed six. Steel casings for cast-in-place concrete, steel pipe, and steel H-piles shall also be driven with diesel, hydraulic, steam, or air hammers.

These hammers shall 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 to 210	27,500	29,500	38,000	23,500
211 to 300	39,000	41,500	54,000	33,500
301 to 450	59,000	63,000	81,000	50,500

In addition, the ram of any diesel or hydraulic hammer shall have the following minimum weights:

Maximum Driving Resistance (tons)	Minimum Ram Weight (lbs)
Up to 165	2,700
166 to 210	4,000
211 to 300	5,000
301 to 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 either 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 shall be enough to erode the material next to the pile at the tip. The equipment shall include a minimum of two water jet pipes and two 3/4 -inch jet nozzles. The pump shall produce a constant pressure of at least 100 psi at each nozzle.

6-05.3(9)C PILE DRIVING LEADS

All piles shall be driven with fixed-lead drivers. The leads shall be fixed on the top and bottom during the pile driving operation. Leads shall 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, the Contractor shall use spuds and chocks as little as possible. In building a trestle or foundation with inclined piles, leads shall be adapted for driving batter piles.

A helmet of the right size for the hammer shall distribute the blow and protect the top of steel pile or steel casing from driving damage. The driving head shall be positioned symmetrically below the hammer's striking parts, so that 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 other than those fixed at the top and bottom may be used to complete driving when all of the following criteria are met:

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; and
2. The pile driving system (hammer, cushion and pile) shall 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 one production pile per pier.

The Contractor shall submit the revised fixing of leads set-up and PDA analysis to the Engineer prior to pile driving.

6-05.3(10) TEST PILES

If specified in the Contract, the Contractor shall drive test piles to determine pile lengths satisfying the specified load-carrying capacity, penetration, or both. Test piles shall:

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 either treated or untreated);
2. Be driven with pile tips if the permanent piles are to have tips;
3. Be prebored when preboring 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. Long enough to accommodate Project Site soil conditions and Contract requirements;
6. Driven with the same equipment and methods to be used for the permanent piles;
7. Located where the Engineer directs; and
8. Driven before the permanent piles in a given 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 prior to reaching any specified minimum tip elevation.

Timber test piles shall be driven outside the footing and cut off 1 foot below the finished ground line. Timber test piles shall not be used in place of permanent piles.

Steel test piles and all types of concrete test piles shall become permanent piles. The Engineer has reduced the number of these permanent piles by the number of test piles.

The Contractor shall base test pile length on test-hole data provided in the Contract. Any test pile not long enough to meet Contract requirements shall be replaced (or spliced if the Contract allows splicing) at no additional cost to the Owner.

In foundations and trestles, test piles shall 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 shall be driven to the same ultimate bearing capacity as the production piles. Test piles shall penetrate to at least the minimum tip elevation(s) specified in the Contract. If no minimum tip elevation is specified, test piles shall 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, the Contractor shall 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 shall 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 shall be within 2 inches of the locations indicated in the Contract. For piles capped below final grade, the tops of piles at cut-off elevation shall be within 6 inches of the horizontal locations indicated in the Contract. No pile edge shall be nearer than 4 inches from the edge of any footing or cap. Piles shall be installed such that the axial alignment of the top 10 feet of the pile is within 4 percent of the specified alignment. No misaligned steel or concrete piles shall be pulled laterally. A properly aligned section shall not be spliced onto a misaligned section for any type of pile. All piles shall be driven vertically unless indicated otherwise on the Drawings.

6-05.3(11)B FOUNDATION PIT PREPARATION

The Contractor shall replace any damaged pile whether before or during driving at no additional cost to the Owner.

The Contractor shall complete all foundation pits (and build any required cofferdams or cribs) before driving foundation piles. The Contractor shall adjust pit depths to allow for upheaval caused by pile-driving. Before constructing the footing or pile cap, the Contractor shall restore the pit bottom to the specified elevation by removing heaved material or by backfilling with granular material specified in the Contract.

6-05.3(11)C PREPARATION FOR DRIVING

Treated and untreated timber piles shall 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 shall 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 shall be snipped or chamfered to fit the hammer. On treated piles, the heads shall be snipped or chamfered to at least the depth of the sapwood to avoid splitting the sapwood from the pile body.

The Contractor shall match timber pile sizes in any single bent to prevent sway braces from undue bending or distorting.

When driven, pile faces shall be turned as shown on the Drawings.

No precast-prestressed pile shall 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 shall reach a compressive strength of at least 4,000 psi before the piles are driven.

Helmets of approved design shall protect the heads of all precast concrete piles as they are driven. Each helmet shall have fitted into it a cushion next to the pile head. The bottom side of the helmet shall be recessed sufficiently to accommodate the required pile cushion and hold the pile in place during positioning and driving. The inside helmet diameter shall be determined before casting the pile, and the pile head shall be formed to fit loosely inside the helmet.

Steel Casing, steel pipe, or H-piles shall have square-cut ends. During driving, each pile head shall 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 shall be driven continuously until the required load bearing capacity shown in the Contract has been achieved. Pauses during pile driving, except for splicing, mechanical breakdown, or other unforeseen events, shall not be allowed.

If the Contract specifies a minimum tip elevation, the pile shall 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, the Contractor shall continue driving the pile until the required bearing capacity is achieved. If no minimum tip elevation is specified, then the piles shall be driven to the load bearing capacity shown 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 in order to reach a specified minimum tip elevation, the Contractor shall 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 shall 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; or
4. Penetrate through a previously placed embankment.

"Normal means" refer to methods such as preboring, spudding, or jetting. Blasting or drilling through obstructions are not considered "normal means" and shall not be used.

Prebored holes and pile spuds shall have a diameter no larger than the least outside dimension of the pile. After the pile is driven, the Contractor shall fill all open spaces between the pile and the soil caused by the preboring or spudding with dry sand, or pea gravel, or controlled density fill as approved by the Engineer.

If water jets are used, the jets shall be withdrawn before the pile reaches its final penetration, and the pile shall then be driven to its final penetration and bearing capacity. The pile shall 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 shall be redriven in place or pulled and replaced by a new pile. To check on pile loosening, the Contractor shall attempt to redrive at least one in every five piles as selected by the Engineer.

If the Engineer requires, the Contractor shall overdrive the pile beyond the minimum load-bearing capacity and minimum tip elevation shown in the Contract. In this case, the Contractor will not be required to:

- 1) Use other than "normal means" to achieve the additional penetration;
- 2) Bear the expense of removing or replacing any pile damaged by overdriving; or
- 3) Bear the expense of overdriving the pile more than 3 feet as specified in Section 6-05.5.

In driving piles for footings with seals, the Contractor shall use no method (such as jetting or preboring) that might reduce friction capacity.

6-05.3(11)E USE OF FOLLOWERS FOR DRIVING

Followers shall not be used 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 will not be 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 shall, in every group of 10 piles, drive one long pile without a follower to the required bearing capacity and minimum tip elevation. This long pile shall be used to test the bearing capacity of the piles driven with a follower in the group. The tip elevation of the long pile shall be similar to the tip elevations of the piles driven with the follower. If the tip elevations vary considerably, the Contractor shall redrive the remaining piles in the group to the tip elevation of the longer pile.

6-05.3(11)F PILE DAMAGE

The Contractor shall 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 shall leave it empty until the Engineer has inspected and accepted it. The Contractor shall make available to the Engineer a light suitable for inspecting the entire length of its interior. The Engineer will reject any casing that is 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 shall remove and replace any rejected casing at no additional cost to the Owner.

Pile heads which have been broomed, rolled, or otherwise damaged shall be cut back to undamaged material before proceeding with driving or acceptance of the pile.

6-05.3(11)G PILE CUTOFF

The Contractor shall trim the tops of all piles to the true plane and to the elevation indicated in the Contract. If a pile is driven below cutoff elevation without the Engineer's approval, the Contractor shall 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, shall be driven down again.

Any piles under timber caps or grillages shall 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 shall be straightened without damage before it is cut off or braced.

Steel casings shall be cut off at least 6 inches below the finished ground line or at the low water line if a casing may be visible.

6-05.3(11)H PILE DRIVING FROM OR NEAR ADJACENT STRUCTURES

The Contractor shall not drive piles from an existing structure unless all of the following conditions are met:

1. The existing structure is to be demolished within the Contract;
2. The existing structure is permanently closed to traffic; and
3. Working Shop Drawings are submitted in accordance with Sections 6-01.9 and 6-02.3(16), showing the structural adequacy of the existing structure to safely support all of the construction loads.

To minimize the detrimental effects of pile driving vibrations on new concrete less than 28 days old, piles shall not be driven closer to the new concrete than the distance determined by the following formula:

$D = C \text{ times the square root of } E$

Where: D = distance in feet

E = rated hammer energy in foot-pounds

C = coefficient shown 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
5	0.13	21-28	0.08

This distance may be reduced if approved in writing by the Engineer.

6-05.3(12) DETERMINATION OF BEARING VALUES

The following formula shall be used to determine ultimate bearing capacities:

$$P = F \times E \times L_n(10N)$$

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 H¹, 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"

¹For closed-end diesel hammers (double-acting), the developed hammer energy (E) is to be 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 shall 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 in a manner 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 shall be deducted from "H" to determine its true value in the formula;
7. For timber piles, bearing capacities calculated by the formula above shall be considered effective only when it is less than the crushing strength of the piles; and
8. 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 shall be driven until the penetration resistance is a minimum of 1.0 blow/inch for the last 2 feet of driving.

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, bearing capacities shall be determined either: (1) by 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 (2) by applying a test load.

6-05.3(13) TREATMENT OF TIMBER PILE HEADS

After cutting timber piles to correct elevation, the Contractor shall thoroughly coat the heads of all untreated piles with two 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 shall brush three 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 shall then be capped with alternate layers of an approved roofing asphalt and a waterproofing fabric that conforms to Section 9-11.2. The cap shall be made of four layers of an approved roofing asphalt and three layers of fabric. The fabric shall 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, its edges shall be fastened with large-head galvanized nails or with three turns of galvanized wire. The edges of the cover shall be neatly trimmed.

On any treated timber pile encased in concrete, the cut end shall receive two 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 shall add extensions, or build-ups (if necessary) on precast concrete piles after they are driven to the required bearing capacity and minimum tip elevation.

Before adding extensions or build-ups to precast-prestressed piles, the Contractor shall 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 build-up shall reach a minimum compressive strength of 5,000 psi at 28 days.

Before adding to a non-prestressed precast concrete pile, the Contractor shall cut the pile head to a depth 40 times the diameter of the vertical reinforcing bar. The final cut shall be perpendicular to the axis of the pile. Reinforcement of the same density and configuration as used in the pile shall be used in the build-up and shall be fastened firmly to the projecting steel. Forms shall be placed to prevent concrete from leaking along the pile. The concrete in the build-up shall 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 shall thoroughly wet the top of the pile. Forms shall remain in place at least three days.

6-05.3(15) COMPLETION OF CAST-IN-PLACE CONCRETE PILES

After acceptance of the casing by the Engineer (see Section 605.3(11)F), the driven casing shall be cut off horizontally at the required elevation. They shall be clean and free of water when concrete and reinforcing steel are placed.

These piles shall 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 shall be fastened rigidly into a single unit, then lowered into the casing before the concrete is placed. Loose bars shall not be used.

Spiral hooping reinforcement shall be deformed steel bar, plain steel bar, cold-drawn wire, or deformed wire.

6-05.3(15)B PLACING CONCRETE

The Contractor shall remove all debris and water from the casing before placing concrete. If the casing cannot be dewatered, the casing shall be removed (or cut off 2 feet below the ground surface and filled with sand) and a new casing shall be driven at a location determined by the Engineer.

The Contractor shall place concrete continuously through a rigid conduit at least 5 feet long. The concrete shall be directed down the center of the pile casing completely filling the casing including around the reinforcement. The top 5 feet of concrete shall be placed with the tip of the conduit below the top of fresh concrete. The Contractor shall vibrate, as a minimum, the top 10 feet of concrete. In all cases, the concrete shall be vibrated to a point at least 5 feet below the original ground line.

6-05.4 MEASUREMENT

Bid items of work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

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:

1. Furnishing timber piles (untreated or name of treatment).
2. Precast concrete and precast-prestressed concrete piles.
3. Cast-in-place concrete piles.
4. Furnishing steel piles.

Measurement for furnishing and driving test piles will be the number actually 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.

6-05.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 6-05 will be made at the Bid item prices Bid for Bid items listed or referenced as follows:

1. **"Furnishing and Driving (Type) Test Pile"**, per each.

The Bid item price for "Furnishing and Driving (Type) Test Pile" shall 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, preboring when preboring is specified for the permanent piles, for pulling the piles or cutting them off as required, and for removing them from the site or for delivery to the Owner for salvage when ordered by the Engineer. This Bid item price shall also include all costs in connection 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 site of this work shall be at no additional cost to the Owner.

2. **"Driving Timber Pile (untreated or name treatment)"**, per each.

The Bid item price for "Driving Timber Pile (untreated or name treatment)" shall 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 prices for "Driving Concrete Pile (Size)" and for "Driving Steel Pile" shall include all costs for the work required to drive the pile to the bearing and/or penetration specified. When overdriving piles beyond the minimum bearing capacity and/or minimum tip elevation specified in the Contract is required by the Engineer, payment for the first 3 feet of overdriving shall be included in the Bid item prices for "Driving Concrete Pile (Size)" and for "Driving Steel Pile". Additional penetration beyond the first 3 feet of overdriving will be paid for in accordance with Section 1-09.4.

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 Bid item prices for "Furnishing Timber Piles, (Untreated or Name Treatment)", for "Furnishing Concrete Piles, (Size)", and for "Furnishing Steel Piles" shall include all costs for the work required to furnish and store the piles specified and shall include extra pile length ordered but not driven.

8. **"Precast Concrete Pile Buildup"**, per each.

Payment for build-ups of precast or precast-prestressed concrete piles will be made in accordance with Section 1-09.4. No payment will be made for build-ups or additional lengths of build-up 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)" shall 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 which are incorporated as permanent piles shall 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.**

Payment for build-ups of precast or precast-prestressed concrete piles will be made in accordance with Section 1-09.4. No payment will be made for build-ups or additional lengths of build-up 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.

Any pile which is damaged or destroyed before or at the time it is being driven shall be replaced by the Contractor at no additional cost to the Owner.

The various Bid item prices for driving piles shall cover all costs related to the use of water jets, preboring, or spudding. All costs the Contractor incurs in redriving piles loosened as a result of water jets, preboring, or spudding shall be at no additional cost to the Owner.

The Bid item price for furnishing concrete pile (size specified) shall 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 shall 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 shall 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 shall redrive 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 shall become the property of the Contractor and shall be disposed of by the Contractor.

The Engineer will inspect all piles prior to driving and reserves the right to have any pile which is damaged or destroyed before or at the time it is being driven replaced by the Contractor at no additional cost to the Owner.

The Contractor shall furnish the necessary 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 shall be considered incidental to the construction and shall be included in the Bid item prices for the various 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 shall be considered incidental to the pile Bid items and shall be at no additional cost to the Owner.

All cost for submittals shall be as specified in Section 1-05.3.

Payment for "Steel Reinforcing Bar" shall be in accordance with Section 6-02.5.

All cost and expense for jetting, sand and pea gravel, and vibration monitoring shall be considered incidental to the Bid item price for the pile Bid item and shall 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 shall be included in the various Bid item prices for driving piles and shall be at no additional cost to the Owner.

The cost of overdriving per Section 6-05.3(11)D shall be incidental to the various Bid item prices for furnishing and driving piles and shall be at no additional cost to the Owner.

SECTION 6-06 BRIDGE AND PEDESTRIAN RAILINGS

6-06.1 DESCRIPTION

Section 6-06 addresses the work of providing and building bridge railings and pedestrian railings that meet the requirements of the Contract.

6-06.2 MATERIALS

Material shall meet the requirements of the following Sections:

Timber Railing	9-09
Metal Railing	9-06.18

6-06.3 CONSTRUCTION REQUIREMENTS**6-06.3(1) TIMBER WHEEL GUARDS AND RAILINGS**

Timber wheel guards and timber railings shall be true to line and grade and framed accurately. Construction methods not specified in this Specification Section shall follow the construction requirements of Section 6-04.

Unless the Contract indicates otherwise, wheel guards shall be:

1. Beveled and surfaced on the roadway side and surfaced on the top edge. They may be surfaced on four sides (S4S);
2. Laid in sections at least 12 feet long; and
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 shall be S4S and painted as required in Sections 6-04 and 6-07. Railing members shall be fastened securely together, with the bolts tightened once at installation, and again just before the Physical Completion Date. The Contractor shall 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 shall be made of aluminum alloy or steel.

Before fabricating the railing, the Contractor shall 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(5)). Anchor bolts or wedge anchors shall be positioned with a template to ensure that bolts match the hole spacings of the bottom channels or anchorage plates.

Where specified, cover plates shall fit the bottom channel tightly after being snapped into position.

Metal railings shall be installed true to line and grade (or camber). After first setting the railing, the Contractor shall readjust all or part of it, if necessary, to create an overall line and grade as indicated on the Drawings.

6-06.4 MEASUREMENT

Bid items of work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

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

Compensation for the cost necessary to complete the work described in Section 6-06 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

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)" shall 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. In case no Bid item is included in the Bid Form for "Bridge Railing, (Type)" and "Metal Railing, (Type)" and payment is not otherwise provided, all metal railings shall 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)" shall 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 addresses the work of preparing the surface, providing and applying the paint, and cleaning up. This work shall comply with all requirements of the Contract.

6-07.2 MATERIALS

Materials shall comply with the requirements in Section 9-08.

6-07.3 CONSTRUCTION REQUIREMENTS**6-07.3(1) PAINTING NEW STEEL STRUCTURES****6-07.3(1)A GENERAL**

Shop painting of structural steel shall comply with Section 6-03.3(30). No new structural steel shall be painted until inspected by the Engineer.

6-07.3(1)B NUMBER OF COATS AND COLOR

All new structural steel work shall be cleaned and painted with three coats of paint, except where specified otherwise in the Contract. Cleaning shall conform to the requirements set forth in 6-07.3(1)F. The first coat shall be applied immediately after sandblasting the steel in accordance with the applicable parts of Section 6-03.3(30). The second and third coats shall be applied after erection except as otherwise specified in Section 6-03.3(41). The color of each succeeding coat shall be sufficiently different from that previously applied to readily permit the discovery of an incomplete application of the paint coat. The color of the third coat shall be as specified in the Contract. Three color samples, approximately 10 inches by 10 inches of the final coat shall be submitted to the Engineer.

6-07.3(1)C WEATHER CONDITIONS

Unless the manufacturer's instructions state otherwise and the Engineer approves, paint shall not be applied when:

1. The air and metal are cooler than 40°F;
2. Metal surfaces are damp or the air is misty or the surface temperature is less than 5°F above the dew point;
3. The Engineer believes conditions are unsuitable; or
4. The metal is hot enough to cause the paint to blister and leave a porous finish.

Steel painted under cover in damp or cold weather shall remain under cover until the paint dries or weather conditions permit open exposure.

6-07.3(1)D APPLICATION

Painters shall be competent and do careful work. All field applied coats shall be brushed on unless the Contract specifies otherwise. All paints shall be applied in compliance with manufacturer's recommendations, unless noted otherwise in the Contract.

Painters shall use round or oval shaped brushes, but with aluminum paint, may use flat brushes up to 4 inches wide. Brushing shall first be in a series of tight circles to fill surface roughness, and then in parallel strokes to leave a smooth, even coating that adheres closely to the metal or previous coat. On surfaces that cannot be brushed, painters shall use sheepskin or other daubers approved by the Engineer.

Prior to the application of 1st coat primer, 2nd coat primer, or final coat, the Contractor shall obtain approval from the Engineer who will verify that the surfaces to be painted during that day have first been cleaned in accordance with these Specifications, unless the Contract specifies otherwise.

Bolts, the edges of plates, angles, and other rolled shapes shall receive an extra heavy coating. Painters shall work the paint well into all joints and crevices. Unless the manufacturer's instructions state otherwise and the Engineer approves, all areas named in this paragraph shall be painted lightly just before general painting. This light coating shall be recoated when the general coat is applied.

The Contractor shall schedule operations so that all sand blasted surfaces are primed before the end of the Working Day. Any blasted surface not primed before the end of the Working Day shall be reblasted and primed. If the air temperature or the temperature of the steel falls below the dewpoint after cleaning and prior to application of the first Primer Coat, the Contractor shall reclean the affected area(s) to a condition acceptable to the Engineer at no additional cost to the Owner.

When A-6 (Zinc Dust Zinc Oxide Primer) is used as a primer, the Contractor shall insure that the zinc solids are continually mixed in solution. The Contractor shall mix only the amount of A-6 that can be used up within the current Working Day. Any remaining A-6 primer shall be discarded at the end of the day.

Unless the manufacturer's instructions state otherwise and the Engineer approves, the Contractor shall allow each field coat of paint to cure for a minimum of 18 hours, prior to the application of the succeeding coat of paint. Each succeeding field coat of paint shall be applied within 72 hours after the application of the previous coat of paint.

Should a painted area indicate bond failure, become soiled, contaminated, or rusted prior to the application of any subsequent coats, the Contractor shall reclean and repaint the area at no additional cost to the Owner.

See Section 107.5 regarding the prevention of environmental pollution and the preservation of public natural resources including as applicable, permit requirements and other requirements in the Contract.

Any structural defects, including cracks, missing bolts or rivets, deterioration, etc., detected during the painting of these structures shall be promptly brought to the attention of the Engineer.

If the Contract permits spray painting, airless spray machines shall apply paint as these Specifications require unless the manufacturer recommends otherwise and the Engineer approves. All sprayed paint shall be brushed as described elsewhere in the Section. The Contractor shall not, in attempting to operate a sprayer, add more thinner or other substances than the formulas permit. Before airless spray painting, the Contractor shall demonstrate the airless sprayer application to a test area selected by the Engineer. If the airless sprayer does not produce acceptable results, the Engineer may prohibit its use and require brushing instead.

Before it is removed from its containers, paint shall be stirred thoroughly by a mechanical mixer or by other means. During application, it shall be stirred often enough to keep pigments in suspension.

Paint shall be shipped from the factory at brushing consistency. In no case shall thinner, other than minor amounts needed for cleanup, be used on the project. Any thinner used for cleanup shall be used and stored off the bridge structure.

The final coat on any surface exposed to view shall be made with paint from a common batch. The Contractor shall provide the Engineer with a Manufacturer Certificate of Compliance stating that the final coat is, in fact, from a common batch including material invoices and lot numbers.

6-07.3(1)E REMOVAL OF UNACCEPTABLE PAINT

The Contractor shall remove and replace any paint that has the wrong color, is of improper consistency or purity, or that is applied on metal not cleaned according to Specifications at no additional cost to the Owner.

6-07.3(1)F FIELD CLEANING

After completing erection work (including bolting, straightening bent material, etc.), the Contractor shall thoroughly clean all metal surfaces to an acceptable condition, using metal brushes, scrapers, chisels, hammers, sandblasting or other means the Engineer requires to remove rust, scale, and dirt. Solvents may be used to remove oil and grease, and bristle or wood fiber brushes to remove loose dust. If the structure is covered with dirt or concrete residue, pressure flushing may be required (as specified in Section 6-07.3(2)).

When shipping, handling, or welding injures the shop coat, damaged areas shall be thoroughly cleaned by wire brushing before field painting. Between coats of paint, if the Engineer requires, the Contractor shall reclean the structure by the methods described above.

6-07.3(1)G FIELD PAINTING

Immediately after the Engineer approves the field cleaning, the Contractor shall apply one touch-up coat of the same paint used for the shop coat to these areas: bolt heads, areas where the shop coat has been broken, and all marks made during shipping or erection.

The first field coat shall be applied only after the touch-up coat is completely dry. If the first field coat leaves small cracks and cavities that are not watertight, they shall be filled with single component urethane sealant meeting the requirements of Federal Specification TT-S-00230C, Type II, Class A (applied per manufacturer's recommendation) before the second field coat is applied. No later coat shall be applied until the full thickness of the previous coat has dried.

6-07.3(2) REPAINTING EXISTING STEEL STRUCTURES

Unless otherwise specified in the Contract, maintenance painting includes cleaning and painting the metal parts of an existing bridge. Cleaning means removing rust, scale, dead paint, dirt, grease, and other foreign matter. Foreign matter firmly encapsulated in the existing paint, need not be removed. The Contractor shall clean and paint all exposed metal surfaces that may rust. These include all metal surfaces that do not touch other metal, wooden floor or truss members, concrete or stone masonry, or other surfaces.

Pressure flushing shall precede all other methods of cleaning the metal surfaces. Flushing may be omitted in some areas as approved by the Engineer.

Prior to pressure flushing and abrasive blasting, the Contractor shall submit for approval by the Engineer a written procedure for collection and removal of debris and blasting material.

Pressure flushing shall be done with clean, fresh water. The nozzle shall have sufficient pressure to remove all soilage debris, loose paint and loose rust scale from all metal surfaces. The pressure flushing equipment shall produce at least 3,000 psi at the nozzle and a discharge of at least 4 gpm. The nozzle shall have a 25-degree tip and shall be held no more than 9 inches from the surface being washed.

Rust removal shall be by means of abrasive blasting in accordance with SSPC-SP6 specifications. All rust spots that are abrasive blasted shall be blasted to a uniform white metal appearance with no areas of stain and gray mill scale permitted. There shall be no evidence of red or yellow rust at the edges of the blasted area. The blasted area shall be extended to sound paint, and the sound paint edges shall be feathered to give a smooth surface. Minimum sandblasting nozzle pressure shall be 90 psi.

White metal is defined by the Structural Steel Painting Council No. Sa3 as a surface with gray-white metallic color, slightly rough, to form a suitable base for paint. If the old paint at the edge of an abrasive blasted area lifts after the spot coats are applied, the lifted paint shall be scraped off and the damaged areas repainted. Rust spots which cannot be removed effectively by abrasive blasting shall be removed with power brushing, scraping or other effective means.

All corroded areas shall be sweep-blasted 4 to 6 inches beyond the corroded area during spot blasting procedures. Non-galvanized railing shall be 100% sandblasted to Commercial Blast (SSPC-SP6) specifications.

Abrasive blasting operations shall be done in such a manner that no damage occurs to any portions of the work whether partially or entirely completed.

After abrasive blasting, all loose rust, dirt, sand and dust shall be thoroughly removed before paint is applied. Abrasive blasting clean-up and painting shall comply with the pollution prevention requirements of Section 1-07 and any additional requirements specified in the Contract.

A period of three days shall elapse before applying paint to a surface which has been cleaned by flushing, taking care before painting to remove any dust or dirt which may have settled on the steel members in the intervening time. In those areas where flushing cannot be safely accomplished, the surfaces shall be cleaned to an acceptable condition with an approved solvent.

Painting shall not begin until after approval of surface preparation of each section of the structure by the Engineer.

After the touch-up paint has dried, all cracks and cavities which are not sealed with the spot coats, and all cracks and cavities throughout the bridge structure which border upon rusted or stained areas, shall be sealed with single component urethane sealant meeting the requirements of Federal specification TT-S-00230C, Type 2, Class A (applied per manufacturer's recommendations) before the first coat is applied.

The first coat of paint shall conform to Formula A-6 (Zinc Dust Zinc Oxide Primer) and shall be applied immediately after the steel has been cleaned by sandblasting. The second coat shall also conform to Formula A6 (Zinc Dust Zinc Oxide Primer). The third coat shall conform to Formula C-9-86 (Phenolic Finish coat for Steel). The color of each succeeding coat shall be sufficiently different from that previously applied to readily permit the discovery of an incomplete application of the paint coat. The color of the third coat shall be as specified in the Contract. Three color samples, approximately 10 inches by 10 inches, of the final coat shall be submitted to the Engineer.

If an existing coated surface must be color matched, color samples of the paint manufacturer's product, in the number of shades indicated in the Contract, shall be submitted for the Engineer's approval.

The cleaning-painting requirements of Sections 6-07.3(1)C, 6-07.3(1)D, and 6-07.3(1)E shall apply here unless the Contract specifies otherwise. The Contract typically specifies the number of coats required. If no number is given, the clean metal shall be painted with 3 coats.

If roadway or sidewalk planks lie so close to the metal that they prevent proper cleaning and painting, the Contractor shall remove or cut the planks to provide at least a 1-inch clearance. Any plank removal or cutting shall be done as approved by the Engineer. The Contractor shall replace all planks after painting. If removal breaks or damages the planks and makes them unfit for reuse, the Contractor shall replace them at no additional cost to the Owner.

6-07.3(3) PAINTING TIMBER STRUCTURES

6-07.3(3)A NUMBER OF COATS AND COLOR

Unless the Contract specifies otherwise:

1. Rails and rail posts on timber bridges shall receive 2 coats (with the wheel guard painted only on its top edge and roadway side).
2. Other timber work shall receive 3 coats if the Contract requires other timber work to be painted.

Paint color shall be as indicated in the Contract.

6-07.3(3)B APPLICATION

All wood surfaces which are to be painted shall be prepared in accordance with the paint manufacturer's recommendations and be thoroughly dry and free from oil and dirt. Paint shall be applied by brush, spread evenly, and worked thoroughly into all seasoning cracks, corners, and recesses. No later coat shall be applied until the full thickness of the previous coat has dried.

Final brush strokes with aluminum paint shall be made in the same direction to ensure that powder particles "leaf" evenly.

If a painted surface has been stained by creosote, it shall be given one or more coats of an approved shellac before repainting.

6-07.3(3)C PAINTING TREATED TIMBER

Timber treated with creosote or oil-borne, pentachlorophenol preservatives shall normally not be painted.

Timber treated with water-borne preservatives shall 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 shall be washed and brushed away with the moisture content reduced again to the specified level before painting. Stored timber awaiting painting shall be covered and stacked with spreaders to ensure air circulation.

6-07.3(4) PAINTING GALVANIZED SURFACES

All galvanized surfaces to be painted shall be prepared and painted as follows:

1. Clean all surfaces thoroughly with toluene base solvent;
2. Wipe off the solvent with clean rags until surface is dry; and
3. The clean and dry surface shall be painted according to the following schedule:

First Coat	A-6-86	Zinc Dust Zinc Oxide Primer.
Second Coat	C-9-90	Phenolic Finish Coat for Steel.
Third Coat	C-9-90	Phenolic Finish Coat for Steel.

The color of the finish field coat shall be as specified in the Contract.

Each coat shall be dry before the next coat is applied. All coats applied in the shop *shall* be dried hard before shipment.

The second and third coats shall be applied after field erection and shall conform to Formula C-9-90 (Phenolic Finish Coat for Steel). The color of each succeeding coat shall be sufficiently different from that previously applied to readily permit the discovery of an incomplete application of the paint coat.

If an existing coated surface must be color matched, color samples of the paint manufacturer's product, in the number of shades the Contract requires, shall be submitted for the Engineer's approval. After the color has been selected by the Engineer, three color samples, approximately 10 inches by 10 inches of the selected color shall be submitted to the Engineer.

6-07.3(5) PAINT FILM THICKNESS

A full, wet coat of Formula A-5-61 free from runs and sags produces the proper film thickness (the rapid solvent release in this vinyl pretreatment makes it difficult to measure wet film thickness). Dry film thickness shall be between 0.4 and 0.7 mils.

Any other finish, no matter how it is being applied, shall have a wet thickness of at least 3.0 mils per coat and a dry film thickness of at least 1.5 mils per coat.

If the specified number of coats do not produce a combined dry film thickness of at least the sum of the thicknesses required per coat, the Contractor shall apply another full coat of finish paint.

Film thickness, both wet and dry, shall be measured by suitable gages. Wet measurements shall be taken immediately after the paint is applied, and dry measurements after the coat is dry and hard.

6-07.3(6) PROTECTION OF PUBLIC AND PRIVATE PROPERTY

See Section 1-07 for General Requirements for protecting public and private property, protecting the traffic, protecting the environment, and other legal responsibilities. At the pre-construction conference (Section 1-08.1(2)), or at least 10 Working Days prior to start of painting, the Contractor shall submit a written detailed method for all work related to the painting process as indicated in the Contract. This method shall also indicate a supervisory employee of the Contractor who shall be directly involved in the performance of this work.

The Contractor is required to post signs approved by the Engineer for boaters and traffic regarding the cleaning and painting operations. These signs shall also include information regarding accident spills.

6-07.3(7) MOISTURE CURED URETHANE PAINT

The Contractor shall submit the manufacturer's recommendations for preparation, prime coat(s) and finish coat(s) application methods, curing times, and other information as necessary to ensure material and workmanship acceptable to the Engineer.

6-07.4 MEASUREMENT

Bid items of work completed pursuant to the Bid Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

6-07.5 PAYMENT

The Bid Form contains no separate payment item for painting because Bid item prices cover all costs related to painting new steel or timber structures. Costs related to painting include preparing the surface; applying the paint; protecting and drying the coatings; protecting pedestrians, vehicles, and public and private property from paint; and supplying all tools, tackles, scaffolding, labor, and materials needed to complete the work.

When required, repainting existing steel bridge will be specified in the Contract.

SECTION 6-08 WATERPROOFING**6-08.1 DESCRIPTION**

Section 6-08 addresses the work of applying waterproofing materials to Portland cement concrete surfaces as required by the Contract.

6-08.2 MATERIALS

Materials shall meet the requirements of the following sections:

Asphalt for Waterproofing	9-11.1
Waterproofing Fabric	9-11.2
Portland Cement Mortar	9-11.3

6-08.3 CONSTRUCTION REQUIREMENTS**6-08.3(1) STORAGE OF FABRIC**

The fabric shall be stored in a dry, protected place. Rolls shall not be stored standing on end.

6-08.3(2) PREPARATION OF SURFACE

Preparation of surfaces shall be in accordance with the manufacturer's recommendations. Concrete surfaces shall be reasonably smooth and without projections or holes that might puncture the waterproofing membrane. The surfaces shall be dry, with all dust and loose material removed. The Contractor shall 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 shall be stirred frequently as it is heated to between 300°F and 350°F. Each heating kettle shall have a thermometer.

Each coat of primer or asphalt shall begin at the low point of the surface so that water runs over (not against or along) the laps.

In applying the waterproofing, the Contractor shall:

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 that 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 than 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 three complete moppings of asphalt shall ensure that no fabric layer ever touches another fabric layer or the concrete surface. The Contractor shall examine all laps and ensure that they are thoroughly sealed down.

Each mopping shall cover completely, with a coat heavy enough to hide the fabric weave and all gray spots from the concrete. On horizontal surfaces, at least 12 gallons of asphalt shall be used for every 100 square feet of finished work. On vertical surfaces, at least 15 gallons per 100 square feet shall be used.

At the end of each day's work, all fabric that was laid shall have received its final mopping of asphalt.

Wherever the membrane ends or is punctured by drains, pipes, etc., the Contractor shall seal the area to prevent water from entering between the waterproofing and the concrete surface.

All flashing (at curbs, against girders, spandrel walls, etc.) shall be made of separate sheets that lap the main membrane by at least 12 inches. Flashing shall be sealed closely:

- (1) with full metal flashing; or
- (2) by imbedding its upper edges in a groove poured full of an acceptable joint cement.

At each expansion joint, the membrane shall not be broken but shall be folded to permit movement. At either end of the bridge, the membrane shall run well down abutments and shall allow for expansion and contraction.

6-08.3(4) PROTECTION COURSE

If the Drawings require, the Contractor shall 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 shall be a mix of one part Portland cement to two parts sand. It shall be distributed evenly over the membrane, tamped gently into place, finished by hand to a smooth, hard surface, then covered and kept moist for one week.

6-08.4 MEASUREMENT

Bid items of work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

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

Compensation for the cost necessary to complete the work described in Section 6-08 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **"Waterproofing"**, per square yard.

The Bid item price for "Waterproofing" shall 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 shall be included in the Bid item price for "Waterproofing".

SECTION 6-09 CRIBBING

6-09.1 DESCRIPTION

Section 6-09 addresses the work of providing Materials and constructing cribbing as required by the Contract.

6-09.2 MATERIALS

Materials shall meet the requirements of Section 9-27.

6-09.3 CONSTRUCTION REQUIREMENTS**6-09.3(1) GENERAL REQUIREMENTS****6-09.3(1)A FOUNDATIONS**

Before placing any gabion cribbing, the Contractor shall excavate the foundation or bed to the specified grade in accordance with Section 2-09.3(4). Foundation soils found to be unsuitable shall be removed and replaced in accordance with Section 2-09.3(1)C.

6-09.3(2) RESERVED**6-09.3(3) RESERVED****6-09.3(4) RESERVED****6-09.3(5) RESERVED****6-09.3(6) GABION CRIBBING****6-09.3(6)A DESCRIPTION**

Gabions shall be constructed as indicated in the Contract.

6-09.3(6)B BASKETS

Baskets may be fabricated from either woven or welded steel wire; however, a gabion structure shall not include both. Baskets may be assembled with either lacing wire or clip fasteners; however, a perimeter or diaphragm edge shall not include both.

6-09.3(6)C DIMENSIONS

The Contractor shall supply gabion baskets in the lengths and heights the Drawings require. Each length shall be a whole number multiple (2 times, 3 times, and so on) of horizontal width. Horizontal width shall be 36 inches. All baskets from the same manufacturer shall be the same width and shall be within a tolerance of 5 percent of the manufacturer's stated sizes.

6-09.3(6)D FABRICATION OF BASKETS

Gabions shall be made so that the sides, ends, lid, and diaphragms can be assembled into rectangular baskets of the required sizes at the construction site. Common-wall construction may be used in gabion structures up to 12 feet high. Common-wall construction includes any basket where its top serves as the bottom of the one above it, or where one wall serves an adjacent basket. When gabion structures are more than 12 feet high, the baskets shall have independent sides, ends, top, and bottom.

Each gabion shall be divided by diaphragms into cells the same length as horizontal basket width. Diaphragms shall be made of the same mesh and gage as the basket body.

All perimeter and diaphragm edges shall be laced or clipped together so that joints are at least as strong as the body of the mesh itself. The ends of the lacing wire shall be anchored by three tight turns around the selvage wire.

6-09.3(6)E FILLING OF BASKETS

Stone shall be placed in such a manner as to meet the unit weight requirements of Section 6-09.3(6)F.

Filling shall be in compacted layers not more than 14 inches deep. If cross-connecting wires are required, the Contractor shall adjust the number and depth of layers so that wires occur between the compacted layers.

6-09.3(6)F UNIT WEIGHT REQUIREMENTS AND TEST

The unit weight of the filled gabion basket shall be at least 100 pounds per cubic foot. Should the unit weight be less than 100 pounds per cubic foot, the gabion will be rejected and the Engineer will require the Contractor to conduct and pass additional unit weight tests before completing other gabions.

The Contractor shall conduct either of the following unit weight tests to prove the density of completed gabions:

1. A filled gabion basket shall be selected from the completed structure and weighed; or
2. A gabion basket shall be filled with stone from a loaded truck that has been weighed. After filling, the truck and unused stone shall be weighed again. The difference between the two weighings shall be used to determine weight per cubic foot of the material in the gabion.

The Contractor shall conduct one unit weight test for each 500 cubic yards of gabions placed. The Engineer may reduce the specified frequency of these tests after proper unit weight has been consistently demonstrated.

In conducting unit weight test A or B, the Contractor shall provide and use scales that comply with Section 1-09.2.

6-09.3(6)G GABION CRIBBING CONSTRUCTION

Each row or tier of baskets shall be reasonably straight and shall conform with the alignment and grade indicated on the Drawings. Hexagonal mesh baskets shall be stretched endwise before filling. The stone shall be carefully placed in layers, then tamped or vibrated. The last layer shall fill each basket completely so that the secured lid rests upon the stone. Each basket shall be laced securely to all adjacent baskets and its lid then laced or clipped to the sides, ends, and diaphragms.

All selvage wires of ends of adjacent baskets shall be laced together. The bottom selvage of the basket being constructed on a previously constructed basket shall be laced to the top of that basket.

Excavation for gabions shall comply with the requirements for structure excavation in Section 2-09.

Backfilling behind or around gabions shall comply with Section 2-09.3(1)E.

6-09.4 MEASUREMENT

Bid items of work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Gabion cribbing will be calculated by the cubic yard neat line volume of gabion baskets in place, using the manufacturer's stated dimensions.

Structure excavation will be measured by the cubic yard as specified in Section 2-09.4.

6-09.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 6-09 will be made at the Bid item prices Bid for the Bid items listed or referenced as follows:

1. "Structure Excavation", per cubic yard.

The Bid item price for "Structure Excavation" will be as specified in Section 2-09.5. All costs for special corners shall be included in the Bid item price per cubic yard for the adjacent bins measured as specified in Section 6-09.4.

2. "Gabion Cribbing", per cubic yard.

The Bid item price for "Gabion Cribbing" shall include all costs for the work required to furnish and install the gabion cribbing as specified.

SECTION 6-10 CONCRETE BARRIER

6-10.1 DESCRIPTION

Section 6-10 addresses the work of building precast or cast-in-place cement concrete barriers as required by the Contract.

6-10.2 MATERIALS

Materials shall meet the requirements of the following sections:

Portland Cement	9-01
Aggregates	9-03
Premolded Joint Fillers	9-04.1
Reinforcing Steel	9-07

Wire rope shall be Class 6 x 19, made of improved plow steel that has been galvanized and performed. Galvanizing shall meet ASTM A 603. The wire rope shall have right regular lay and a fiber core. It shall be 5/8 inch in diameter and have a minimum breaking strength of 15 tons.

All hardware (connecting pins, drift pins, nuts, washers, etc.) shall be galvanized in keeping with AASHTO M 232.

Connecting pins shall comply with ASTM A 449 and after galvanizing shall be checked for embrittlement in accordance with ASTM A 143. All other hardware shall comply with ASTM A 307.

6-10.3 CONSTRUCTION REQUIREMENTS

6-10.3(1) PRECAST CONCRETE BARRIER

The concrete in precast barrier shall reach a compressive strength of at least 4,000 psi at 28 days. No concrete barrier shall be shipped 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 meet this strength requirement. The Contractor may, however, alter the mix and aggregate grading if:

1. The Contractor indicates the substitution in accordance with 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 shall be cast in steel forms. After release, the barrier shall be finished to an even, smooth, dense surface, free from any rock pockets or holes larger than 1/4 inch across. Troweling shall remove all projecting concrete from the bearing surface.

Precast concrete barrier shall be cured in accordance with Section 6-02.3(25)E except that the barrier shall be cured in the forms until a rebound number test, or test cylinders which have been 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 shall be the same length, except end sections and variable length units needed for closure. All barrier shall be new and unused. The manufacturer shall be responsible for any damage or distortion that results from manufacturing.

Only one section less than 10 feet long may be used in any single run of precast barrier, and it shall be at least 8 feet long. It may be precast or cast-in-place. Hardware identical to that used with other sections shall interlock such a section with adjacent precast sections.

When the barrier is being built next to roadway lanes open to traffic, a terminal section shall 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 shall 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 shall be made of Class 4000 concrete that meets the requirements of Section 6-02. The Contractor may use Portland cement Type III and shall be at no additional cost to the Owner.

Immediately after removing the forms, the Contractor shall complete any finishing work needed to produce a uniformly smooth, dense surface. The surface shall have no rock pockets and no holes larger than 1/4 inch across. The barrier shall be cured in accordance with the requirements described in Section 6-02.3(11)B.

The maximum allowable deviation from a 10-foot straightedge held longitudinally on all surfaces shall be 1/4 inch.

The Contractor may build cast-in-place concrete barrier by the slip-form method. Concrete for slip-form barrier shall meet 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 shall be finished and cured as specified in Section 6-02.3(11)B.

At least 3 Working Days in advance of delivery to the Project Site, the Contractor shall request the Engineer to verify the concrete barrier to be free from stains, smears, and any discoloration.

6-10.3(3) RESETTING CONCRETE BARRIER

The Contractor shall reset concrete barrier as indicated in the Contract. If resetting is impossible immediately after removal, the Contractor shall 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 shall 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 in 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" shall be visibly stamped or stencil painted on each barrier segment.

All barrier shall 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, shall immediately repair the damage to a condition acceptable to the Engineer, or replace it with an undamaged section.

Temporary barrier no longer needed shall be removed from the Project Site.

6-10.3(6) PLACING CONCRETE BARRIER

Precast concrete barrier shall rest on a paved foundation shaped to a uniform grade and section. The foundation surface shall meet this test for uniformity:

When a 10-foot straightedge is placed on the surface parallel to the centerline for the barrier, the surface shall not vary more than 1/4 inch from the lower edge of the straightedge. If deviations exceed 1/4 inch, the Contractor shall correct them as required in Section 5-04.3(12).

The Contractor shall align the joints of 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 permit the Contractor to obtain vertical alignment of the barrier by shimming. Shimming shall be done with a polystyrene, foam pad (12 by 24 inches) under the end 12 inches of bearing surface.

Precast barrier shall be handled and placed with equipment that does not damage or disfigure it.

6-10.4 MEASUREMENT

Bid items of work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

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, one 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.

6-10.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 6-10 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows;

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. "Steel Reinforcing Bar", per pound.

The Bid item prices for "Precast Concrete Barrier Type _____" and for "Cast-In-Place Concrete Barrier" shall 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" shall 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.

5. "Cast-In-Place Concrete Barrier Light Standard Section", per each.
6. "Temporary Concrete Barrier", per linear foot.

The Bid item prices for "Cast-In-Place Concrete Barrier Light Standard Section" and for "Temporary Concrete Barrier" shall 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 shall remain the property of the Contractor.

Payment for transition sections between different types of barrier shall be made at the Bid item price for the type of barrier indicated on the Drawings for each transition section.

SECTION 6-11 PRECAST CONCRETE RETAINING WALL STEMS**6-11.1 DESCRIPTION**

Section 6-11 addresses the work of constructing WSDOT Standard Plan Reinforced Concrete Retaining Walls Type 1, 2, 3, and 4 using precast concrete wall stems.

6-11.1(1) RETAINING WALL SUBMITTALS

Before proceeding with construction of the retaining walls using precast concrete wall stems, the Contractor shall submit the following to the Engineer in accordance with Section 6-02.3(16):

1. Shop Drawings for fabrication of the wall stems, showing dimensions, reinforcing steel, joint and joint filler details, lifting devices with the manufacturer's recommended safe working capacity, and material specifications;
2. Shop Drawings for the erection of the wall stems showing falsework dimensions, support points, support footing sizes, erection blockouts, member sizes, connections, and material specifications; and
3. Calculations for the precast wall, the connection between the precast wall and the cast-in-place footing, and any modifications to the cast-in-place footing.

Calculations shall be by a professional civil engineer licensed in the State of Washington (see Section 1-05.3(12)).

6-11.2 MATERIALS

Concrete for the precast concrete wall stems and for the cast-in-place footing shall meet all the requirements for concrete Class 4000 as stated in Section 6-02.3. A water reducing admixture meeting the requirements of Section 9-23.6 shall be used for the cast-in-place footing.

6-11.3 CONSTRUCTION REQUIREMENTS

The precast concrete wall stems shall be fabricated in accordance with the dimensions and details shown on the Drawings, except as modified in the approved Shop Drawings.

The precast concrete wall stems may be fabricated full height in 8, 16, or 24 foot widths and with a mating shear key between adjacent panels. The shear key shall have beveled corners and shall be 1 1/2 inches in thickness.

The width of the shear key shall be 3 1/2 inches minimum and 5 1/2 inches maximum.

The shear key shall be continuous and shall be of uniform width over the entire height of the wall stem. Rolled on textured finishes shall not be used. Precast stem walls shall be cast in a vertical position if the Drawings call for a form liner texture on both sides of the stem wall.

The precast wall panel shall be rigidly held in place during placement and curing of the footing concrete.

To ensure an even flow of concrete under and against the base of the wall, a form shall be placed parallel to the wall stem, above the footing, to allow a minimum 1-foot head to develop in the concrete during concrete placement.

The reinforcing steel shall be shifted to clear the erection blockouts in the wall stem by 1-1/2 inches minimum.

All panel joints shall be constructed with joint filler installed on the rear (backfill) side of the wall. The joint filler material shall extend from 2 feet below the final ground level in front of the wall to the top of the wall. The joint filler shall be an inorganic flexible material and shall be installed to create a waterproof seal at panel joints.

The soil bearing pressure beneath the falsework supports for the wall stems shall not exceed the maximum design soil pressure shown on the Drawings for the retaining wall. The wall stem shall be placed a minimum of 1 inch into the footing to provide a shear key. The base of the stem shall be sloped 1/2 inch per foot to facilitate proper concrete placement.

6-11.3(1) TOLERANCES

The construction tolerances for the precast retaining wall stems shall be:

Height	±1/4 inch
Width	±1/4 inch
Thickness	+ 1/4 inch to - 1/8 inch
Conc. cover for steel reinforcing bar	- 1/8 inch to + 3/8 inch
Width of panel joints	± 1/4 inch
Offset of panels ¹	± 1/4 inch

NOTE ¹deviation from a straight line extending 5 feet on each side of panel joint.

6-11.4 MEASUREMENT

Measurement of the materials involved in constructing the precast concrete retaining wall stems and cast-in-place footing will be in accordance with Section 6-02.4 for the applicable related Bid items of Work involved in constructing WSDOT Standard Plan Reinforced Concrete Retaining Walls Type 1, 2, 3, and 4.

6-11.5 PAYMENT

All costs associated with constructing the retaining walls using precast concrete retaining wall stems shall be included in the Bid item prices for the applicable related Bid items of Work required for construction of WSDOT Standard Plan Reinforced Concrete Retaining Walls Type 1, 2, 3, and 4.

DIVISION 7 STORM DRAIN, CULVERTS, SANITARY AND COMBINED SEWERS, WATER MAINS AND RELATED STRUCTURES

SECTION 7-01 DRAINS

7-01.1 DESCRIPTION

Section 7-01 describes work consisting of constructing subsurface drains in accordance with the Contract. This work shall include installation of solid and perforated pipe, filter Material, filter fabric (geotextile), sidewalk drains, and gravel drains. Subsurface drains shall be constructed of gravel filter Material and may include perforated pipe and filter fabric as detailed on the Drawings.

7-01.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Gravel Backfill for Drains	9-03.12
Filter Material	9-03.12(4)
Joints, Rubber Gaskets	9-04.4
Pipe and Tubing	9-05
Geotextiles	9-37

Notes: Unless indicated otherwise in the Contract (all pipe sizes are inside diameter):

1. Corrugated Polyethylene Drainage Tubing Drain Pipe shall be limited to less than 10 inch.
2. Corrugated Polyethylene Drain Pipe shall be limited to 12 inch minimum to 36 inch maximum.
3. Perforated PVC Subsurface Drain Pipe shall be limited to a maximum 8 inch.

All reference to filter fabric shall be construed to mean a geotextile Material as specified in Section 9-37, Geotextile, Underground Drainage, Low Survivability, Class to be specified in Contract.

7-01.3 CONSTRUCTION REQUIREMENTS

7-01.3(1) EXCAVATION

Trenching is subject to the provisions of 7-17.3(1). Work in excavations over 4 feet deep are subject to the provisions of Section 7-17.3(1)A7a, Trench Safety Systems.

A trench shall be excavated to the grade, line, and dimensions indicated on the Drawings. The subsurface drain pipe shall be installed with watertight rubber gasketed joint.

The subsurface drain trench shall be dug to the required alignment and grade only as far in advance of pipe installing as the Engineer will approve.

The clear width of trench measured at the springline of the pipe in place shall be 24 inches, or 1 foot greater than the outside diameter of the pipe, whichever is the greater. Standard Plan no. 284 trench width is not applicable to drain pipe and subsurface drain pipe.

There shall be no mixing of filter Material with backfill Material. See Section 2-03.3(10) regarding selected Material.

7-01.3(2) PLACING PIPE AND FILTER MATERIAL

See Section 2-12.3(2) for construction requirements for other than subsurface drains.

The filter Material for pipe shall be damp when placed in the trench and shall be deposited uniformly on both sides of the pipe for the full width of the trench and to the springline of the pipe. The Material shall be tamped in 4-inch lifts to provide thorough compaction under and on each side of the pipe. Succeeding lifts of gravel shall be deposited in 8-inch lifts and be thoroughly compacted to the depth shown on the Drawings.

The geotextile shall be placed in the manner and at the locations as indicated in the Contract. The surface to receive the geotextile, and the trench into which the geotextile is to be placed, shall be free of obstructions and debris.

Should the geotextile be damaged during construction, the torn or punctured section shall be repaired 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 shall be the trench width.

The Contractor shall construct sidewalk drains where indicated in the Contract in accordance with Standard Plan 241b. Pipe shall be placed under the sidewalk in 1 pipe length and shall extend across the planting area to the pavement gutter line at the face of curb. Where curb exists or new curb is to be installed, the curb side terminus of the drain pipe shall be encased in a 14-inch x 24-inch reinforced cement concrete curb block of the depth indicated in the Contract.

Subsurface drains, as specified in Section 9-05.3, shall be located as shown in the Contract.

Clearances between drains and other utilities shall be maintained per Section 1-07.17(2).

When it is necessary to intercept water flowing underneath pavement, the subsurface drain shall be constructed as detailed in the Contract.

All drain pipe shall be installed with the bell or larger end upstream, and shall be open, clean, clear of debris, and free draining.

7-01.3(3) JOINTS

Polyvinyl chloride (PVC) drain pipe shall be installed upstream with the bell end upstream. Corrugated polyethylene drain pipe shall be jointed with snap-on, screw-on, or wraparound coupling bands as recommended by the pipe manufacturer.

7-01.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Filter Material, (Type)" will be per cubic yard based on the neat line cross section indicated on the Drawings.

Measurement for geotextile will be as specified in Section 2-12.4.

No Measurement will be made for the reinforced concrete curb block at the curb face.

Measurement for "Pipe, Subsurface Drain, (Material), (Size)" and for "Sidewalk Drain, 4-Inch, Type 281" will be by the linear foot measured along the centerline of the pipe from pipe end to pipe end.

7-01.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-01 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **"Pipe, Subsurface Drain, (Material), (Size)"**, per linear foot.

The Bid item price for "Pipe, Subsurface Drain, (Material), (Size)" shall include all costs for the work required to furnish and install the pipe, excavate the pipe trench, haul and dispose of excess excavated Material.

2. **"Filter Material, (Type)"**, per cubic yard.

The Bid item price for "Filter Material, (Type)" shall include all costs for the work required to furnish, install, and compact the Mineral Aggregate filter Material specified on the Drawings, and shall also include, 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. **"Sidewalk Drain, (Size), (Material)"**, per linear foot.

The Bid item price for "Sidewalk Drain, (Size), (Material)" shall include all costs for the work required to furnish and install the drain pipe with intake screen and the reinforced concrete curb block, excavation and backfill, saw cut and remove the existing curb. It shall also include excavation at the inlet end of the pipe to make a gravel drain that has minimum dimensions of 12 inch wide by 12 inch deep by 3 feet in length.

4. **"Gravel Drain, (Type)"**, per linear foot.

The Bid item price for "Gravel Drain, (Type)" shall include all costs for the work required to excavate a trench 12 inches wide, fill it with Mineral Aggregate filter Material to a depth of 12 inches, haul and dispose of excess excavated Material and backfill trench with suitable excavated Material.

5. **Other payment information.**

Any part of the trench excavated below grade or to a greater width than specified in the Contract shall be backfilled with filter Material as specified in the Contract at the Contractor's sole expense.

Payment for geotextile will be in accordance with Section 2-12.5.

SECTION 7-02 CULVERTS**7-02.1 DESCRIPTION**

Section 7-02 describes work consisting of constructing Culverts of the various types and classes indicated in the Standard Plans, and at locations and as otherwise indicated in the Contract.

7-02.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Mortar and Grout	9-04.3
Pipe	9-05
Junction Box	9-12.9

Where steel or aluminum Culvert pipe, pipe arch, or end sections are referred to in this Section, it shall be understood that steel is zinc coated (galvanized) or aluminum coated (aluminized) corrugated iron or steel (see Section 9-05.9), and aluminum is corrugated aluminum alloy (see Section 9-05.6).

The class of concrete pipe, or the thickness of steel or aluminum pipe, or pipe arch shall be the same for the entire length of the Culvert, and shall be required using as a basis the maximum height of cover indicated on the Drawings.

Beveled end sections shall be of the same Material as the Culvert pipe to which they are attached.

Box Culvert shall be in accordance with the Drawings.

7-02.3 CONSTRUCTION REQUIREMENTS**7-02.3(1) PLACING CULVERT PIPE****7-02.3(1)A GENERAL**

A trench shall be excavated to the alignment, depth, and grade shown on the Drawings. Excavations over 4 feet deep and Culvert work in ditches and channels over 4 feet deep are subject to the provisions of Section 7-17.3(1)A7a, Trench Safety Systems.

Proper preparation of foundation, placement of foundation Material where required, and placement of the first lift of bedding Material shall precede the installation of all Culvert pipe. This shall include necessary leveling of the native trench bottom, or leveling the top of the foundation Material where required, as well as placement and compaction of required backfill Material to a uniform grade so that the entire length of pipe is uniformly supported on a uniformly dense and unyielding base.

Material meeting the requirements of gravel backfill for pipe bedding, when required in the Contract, shall be placed under the pipe and along the sides of the pipe in accordance with Standard Plan no. 285. Bedding shall be placed in two or more lifts. The first lift shall be placed, spread, and compacted to a uniform thickness of 4 inches or 6 inches (as indicated on Standard Plan no. 285) before the pipe is installed so that the pipe is uniformly supported along the barrel. Subsequent lifts of pipe bedding, of not more than 6 inches in thickness, shall be placed and compacted along the sides to the height shown in Standard Plan no. 285. Lifts shall be brought up evenly on both sides of the pipe and shall be worked carefully under the pipe haunches and then compacted. If the Engineer determines that the Material existing in the bottom of the trench is acceptable for bedding the pipe, gravel backfill for pipe bedding will not be required. In this case, the existing native Material shall be loosened and stockpiled for reuse as bedding, and the bottom regraded and compacted to form a dense and unyielding base.

When indicated in the Contract, a dike or plug of impervious Material shall be placed near the intake end of the Culvert to prevent piping. The dike shall be 2 feet long and adequately placed around the pipe into native material to form an impervious barrier. When suitable impervious Materials are not available at the site, suitable backfill shall be obtained as provided in Section 2-09.3(1)E.

Where pipe is to be placed in a new embankment, the embankment shall be constructed for a distance each side of the pipe location of not less than five times the diameter of the pipe and to a minimum height above the pipe equal to 1/2 the outside diameter of the pipe. The embankment Material shall be compacted to 95 percent of maximum density, and the moisture content at the time of compaction shall be between optimum and 3 percentage points below optimum as determined by the Compaction Control Tests specified in Section 2-03.3(14)E. The trench shall then be excavated to a width as indicated in Standard Plan no. 284 and the pipe installed and backfill compacted in accordance with Section 7-17.3(3).

The ends of the pipe, box or pipe arch shall be rigidly supported to prevent movement before and during the construction of end walls or headers.

Culverts shall not extend beyond the staked limits.

Culvert pipe shall be constructed within the same tolerance limits as specified for Sewer pipes in Section 7-17.3(2)B.

All Culverts and end sections shall be open, clean, and free draining.

If the Contractor proposes an alternate pipe installation, Shop Drawings for the alternate shall be submitted to the Engineer for approval prior to procuring or constructing the alternate.

Pipe installed under side road connections, where the depth of cover is less than 2 feet, shall not be of the bell and spigot type, but shall have beveled ends.

7-02.3(1)B PLACING CONCRETE PIPE**7-02.3(1)B1 GENERAL**

In the trench, concrete pipe shall be installed beginning at the lower end, with the bell or groove end up grade. For pipe with elliptical reinforcement, the minor axis of reinforcement shall be in a vertical position.

When it is necessary to connect dissimilar pipe, an adapter coupling shall be used as detailed on the Drawings.

7-02.3(1)B2 RUBBER GASKETED JOINTS

In installing concrete pipe with rubber gaskets, the bottom of the trench shall be dewatered, firm, and free of loose material so that joining can be accomplished without contaminating the joint with soil or other deleterious material.

Pipe with affixed gaskets shall be handled carefully to avoid knocking the gasket out of position or contaminating it with foreign Material. Any gasket so disturbed shall be removed, cleaned, relubricated if required, and replaced before joining the pipe sections.

The pipe shall be properly aligned before joints are forced home. Sufficient pressure shall be applied in making the joint to ensure that the joint is home, as defined in the standard installation instructions provided by the pipe manufacturer. The Contractor may use any method recommended by the pipe manufacturer and acceptable to the Engineer for pulling the pipe together, except that driving or ramming by hand or machinery will not be permitted. Any pipe damaged during joining and joint tightening shall be removed and replaced at no expense to the Owner.

Sufficient restraint shall be applied to the line to ensure that joints once home remain undisturbed. At the end of the Day's work, the last pipe section shall be braced to prevent creep.

7-02.3(1)B3 HAND MORTARED JOINTS

On bell and spigot type pipe, the lower portion of the bell shall be filled with stiff mortar, composed of one part Portland cement and three parts fine sand and shall be sufficiently thick to make the inner surfaces of the abutting sections flush and even as the pipe is installed. On tongue and groove pipe, the lower 1/2 of the groove and the upper 1/2 of the tongue shall be coated with a thin layer of mortar composed of one part Portland cement and two parts fine sand. The use of aluminum powder or calcium chloride in any mortar will not be allowed. After covering the ends with mortar, the spigot end (or tongue end) shall be inserted into the bell (or groove) as far as the construction of the pipe permits.

After each section of the pipe is installed, uniformly matched, and the sections fitted as close as the construction of the pipe permits, the joint, both inside and out, shall be filled and sealed with the mortar mix as specified in the previous paragraph. After sealing, the joint on the inside of the pipe shall be cleaned of all surplus mortar and smoothed flush to match the shape of surrounding surface. The mortar outside the pipe shall be properly cured by covering with polyethylene sheeting, damp sand, or spraying with curing compound; the Culvert shall not be backfilled until the mortar has set for at least 24 hours.

7-02.3(1)B4 ELLIPTICAL REINFORCEMENT

In lieu of marking circular pipe with elliptical reinforcement in accordance with ASTM C 76, the location of the top of the pipe shall be indicated by 3-inch wide, waterproof, painted stripes on the inside and outside of the pipe for a distance of 2 feet from each end of the pipe section.

7-02.3(1)C PLACING STEEL OR ALUMINUM PIPE**7-02.3(1)C1 GENERAL**

Metal pipe and metal pipe arch shall be placed in a trench prepared as specified in Section 7-02.3(1)A. Separate sections of the pipe shall be installed in the trench with the outside laps of circumferential joints upgrade and with longitudinal laps positioned other than in the invert, and firmly joined together with approved bands.

7-02.3(1)C2 INSTALLATION OF METAL END SECTIONS**7-02.3(1)C2a GENERAL**

Metal end sections shall be installed in accordance with WSDOT Standard Plan nos. B-7 and B-7a.

7-02.3(1)C2b RESERVED**7-02.3(1)C2c MITERED ENDS**

The ends of steel Culvert pipe or pipe arch shall not be beveled unless specified otherwise in the Contract. If beveled ends are specified, the ends of Culvert pipe over 30 inches in diameter shall be mitered to conform to the slope of the embankment in which the Culvert is to be placed whether the Culvert is constructed normal to or at an angle with the centerline of the roadway.

Beveled steel pipe end sections 12 inches through 30 inches in diameter shall 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 shall be constructed in accordance with WSDOT Standard Plan no. B-7a.

7-02.3(1)C3 PROTECTIVE TREATMENT**7-02.3(1)C3a TREATMENT OF STEEL PIPE**

Steel pipe and pipe arch Culverts shall be coated by one of the following protective treatments, when such treatment is required in the Contract:

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.

7-02.3(1)C3b TREATMENT OF ALUMINUM PIPE

When plain aluminum pipe or pipe arch is used where it makes contact with Portland cement concrete or concrete pipe, all aluminum surfaces in contact with, and to 1 foot beyond the contact zone with the concrete or concrete pipe shall be cleaned and painted with two coats of paint. The aluminum pipe to be painted shall be cleaned with solvent to remove contaminants. After cleaning, the pipe shall be painted with two coats of paint conforming to Federal Specification TT-P-645 (Primer, Paint, Zinc Chromate, Alkyd Vehicle).

7-02.3(2) JUNCTION BOX

Junction boxes shall be only used where private storm service drain, or other small diameter storm pipe, needs to be connected with an existing Culvert. Sanitary, or combined storm and sanitary, connections will not be allowed with a Culvert system or with a junction box to a Culvert system. Junction box shall be installed as shown on the Drawings. See Standard Plan no. 277 and Section 9-12.9.

7-02.3(3) BACKFILLING

Placement and compaction of backfill Material above the bedding zone shall be performed in accordance with the requirements specified in Section 7-17.3(3) Backfilling Trenches.

The Contractor shall not operate tractors or other heavy equipment over the Culvert until it has been backfilled as provided above, or until the embankment has reached a height of 2 feet above the top of the Culvert, or as provided in Section 1-07.7 if the site of the Culvert is at a location where legal highway load limitations are not in effect.

7-02.3(4) REMOVING AND REINSTALLING CULVERTS

In the case of concrete pipe, all joints of the pipe before being reinstalled shall be cleaned so as to be free from all adhering Materials, including old mortar placed as a collar or seal in the original construction.

All Culvert sections removed and not reinstalled shall become the property of the Contractor.

7-02.3(5) PLUGGING EXISTING CULVERTS

Where shown on the Drawings, existing Culverts shall be plugged on the inlet end as specified in Section 2-02.3(5). Culvert to be abandoned and filled shall be as specified in Section 2-02.3(5).

7-02.3(6) FISH PASSAGE AT CULVERTS

Where the Work included culverts that accommodate fish passage, the construction will be as specified in the Contract.

7-02.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for Junction Box will be per each.

Measurement of Culvert pipe, box Culvert, or pipe arch Culvert will be the number of linear feet of completed installation measured along the invert.

Measurement of beveled end sections will be considered as part of the Culvert pipe, box Culvert, or pipe arch Culvert and will be measured as part of Culvert pipe, box Culvert, or pipe arch Culvert.

Embankment construction before Culvert placement under the applicable provisions of Section 7-02.3(1) will be measured in accordance with Section 2-03.

7-02.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-02 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "Pipe, Culvert, (Material), (Class), (Size)", per linear foot.
2. "Pipe Arch, (Material), (Class), (Size)", per linear foot.

The Bid item prices for "Pipe, Culvert, (Material), (Class), (Size)" and for "Pipe Arch, (Material), (Class), (Size)" shall include all cost for the work required to furnish and install Culvert pipe and pipe arch, as specified in Section 7-02 including beveled end sections when required and final cleaning of the Culvert.

3. "Junction Box", per each.

The Bid item price for "Junction Box" shall include 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, and backfill with suitable native material.

4. **Other payment information.**

Where Culvert pipes are to be removed and are not to be reinstalled, see Section 2-02.5 for payment.

No payment will be made for plugging existing pipes. See Section 2-02.5.

Alternate pipe installations to that shown on the Drawings and approved by the Engineer shall have no increase in the Bid item price to the Owner.

All costs involved in storing, protecting, re-handling, disposing, and/or placing the excavated Material shall be included in the applicable Bid items of Work.

All costs of cleaning and painting aluminum pipe surfaces as specified in Section 7-02.3(1)C3b shall be included in the Bid item price for the aluminum pipe or pipe arch.

Payment for Section 7-02.3(1)C3a treatment shall be incidental to the Bid item price for the aluminum pipe or pipe arch and no separate or additional payment will be made therefore.

Payment for trench safety systems, when applicable, will be as specified in Section 7-17.5.

SECTION 7-03 STRUCTURAL PLATE PIPE, PIPE ARCH, ARCH, AND UNDERPASS**7-03.1 DESCRIPTION**

Section 7-03 describes work consisting of constructing structural plate pipe, pipe arches, arches, and underpasses of various types and designs in accordance with WSDOT Standard Plan nos. B-8 and B-8a, and as specified in Contract, and at the locations and grades indicated on the Drawings.

Structural plate pipes shall be full circle of the type, gauge or thickness, and diameter specified in the Contract. Structural plate pipe arches shall be a multi-centered shape made up of four circular arcs tangent to each other at their junctions and symmetrical about the vertical axis and of the type, gauge or thickness, and span specified in the Contract.

Structural plate arches shall be a single-centered circular arc shape, placed on a reinforced concrete foundation, and of the design, type, gauge or thickness, and span as provided for in the Contract.

Structural plate underpasses shall be a multi-centered shape made up of a variable number of circular arcs tangent to each other at their junctions and symmetrical about the vertical axis and of the design, type, gauge or thickness, and span specified in the Contract.

Structural plate pipe, pipe arches, arches, and underpass work in ditches, channels, and trench excavations over 4 feet deep are subject to the provisions of Section 7-17.3(1)A7a, Trench Safety Systems.

7-03.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Concrete Class 3000	6-02.3
Pipe, Pipe Arch, Arch, and Underpass	9-05
Reinforcing Steel	9-07

Bolts and bolted connections shall conform to AASHTO M 167 for steel and to AASHTO M 219 for aluminum.

7-03.3 CONSTRUCTION REQUIREMENTS

7-03.3(1) FOUNDATIONS

7-03.3(1)A GENERAL

Structural plate pipes, pipe arches, underpasses, and bases for arches shall be placed on stable foundations prepared to the widths, depth, and grade as shown on the Drawings. Soft spots encountered in the foundation shall be excavated to a depth, and backfilled and compacted with Material as indicated in the Contract.

Rock, in either ledge or boulder formation, hard pan, or cemented gravel occurring in the base material shall be excavated below grade and backfilled with suitable Material to provide a minimum 8-inch cushion under the pipes, pipe arches, or underpasses.

Concrete required for constructing structural plate arch foundations shall be Class 3000 concrete in conformance with the requirements of Section 6-02.3.

7-03.3(1)B STRUCTURAL PLATE PIPE, PIPE ARCH, AND UNDERPASS

The foundation for structural plate pipes, pipe arches, and underpasses, shall be shaped to conform to their bottom form, and shall form firm and uniform bearing throughout their length. Where pipes, pipe arches, or underpasses are to be installed in new embankment, the embankment shall be constructed to the 1/3-point of structural plate pipes (measured from the invert of the pipe), to the height of maximum horizontal dimension of structural plate pipe arches as provided for in WSDOT Standard Plan nos. B-8 and B-8a, and in the case of a special design, as indicated on the Drawings, after which the trench shall be excavated and installation made.

The ends of structural plate pipes, pipe arches, arches, or underpasses, shall not be mitered unless indicated otherwise in the Contract. If mitered ends are specified, the slope shall conform to the slope of the embankment in which the Culvert is to be placed and shall be limited to the top arc only.

7-03.3(1)C STRUCTURAL PLATE ARCH

The base for structural plate arches shall be as shown on the Drawings.

7-03.3(2) ASSEMBLING

Structural plate pipes, pipe arches, arches, and underpasses shall be assembled in place in accordance with the manufacturer's instructions, which shall accompany the shipment of Materials and show the position of each plate and the order of assembly. The Contractor shall submit the manufacturer's instructions at least 5 Working Days prior to construction.

7-03.3(3) BACKFILLING

After the structural plate pipe, pipe arch, arch, or underpass has been placed in position, it shall be backfilled in accordance with Section 7-02.3(3).

7-03.3(4) FOUNDATION TREATMENT

Earth, or other Material when specified in the Contract, shall be placed and compacted beneath structural plate pipes, pipe arches, or underpasses in conformance with WSDOT Standard Plan no. B-11.

7-03.3(5) HEADWALLS

If headwalls are specified on the Drawings, they shall be constructed as soon as the embankment has been completed to a sufficient height over the structure to allow the required work. Headwalls shall be constructed in accordance with the applicable portions of Section 6-02.

7-03.3(6) ALTERNATE INSTALLATION

If the Contractor proposes an alternate installation, Shop Drawings for the alternate shall be submitted to the Engineer for approval at least 10 Working Days prior to procuring or constructing the alternate. See Section 1-05.3(5).

7-03.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement of structural plate pipes, pipe arches, arches, and underpasses, will be the number of linear feet of completed installation measured along the invert.

Concrete will be measured by the cubic yard as specified in Section 6-02.4.

Steel reinforcing bars will be measured by the pound as specified in Section 6-02.4.

Structure excavation will be measured by the cubic yard as specified in Section 2-09.4.

Gravel backfill for foundation will be measured by the cubic yard as specified in Section 2-09.4.

7-03.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-03 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "Structural Plate Pipe, (Material), (Thickness), (Diameter)", per linear foot.
2. "Structural Plate Pipe Arch, (Material), (Thickness), (Span)", per linear foot.
3. "Structural Plate Arch, (Material), (Thickness), (Span)", per linear foot.
4. "Underpass, (Design), (Thickness), (Span)", per linear foot.

The Bid item prices for "Structural Plate Pipe, (Material), (Thickness), (Diameter)", for "Structural Plate Pipe Arch, (Material), (Thickness), (Span)", for "Structural Plate Arch, (Material), (Thickness), (Span)", and for "Underpass, (Design), (Thickness), (Span)" of the design, type, gage or thickness, and size specified shall include all costs for the work required to furnish, haul, and assemble in place the completed structure including excavation, stockpiling, disposal, backfilling.

5. **Other payment information.**

Payment for the class of concrete shall be as specified in Section 6-02.5.

Payment for steel reinforcing bar shall be as specified in Section 6-02.5.

Payment for structure excavation shall be as specified in Section 2-09.5.

Payment for imported "Mineral Aggregate, (Type)" backfill shall be per Section 4-01.5.

Payment for trench safety systems will be in accordance with section 7-17.5.

SECTION 7-04 RESERVED**SECTION 7-05 MANHOLES, CATCH BASINS, AND INLETS****7-05.1 DESCRIPTION**

Section 7-05 describes work consisting of constructing manholes, catch basins, inlets, and the rebuilding or rechanneling of existing manholes in accordance with the Contract at locations shown on the Drawings. This work shall also include excavation, and backfilling and compaction as specified in Section 7-17.

Work in trench excavations over 4 feet deep shall comply with Section 7-17.3(1)A7a, Trench Safety Systems.

7-05.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Manholes, Catch Basins, Inlets, Appurtenance, and Related	9-12
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Manholes, catch basins and inlets shall be constructed of pre-cast components in accordance with the following Standard Plan nos.:

Drainage Structure	Standard Plan nos.
Manholes	200a through 207
Catch Basins	240 through 243b
Inlets	250 and 252

Deviations from Standard Plans, other than Material(s) substitutions allowed in Section 9-12, shall be subject to a Shop Drawing submitted by Contractor and approved by the Engineer in accordance with Section 1-05.3(5). Substitution(s) in Materials indicated on the Standard Plans and allowed in Section 9-12 shall 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 manhole components shall be rubber gasket.

The concrete mix for manhole channel shall be Class 6 (3/4) (see Section 5-05.3).

Concrete for manhole, catch basin, and inlet structures shall be Class 4000 (see Section 6-02.3).

Precast manhole components shall conform to ASTM C 478 except as modified in Section 7-05.

7-05.3 CONSTRUCTION REQUIREMENTS

7-05.3(1) MANHOLE

7-05.3(1)A FOUNDATION PREPARATION

7-05.3(1)A1 DEWATERING

Dewatering of manhole and catch basin excavations shall comply with the applicable Sections of Section 7-17.3(1)A.

7-05.3(1)A2 FOUNDATION PREPARATION

Adequate foundation support shall be obtained by compacting the existing subgrade to a 95% for a 12 inch depth in accordance with Section 2-03.3(14)E. Where unsuitable foundation conditions exist, removal of unsuitable Material and replacement with compacted suitable or imported Material will be required.

7-05.3(1)B BEDDING

7-05.3(1)B1 BEDDING AND FOUNDATION SUPPORT FOR PRECAST BASE SECTION

Manholes and catch basins constructed with precast base sections shall be placed to grade upon 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 shall be placed across the area of the excavation for the base to a minimum distance beyond the face of the manhole as indicated on the Standard Plans and shall be graded to provide uniform bearing support with the precast base section.

7-05.3(1)B2 BEDDING AND FOUNDATION SUPPORT FOR CAST-IN-PLACE BASE SECTION

All cast-in-place bases for manholes and catch basins shall be poured to grade upon a properly prepared foundation as indicated in the Standard Plans. Imported Mineral Aggregate Type 2, when required in the Contract, shall be placed and compacted to the same limits specified in Section 7-05.3(1)B1. The concrete base shall meet the requirements indicated in the Standard Plans.

7-05.3(1)C DIMENSIONS

Manhole types indicated on the Drawings shall conform in all respects to dimensions, and range of dimensions when applicable, as shown on the Standard Plans for each type manhole specified.

7-05.3(1)D REINFORCED CONCRETE

7-05.3(1)D1 CONCRETE MIXTURE

Concrete shall meet the requirements of Section 9-12.1.

7-05.3(1)D2 CURING

Upon completion of concrete casting, the precast components shall 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 manhole components.

Precast components may also be water-cured by any approved method that keeps the components continuously moist during the curing period. Cast-in-place components shall be moist cured for a period not less than 7 Days, except that Type III Portland cement concrete shall be cured for not less than 3 Days.

A pigmented membrane curing compound may be applied in lieu of moist curing with prior approval of the Engineer.

7-05.3(1)E BASE

7-05.3(1)E1 GENERAL

Base sections shall conform to the requirements for precast manhole sections in Section 7-05.3(1)F, except that the reinforced base slab shall be made an integral part of the section, and openings for pipe shall be provided to meet job requirements as indicated on the Drawings. The base slab thickness shall be not less than that indicated on the Standard Plans, and on Type 200 and Type 201 manhole the base slab shall be cast monolithically with the wall section or otherwise constructed in such manner as to achieve a completely watertight structure.

Reinforcement of the base slab shall be in accordance with the Standard Plans. The steel shall be placed 1-1/2 inches from the top, and shall extend into the wall of the manhole section and be tied to the longitudinal steel when called for in the Standard Plans. The walls of the base section shall be reinforced in accordance with ASTM C 478. Openings to receive pipe shall be circular, and shall be held to the minimum size possible to accommodate the pipe to be inserted and to effectively seal the joint. Resilient connectors conforming to ASTM C 923 may be used at the Contractor's option.

7-05.3(1)E2 PRECAST BASE

The base section shall 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 shall be thoroughly wetted and then completely filled with mortar and smoothed both inside and out to ensure watertightness. All joints between precast sections shall be rubber-gasketed joints.

Precast sections shall be placed and aligned to provide vertical sides and vertical alignment of the ladder rungs. The completed manhole shall be rigid, true to dimensions, and watertight.

In precast manhole sections where steel loops have been provided in lieu of lift holes, the loops shall be removed flush with the inside wall surface after the manhole has been completed. No sharp cutoff protrusion will be permitted. If concrete spalling occurs as a result of the loop removal, the spalled area shall be restored in a workmanlike manner to a uniform smooth surface with mortar.

All precast manhole bases and catch basins shall be manufactured with thin-walled concrete blockouts for pipe connections conforming to pipe size(s) and alignment(s) shown on the Drawings. Blockouts shall contain no reinforcing steel. Removal of reinforcing steel or of any concrete beyond the blockouts shall not be allowed. Openings for pipe connections in manhole types 200, 201, and 202 shall be no less than the outside diameter of pipe plus 4 inches. Openings for pipe connections in manhole types 200, 201, 202, 203, 204, 205, and 206 shall be no larger than the outside diameter of pipe plus the manhole wall thickness.

7-05.3(1)E3 CAST-IN-PLACE BASE

The first precast section shall be placed on the cast-in-place bottom slab and shall be carefully adjusted to true grade and alignment. The bottom slab shall be constructed in accordance with the modified Standard Plans. The Contractor prior to placing the bottom slab of the manhole shall inspect the existing pipe which the manhole is to be built around. If the existing line is in bad condition, the Contractor shall immediately notify the Engineer to replace the pipe. The bottom slab shall not be placed prior to the replacement of the damaged pipe.

The first manhole section shall be uniformly supported by the base concrete, and shall not bear directly on any pipe.

All lift holes and openings around pipes on precast components and cast-in-place bases or Structures shall be thoroughly wetted, completely filled with mortar, and smoothed and pointed both inside and out to ensure watertightness.

Precast sections shall be placed and aligned so as to provide vertical sides and vertical alignment of the ladder rungs. The completed manhole shall be rigid, true to dimension, and watertight.

7-05.3(1)F PRECAST WALL SECTIONS

Reinforcement for standard (riser) sections shall consist of a single cage of steel, placed at the approximate center of the wall section. The cage shall be welded at every circumferential wire, or lapped 40 diameters and tied. The welded splice shall develop a tensile strength of 50,000 psi.

Joints between sections shall be tongue and groove, and shall provide 1/2 inch nominal annular space and a minimum of 1-1/4 inches lap.

No more than two lift holes shall be cast into each section. Holes shall be so located as to not damage reinforcing or expose it to corrosion. At the manufacturer's option, steel loops may be provided for handling, in lieu of lift holes.

Steps shall be installed in each section so that sections placed together in any combination provide a continuous vertical ladder with rungs equally spaced at 12 inches. The lowest rung shall be not more than 16 inches above the shelf.

Steps shall project uniformly from the inside wall of the manhole per Standard Plan no. 232 and shall be cast or firmly grouted in place to ensure complete watertightness. Where it is intended that manholes be installed without fixed steps, the Contract will so specify.

7-05.3(1)G PRECAST CONES

Standard precast cones shall provide reduction in diameter within a range of height from not less than 18 inches to a maximum 24 inches (see the Standard Plans for cone dimensions). Jointing of cone section to the riser sections shall be similar to jointing between riser sections, but the top surface of the cone section shall be flat and at least 5 inches wide, radially, to receive adjustment bricks. Wall thickness shall be 4 inches minimum, and reinforcing shall conform to the requirements specified for standard sections of the larger diameter. Steps shall be provided as specified for standard precast sections, and an additional step or handhold shall be provided in all concrete cones on the side opposite the ladder steps at about midheight of cone section as shown on Standard Plan no. 208.

No more than two lift holes shall be cast into each cone, and they shall be located so they do not damage reinforcing or expose it to corrosion. At the manufacturer's option, steel loops may be provided for handling, in lieu of lift holes.

Handholds (steps) installed in leveling bricks or flat slab shall be modified to allow a minimum clear opening of 21 inches measured at the shortest dimension, but the handhold shall be not less than 3 inches from the inside face of the wall.

7-05.3(1)H FLAT SLAB COVERS

Standard flat slab covers shall be a minimum of 8 inches thick and shall conform to the outer dimension of the standard sections upon which they are to be placed. Details of opening location and reinforcing shall be as shown on the Standard Plans.

7-05.3(1)I FLAT SLAB REDUCTION SECTIONS

Reductions to 24-inch and 48-inch openings can be made by means of a flat slab reducing section as shown on Standard Plan nos. 200 through 206, "b" series only. Standard flat slab covers shall be a minimum of 8 inches thick and shall conform to the outer dimension of the standard sections upon which they are to be placed. Details of opening location and reinforcing shall be as shown on the Standard Plans.

7-05.3(1)J T-TOP PIPE MANHOLES

T-Top pipe manholes shall conform to the Drawings and shall be provided with foundation and bedding.

7-05.3(1)K JOINTS

Joints between precast manhole components shall be rubber gasketed in a manner similar to pipe joints conforming to ASTM C 443. Shop Drawings of joint details in Standard Plan nos. 200b and 201b, and of end details in Standard Plan nos. 202b, 203b, 204b, 205b, and 206b shall be submitted to the Engineer for approval at least 5 Working Days before manufacture. Completed joints shall show no visible leakage and shall conform to the dimensions of ASTM C 478.

7-05.3(1)L SHOP FABRICATED CORRUGATED METAL MANHOLES

Shop fabricated corrugated metal manholes, shall be constructed in accordance with the Drawings. The Contractor shall submit to the Engineer at least 10 Working Days in advance of ordering, Shop Drawings of the corrugated metal manhole. The corrugated metal manhole shall conform to all applicable provisions of these Standard Specifications.

7-05.3(1)M MANHOLE CHANNELS

All manholes shall be channeled unless otherwise specified in Contract.

Manhole channels shall conform to the curvature of the connecting pipes. Manhole channel slopes shall be made to conform accurately to the Sewer grade and shall be brought together smoothly with well rounded junctions. Where pipe connections have differing grades or differing invert elevations or differing inside diameters, a smooth transition in channel grade(s) or side(s) is required. Channel sides for each pipe shall be carried up vertically from the I.D. at the springline to the crown elevation of the pipe. The concrete shelf between channels shall be smoothly finished and warped evenly with slopes to drain.

7-05.3(1)N MANHOLE PIPE CONNECTIONS

All pipes, except CMP, entering or leaving the manhole shall be provided with flexible joints within 1/2 of a pipe inside diameter or 12 inches, whichever is greater, from the outside face of the manhole structure and shall be placed on firmly compacted bedding, particularly within the area of the manhole excavation which normally is deeper than that of the Sewer trench. Openings surrounding pipes entering the manhole shall be completely filled with either a non-shrink cement sand grout and shall be finished flush with the remaining manhole concrete wall surfaces to ensure watertightness. PVC pipe connecting to manhole shall be provided with a manhole adapter complete with gasket and approved by the Engineer.

7-05.3(1)O BACKFILL

Backfill around drainage Structures, such as manholes, catch basins, inlets, and related Structures, shall consist of suitable Material and shall be placed as a backfill in accordance with Section 7-17.3(3).

7-05.3(1)P MANHOLE GRADE ADJUSTMENT

The Contractor shall be responsible for selecting the appropriate precast concrete manhole components, allowing for a maximum height of 2 foot 2 inch from the top of the cone section or top slab to the finished surface grade for installation of the manhole 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 shall match the adjacent existing roadway surface. On projects calling for regrading and pavement improvements, the grade sheet furnished by the Engineer will show the approximate top grade for manhole within plus or minus 0.2 feet. The final grade will be set by the Engineer.

Final elevation and slope of the frame and cover shall conform to the restored and adjacent street surface. No warping of grades in lieu of manhole frame adjustment will be allowed. All joints in the brick or ring adjustment shall be filled with mortar, and the casting shall be seated in mortar placed on the top brick course. A 3/8-inch thick mortar lining shall be installed inside and outside the adjustment section to provide a smooth, watertight finish.

7-05.3(1)Q LADDER, STEPS AND HANDHOLDS

The Contractor shall submit to the Engineer for approval at least 5 Working Days in advance, the single Material of choice for step, handhold, and ladder from the Section 9-12.2 Materials available, and shall consistently use this single chosen Material in every drainage Structure. Should the Contractor request a different Material between or among different drainage Structures, then the submittal shall be clear in identifying which Material is for which drainage Structure.

Base sections of precast manholes more than 3 feet in height shall be provided with a ladder as detailed in Standard Plan no. 232. Where ladders are required, the bottom step in which the ladder is hung shall be manufactured of the same Material as the ladder.

Steps, handholds, and ladder made of copolymer polypropylene plastic manufactured by Lane International Corp., M. A. Industries, Inc., or approved equal may be substituted for galvanized steel steps, handholds, and ladder.

Where a flat slab is required in the construction of a manhole, the handholds normally required in this area may either be installed in the slab itself, or installed between the slab and leveling bricks, provided that the overall distance to the upper handhold or step, or the distance between the upper handhold or step to the top of frame, is no more than 16 inches. See Sections 7-05.3(1)F and 7-05.3(1)G for additional requirements.

7-05.3(1)R FRAME AND COVER

The casting as shown on Standard Plan no. 230 may be used without extension rings for concrete pavement, or rigid pavement base if the top of casting is level with top of finished pavement and the casting flange is below the rigid pavement. Casting with depth less than the thickness of concrete pavement shall have frame extensions (see Standard Plan no. 231) epoxied to the casting frame by the frame manufacturer to allow the top of casting to be level with the top of finished pavement, and the casting flange to be below the bottom of rigid pavement.

Where Standard Plan no. 230 casting is located within the concrete pavement or within the rigid concrete pavement base, reinforcing in the concrete pavement slab shall be installed as specified in Section 5-05.3(9). Standard Plan no. 230 casting located across, or located within 18 inch 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, ring extension, and leveling brick shall not exceed 26 inches.

7-05.3(1)S CONNECTIONS TO EXISTING MANHOLES

The Contractor shall verify invert elevations prior to construction. Discrepancies in invert elevations shall be immediately brought to the attention of the Engineer. The crown elevation of lateral pipes shall be the same as the crown elevation of the incoming pipe. The existing base shall be reshaped to provide a channel equivalent to that specified for a rechanneled manhole (see Section 7-05.3(1)T).

The Contractor shall excavate completely around the manhole to prevent unbalanced loading. The manhole shall be kept in operation at all times, and the necessary precautions shall be taken to prevent debris or other Material from entering the Sewer. This includes building a tight pipeline sewage bypass as required.

The Contractor shall 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 shall prevent overbreakage. All openings shall provide a minimum of 1 inch and a maximum of 2 inches clearance around the outside circumference of the pipe. Upstream pipes, except PVC pipe, penetrating the walls of manholes shall be placed with the bell facing out such that the bell is placed snug against the outside wall of the manhole as the angle of penetration allows. Pipe, except PVC pipe, leaving or entering manholes shall be provided with a flexible joint within 1/2 of a pipe inside diameter, or 12 inches, whichever is greater from the outside wall of the manhole. After pipes have been placed in their final position, the surface area around the opening in the manhole and the surface of the pipe shall be cleaned of all dirt, dust, grease, oil and other contaminants and then roughened and wetted with water. The opening between pipe and broken out concrete shall be grouted as specified in Section 7-05.3(1)N. PVC pipe connecting to an existing manhole shall be installed according to Section 7-05.3(1)N.

7-05.3(1)T RECHANNEL EXISTING MANHOLE

Rechanneling of an existing manhole shall include all as necessary work, such as, excavating shelf and manhole bottom, filling existing channel or channels with concrete, installing the new channel or channels, constructing new pipe opening or openings, and finishing the channel(s) and shelf(ves). It shall also include the work of connecting the pipe to the manhole in accordance with Section 7-05.3(1)S. Rechanneling shall meet the requirements specified in Section 7-05.3(1)M.

7-05.3(1)U REBUILD EXISTING MANHOLE

Where noted on the Drawings, the Contractor shall rebuild the existing manhole per Standard Plan no. 208 to accommodate a new manhole frame and cover meeting the requirements of Standard Plan no. 230. Work required to rebuild an existing manhole includes excavation around the manhole; removal and salvage of the existing manhole 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 indicated on Standard Plan no. 208. The cone section shall be rebuilt; leveling bricks or rings installed; new manhole steps and handholds installed meeting the requirements of Sections 7-05.3(1)F or 7-05.3(1)G, and a new frame and cover installed in accordance with Section 7-05.3(1)R.

Excavation, backfill with suitable Material, and compaction shall conform to the applicable portions of Section 7-17. Salvage shall be in accordance with 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 shall follow all applicable Specifications of Section 7-05.3(1) for manholes and manhole pipe connections with the exception that no channeling is required. The "joint details by Contractor" in Standard Plan no. 243a shall be submitted by the Contractor to the Engineer for approval at least 5 Working Days in advance of ordering the catch basin.

Catch basins shall be installed as indicated on Standard Plan nos. 260a and 260b unless the Contract indicates otherwise.

Catch basin shall be installed at an elevation which provides at least 2 feet 8 inches of clearance between the outlet pipe and the bottom of the basin. Connections to the catch basin shall be made only either at the pre-drilled holes or at the concrete knock outs provided in the walls of the catch basin. In order to meet this requirement, the Contractor shall 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, and any existing utilities or obstructions that may interfere with installing the inlet connection pipe. All these items have a bearing on the depth of the inlet pipe at the catch basin, and the bottom elevation of the catch basin.

Where it is necessary for the Contractor to set the catch basin deeper to accommodate the deeper incoming pipe, the additional depth of the catch basin requires additional rows of leveling or adjustment bricks, up to a maximum of 16 inches, or installation of a one-foot to two-foot high concrete ring section below the top slab or cone section. This added concrete ring section shall be compatible with the Standard Catch Basin Section and shall accommodate rubber gaskets at the joints.

7-05.3(2)B PIPE CONNECTIONS FOR CATCH BASINS AND INLETS

All new catch basins shall be provided with openings or concrete knockouts for insertion of pipe connections and with a trap for the outlet pipe. The Contractor shall furnish and install new outlet traps for relocated and rebuilt catch basins. When

connections are to be made to existing catch basins with no available hole or knockout, or where a "knockout" of adequate size is not provided, pipe connections shall be accomplished by core drilling, line drilling or wall sawing. All openings shall provide a minimum of 1 inch and a maximum of 2 inches clearance around the circumference of the pipe. Where line drilling is the method used, the method of drilling holes shall prevent overbreakage. After pipes have been placed in position, the opening between pipe and wall of catch basin or inlet shall be grouted as specified in Section 7-05.3(1)N. See Sections 7-08.3(4) and 7-08.3(5) for additional pipe connection requirements.

The outlet trap and the frame and grate shall be located as shown on the Standard Plans and shall be vertically aligned to allow reasonable access for removal and replacement of the outlet trap for vector cleaning maintenance operations.

7-05.3(2)C CATCH BASIN GRADE ADJUSTMENT

Catch basin frame and cover grade adjustment shall be in accordance with Section 7-05.3(1)P.

7-05.3(2)D INLET GRADE ADJUSTMENT

The inlet frame may be either cast into a concrete collar or set flange down on a minimum of one row of concrete adjustment blocks and mortared. It shall not, in any case, be mortared to final grade until the final elevation of the pavement, gutter, ditch or sidewalk in which it is to be placed has been established and permission has been given by the Engineer to mortar the frame in place. Location of inlet will be staked by the Engineer. The bottom of the inlet shall be level with the invert of the outlet pipe.

Existing Type 164 inlets shall be adjusted as shown on Standard Plan no. 268 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 shall include necessary excavation to remove without damage the existing catch basin or inlet, its frame and grate or cover and transporting and installing at the new location. Backfill shall consist of suitable material and compaction shall be in accordance with Section 7-17.3(3). Grade adjustment shall be in accordance with Sections 7-05.3(2)C or 7-05.3(2)D.

The Contractor shall furnish and install new outlet traps (see Section 7-05.3(2)B for outlet trap location requirements).

Existing Type 164 inlets shall be removed and disposed of when a project requires removal and replacement of pavement containing the Type 164 inlet.

7-05.3(2)F REBUILD EXISTING CATCH BASIN

Where noted on the Drawings, the Contractor shall rebuild existing catch basin to accommodate a new frame and grate, or cover, as designated 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, 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 shall conform to the applicable portions of Section 7-17. Salvage shall be in accordance to Section 2-02.3(7). Grade adjustment shall be in accordance with Sections 7-05.3(2)C.

The Contractor shall furnish and install new outlet traps (see Section 7-05.3(2)B for outlet trap location requirements).

7-05.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Extra Depth (Type) Manhole" 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 manholes 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 manhole casting.

Measurement for "Extra Depth, Catch Basin" will be by the vertical foot for any 4 foot diameter riser section required over the 4 foot diameter catch basin Standard section shown in Standard Plan no. 240.

7-05.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-05 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **"Manhole (Type)",** per each.

The Bid item price for "Manhole (Type)" shall include all costs for the work required to furnish and install the manhole complete to finish grade, including excavation, bedding, mortar, non-shrink grout, brick, block, castings, channeling, ladder, steps, connections to pipelines, and backfill with suitable native Material for a manhole depth up to and including 10 feet.

2. **"Extra Depth, (Type) Manhole",** per vertical foot.

The Bid item price for "Extra Depth, (Type) Manhole" shall include all costs for the work required to construct the portion of a manhole in excess of 10 vertical feet. Payment for extra depth of the A and B types of manhole will be made under the three digit Standard Plan number as 200A, 200B, 201A, 201B, etc.

3. **"Rechannel Manhole",** per each.

The Bid item price for "Rechannel Manhole" shall include all costs for the work required to complete the manhole rechanneling work as specified in Section 7-05.3(1)T and of core drilling openings for new pipes to the manhole when performed in an existing manhole.

If connecting a new pipe to an existing manhole requires rechanneling of the manhole, the work involved in connecting such pipe to the manhole is incidental to "Rechannel Manhole", per each, and shall be performed as specified in Section 7-05.3(1)T. If the work involves only the cutting of an opening and connecting the pipe without rechanneling, then this work shall be considered included in the Bid item price for installation of the pipe and no other payment will be made therefore.

4. **"Catch Basin, (Type)"**, per each.

The Bid item price for "Catch Basin, (Type)" shall include all costs for the work required to furnish and install the catch basin including trap, excavation, backfill, adjustment brick and blocks, mortar, non-shrink grout, plaster, and castings.

5. **"Extra Depth, Catch Basin"**, per vertical foot.

The Bid item price for "Extra Depth, Catch Basin" shall include all costs for the work required to construct a catch basin in excess of the standard height as shown in Standard Plan no. 240 when 4 foot diameter riser section(s) are used.

6. **"Inlet, (Type)"**, per each.

The Bid item price for "Inlet, (Type)" shall include all costs for the work required to furnish and install the inlet including excavation, brick, block, mortar, and castings.

7. **"Rebuild (Item)"**, per each.

The Bid item price for "Rebuild (Item)" shall include 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)U or 7-05.3(2)F as applicable.

8. **"Relocate (Item)"**, per each.

The Bid item price for "Relocate (Item)" shall include all costs for the work required to relocate the catch basin or inlet including furnishing and installing new outlet trap, excavation and backfill with native Material, adjustment brick and blocks, mortar, non-shrink grout, plaster and castings in accordance with Section 7-05.3(2)E.

9. **Other payment information.**

When Mineral Aggregate Type 17, or other Mineral Aggregate Type designated by the Engineer, is used as backfill, payment shall be per Section 1-09.4.

Payment for "Extra Excavation", will be per Section 7-17.5.

Foundation Material will be paid as "Mineral Aggregate, (Type)", per 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 in accordance with Section 1-04.1(2).

Final adjustment of the casting for new construction of manhole, catch basin and inlet shall be considered incidental to and included in the Bid item price for the manhole, catch basin, and inlet.

Where a newly constructed manhole and casting has been completed to finished grade set by the Engineer and is later required to be adjusted to a revised grade by the Engineer, the adjustment will be paid in accordance with Section 1-09.4.

Payment for trench safety system will be paid as specified in Section 7-17.5.

SECTION 7-06 PIPE ANCHORS

7-06.1 DESCRIPTION

Section 7-06 describes work consisting of constructing concrete pipe anchors, prefabricated pipe anchors on tongue and groove concrete pipe and other pipes as designated in accordance with details indicated in the Contract.

7-06.2 MATERIALS

Material shall meet the requirements of the applicable portion of Sections 6-02 and 6-03.

7-06.3 CONSTRUCTION REQUIREMENTS

The construction shall be in accordance with the Contract and the applicable portions of Sections 6-02.3 and 6-03.3.

7-06.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

7-06.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-06 will be made at the Bid item price Bid only for the Bid item listed or referenced as follows:

1. **"Pipe Anchor"**, per each.

The Bid item price for "Pipe Anchor" shall include all costs for the work required to furnish and install the pipe anchor.

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, manholes, 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 shall be cleaned as a first order of Work to enhance drainage off and through the Project Site. These facilities shall be kept clean up to the Physical Completion Date.

All existing pipes and drainage Structures connecting to new work shall be cleaned 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, manholes, inlet and outlet Structures, and debris racks shall 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 shall be 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 appurtenances other than those described in Sections 7-01, 7-17 and 7-18.

7-08.2 MATERIALS

Materials shall meet 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 are subject to Trench Safety Systems, Section 7-17.3(1)A7a.

Trench excavation and backfill shall be as specified in Section 7-17.

7-08.3(2) CONNECTIONS TO EXISTING SANITARY SEWERS

When making a connection to an existing sanitary Sewer line or manhole, the Contractor shall 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 "CUT-IN TEE ON EXISTING PIPE". See Section 7-05.3(1)S for connections to existing manholes.

7-08.3(3) PIPE INSTALLING, JOINTING, AND TESTING

Pipe installing, bedding, jointing, backfilling, and pipe connections shall conform to the applicable requirements of Section 7-17. Testing for acceptance as provided in Section 7-17.3(4) will not be required.

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. Both the alignment and the slope shall be straight with the exception of maintaining clearances in accordance with Section 1-07.17(2). Ninety degree (90°) bends will not be allowed.

No connection shall be made 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 shall be Class B bedding.

Connection pipe may be deflected at the joint to avoid obstacles to within the allowable angular deflection recommended by the pipe manufacturer. Such deflection shall be water tight and allow rodding the pipe in a relatively easy manner. Where pipe joints must be deflected, the Contractor shall submit the manufacturer's pipe joint deflection criteria to the Engineer for approval. 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 shall be normal angle.

The Contractor shall 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.

7-08.3(5) INLET CONNECTIONS

Inlet connections are pipe connections from drainage inlets to catch basins or other approved outlets. Inlet connections shall be installed upgrade from catch basin openings or other originations in straight alignment. Where a straight alignment or a uniform slope is not feasible and curves are necessary, the altered alignment shall be made by deflecting each pipe into a smooth curve. Bends with angles greater than 22.5 degrees shall not be used. Each pipe joint deflection shall not exceed that necessary to maintain a watertight connection as recommended by the pipe manufacturer. The Contractor shall submit the pipe manufacturer's pipe joint deflection criteria. Inlet connection slopes shall be not less than 5% nor more than 50% for any or all portions of the connection with or without deflection.

Pipe connections to a catch basin or other approved outlet shall not be made until the compaction requirements as specified in Section 7-08.3(4) have been met and the work has been approved by the Engineer. Bedding for inlet connection pipe shall be Class B bedding.

See Section 7-05.3(2)B for inlet pipe connection requirements.

7-08.3(6) DROP CONNECTIONS

Inside and outside drop connections, used in conjunction with different types of manholes to allow for abrupt drop in elevation of the inflow, shall be constructed as shown on Standard Plan nos. 233a and 233b, and at locations indicated on the Drawings. The invert elevation of the outside drop connection will be specified on the Drawings. The crown elevation of the inside drop connection shall match the crown elevation of the manhole outlet pipe.

7-08.3(7) VERTICAL CONNECTION

Vertical connections shall be constructed in accordance with Standard Plan no. 234, unless the Contract specifies otherwise.

7-08.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

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 manhole, to the invert at the upstream end of the tee as shown on Standard Plan no. 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 manhole as shown on Standard Plan no. 233b.

Measurement for "Vertical Connection (Size)" will be from surface grade to the crown elevation of the connecting pipe.

Measurement for "Pipe, Catch Basin 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 (see Section 7-16.4).

7-08.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-08 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

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)" shall include all costs for the work required to furnish and install the pipe, including connections to catch basins or inlets, excavation, backfill, and compaction.

3. "Drop Connection, (Type), (Size)", per vertical foot.

The Bid item price for "Drop Connection, (Size)" shall include all costs for the work required to furnish and install the complete inside or outside drop connection as shown on Standard Plan nos. 233a and 233b.

4. "Vertical Connection, (Size)", per vertical foot.

The Bid item price for "Vertical Connection, (Size)" shall include all costs for the work necessary to furnish and install the vertical connection as shown on Standard Plan no. 234.

5. **Other payment information.**

The cost for furnishing and installing new outlet trap when installing catch basin connection pipe to existing catch basin shall be included in the Bid item price for "Pipe, Catch Basin Connection, (Material), (Class), (Size)".

Payment for bedding will be in accordance with Section 7-17.5.

Payment for trench safety system will be as specified in Section 7-17.5.

Payment for clay dam, and for CDF bedding and backfill, will be as specified in Section 7-17.5.

SECTION 7-09 PIPE AND FITTINGS FOR WATER MAINS**7-09.1 DESCRIPTION**

Section 7-09 describes work included under Sections 7-09 through 7-15 consisting of the construction of water distribution and transmission pipelines and appurtenances for both temporary and permanent installations.

7-09.2 MATERIALS

Materials shall meet the requirements of Section 9-30.

Polyvinyl chloride, polyethylene, polybutylene, and asbestos cement as pipe material, and the use of elastomers (such as those used in jointing gaskets and packing glands), shall not be used as or incorporated in Water Main to convey potable water.

The Contractor shall only install new and unused Materials suitable and approved for potable water supply.

It is not intended that Materials listed herein for potable Water Mains, fittings, and appurtenances are to be necessarily considered equally suitable or generally interchangeable for all applications. It is intended that "or equal" or "or

approved equal" or any Material substitution will not be allowed unless the Contract so specifies (see Section 1-06.1). Those Materials suitable for the project will be specified in the Contract.

The pipe manufacturer shall test all pipe and fittings as required by these Standard Specifications and by the applicable recognized standards of national organizations referenced (see Section 1-06.2). The pipe manufacturer shall submit to the Engineer two copies of all test results including a Manufacturer's Certificate of Compliance that Material to be delivered to, and intended for incorporating in, the project is represented by the samples tested and that such delivered Materials meet or exceed the specified requirements. No pipe shall be delivered until test results and Manufacturer's Certificate(s) of Compliance are approved by the Engineer.

The Engineer shall have free access to all testing and records pertaining to Material to be delivered to the project Site. The Engineer may elect to be present at any or all Material testing operations.

7-09.3 CONSTRUCTION REQUIREMENTS

The Contractor shall not operate any valve on an existing Water Main.

Trench excavation, bedding, and backfill for Water Mains is described in Section 7-10.

Pipe installation for Water Mains and fittings is described in Section 7-11.

Valves for Water Mains is described in Section 7-12.

Hydrants are described in Section 7-14.

Water service connections are described in Section 7-15.

7-09.4 RESERVED

7-09.5 RESERVED

SECTION 7-10 TRENCH EXCAVATION, BEDDING AND BACKFILL FOR WATER MAINS

7-10.1 DESCRIPTION

Section 7-10 describes work consisting of excavating, bedding, and backfilling for Water Mains and the construction of distribution and transmission Water Mains and appurtenances for both temporary and permanent installation.

Water Mains shall be constructed at the locations shown on the Drawings.

Where rough grading is required at the beginning of Work, such grading, including excavation and embankment construction, shall conform to the requirements of Section 2-03. Rough grading shall be completed before excavating for the Water Main trench.

Borrow and disposal sites shall conform to the requirements of Section 2-03.3(13).

7-10.2 MATERIALS

Materials specified as "Mineral Aggregate, (Type)" shall be in accordance with Section 9-03.

7-10.3 CONSTRUCTION REQUIREMENTS

7-10.3(1) GENERAL

See Section 7-17.3(1)A7a regarding trench excavation safety requirements. See Section 7-10.3(7) for additional trench excavation requirements when the Work involves construction of potable Water Mains and related Structures and appurtenances.

See Sections 1-07.23 and 1-10 regarding construction operations and traffic.

Clear access shall be provided and maintained to fire hydrants, water valves, water meters, water vaults, and related water Structures at all times unless the Contract specifies otherwise.

Clearance shall be left to allow storm water to flow freely in gutters, other conduits, and natural watercourses.

Water distribution main, water transmission main, water services, and fire hydrant and connection pipe shall be installed at least five (5) feet clear of any tree measured edge to edge.

7-10.3(2) UNGRADED STREETS

On ungraded streets, when grading is not called for in the Contract, the depth of trench excavation shall be as indicated on the Drawings and as staked by the Engineer.

Where the Drawings show pipe is to be installed above existing ground surface, an embankment fill shall be made and compacted to conform with the section shown on the Drawings, and the Water Main trench shall be excavated therein. That portion of the embankment below the bottom of the pipe shall be compacted with rollers or mechanical compactors under controlled moisture conditions as required under Method B of Section 2-03.3(14)D.

7-10.3(3) CLEARING AND GRUBBING IN UNGRADED STREETS

See Section 2-01.

7-10.3(4) REMOVAL OF EXISTING STREET IMPROVEMENTS

See Section 2-02.

7-10.3(5) GRADE AND ALIGNMENT**7-10.3(5)A GENERAL**

Trenches for pipe shall be opened in accordance with the lines and grades indicated on the Drawings, and to a depth that maintains the minimum required depth of cover unless indicated otherwise in the Contract (see Section 7-10.3(5)C).

On improved streets, the grade and alignment shall be taken from established points set by the Engineer.

7-10.3(5)B VERIFICATION OF LOCATION

After marking underground facilities (see Sections 1-07.17(1) and 7-10.3(6)) and prior to any pavement cutting or removal or excavation for pipe installation, the Contractor shall verify, in the presence of the Engineer, the locations of existing Water Mains. The Contractor shall arrange to establish their depths at points where connections are to be made. After excavation, the Contractor shall verify the dimensions, type, and condition of the exposed Water Main. Should a condition be discovered which materially differs from indicated in the Contract, the Contractor shall immediately notify the Engineer. When necessary, the profile shall be adjusted as directed by the Engineer so that abrupt changes in grade and alignment of Water Main and connection are prevented.

7-10.3(5)C MINIMUM DEPTH OF COVER

The depth of trenching for distribution Water Mains shall give a minimum depth of cover as indicated on Standard Plan no. 030. The depth of trenching for transmission Water Main shall give the minimum depth of cover as indicated in the Contract. Where profile of Water Main and ground surface is shown on the Drawings, the Water Main shall be installed to the elevation shown on the Drawings, regardless of depth of cover for distribution Water Main indicated on Standard Plan no. 030. Deeper excavation may be required due to localized breaks in grade or due to installing the new distribution Water Main under existing Culverts or other underground facilities where necessary. Excavation shall be to such depth that the cover over the valve operating nut shall be a minimum 1 foot.

7-10.3(6) EXISTING UTILITIES AND TEMPORARY SERVICE CONNECTION

See Section 1-07.17 for utilities and similar facilities and for Water Main clearance requirements.

When utility services occupy the same space as the new Water Main, the Contractor shall do all necessary excavation to fully expose such services. The Contractor shall protect said services and work around them during excavating and pipe installation operations. The Contractor shall be responsible for all damage to the services. When existing services are damaged due to Contractor operations, the Contractor shall immediately notify the Engineer and arrange for timely repair or replacement. In the event of conflict with other underground facilities, the Contractor shall immediately notify the Engineer. Mainline Sewers and storm drains shall not be damaged, removed or relocated. Water Main pipe shall be installed to clear these utilities (see Section 1-07.17(2)).

Existing Water Mains and fittings encountered during trench excavation and indicated on the Drawings to be removed (or if removal is required by the Engineer) shall be removed, and disposed of (Section 1-07.3) or salvaged by the Contractor (Section 2-02).

All ends of abandoned Water Main shall be plugged in accordance with Section 2-02.3(5). Pipe 12 inch and larger shall be abandoned and filled in accordance with Section 2-02.3(5).

In conducting the Work, the existence of and how to address private water service utilities and appurtenances is addressed in Section 1-07.17(1). When it is necessary to provide temporary water supply connections due to conflict between existing privately owned water service laterals and appurtenances and with the new Water Main, it shall be the responsibility of the Contractor to provide temporary services.

Permanent replacement of temporary water services with new water services shall be as directed by the Engineer, and require inspection and approval by SPU Water Customer Service. The Contractor shall give a minimum 2 Working Days advance notice by contacting 206-684-5800. Also see Section 7-15.

Should the Contractor damage or disrupt private water services or appurtenances, the Contractor shall immediately notify the Engineer of any such damage or disruption, shall begin repairs immediately as directed by the Engineer, and shall work continuously until the condition is accepted.

7-10.3(7) TRENCH EXCAVATION**7-10.3(7)A GENERAL**

Sidewalk, pavement, appurtenant Structure, adjacent improvement and underground installation adjacent to and beyond the trench shall not be undermined or disturbed.

The Contractor shall perform excavation to the depth, line, and grade indicated on the Drawings. All excavations shall be made by open cut methods and shall include excavation for pipe bedding as applicable (see Standard Plan no. 350).

The length of trench excavation in advance of pipe installation operations shall be kept to a minimum, and in no case shall it exceed 500 feet for transmission pipeline, and 200 feet for distribution Water Main.

The maximum trench width in the Right of Way shall not exceed the neatline trench width as shown on Standard Plan no. 350.

Outside the Right Of Way and in unimproved areas, trench width above the top of pipe may at the Contractor's option exceed the maximum trench width indicated on Standard Plan no. 350 by sloping or benching. However, all requirements for excavating, handling and disposing of excavated material, and placing and compacting additional suitable backfill, outside of Standard Plan no. 350 neatline trench limits shall be at the sole expense of the Contractor.

When Water Main invert or other elevations are indicated on the Drawings, the Contractor shall excavate to that depth plus any additional excavation as necessary to accommodate the Contract specified class of bedding. When no invert or other elevation is indicated in the Contract, the Contractor shall excavate to a depth, including additional excavation as necessary for the class of bedding when specified in the Contract, to provide the minimum cover as indicated in Standard Plan no. 030. When Water Main elevations are specified in the Contract, excavation below that depth shall be backfilled with suitable native material and shall be compacted to 90% as specified in Section 2-03.3(14)E at the Contractor's sole expense. The Contractor shall provide overexcavation for bells such that pipe barrels and bells along the Water Main are uniformly supported full length.

Grading and other excavations nearby shall be controlled to prevent surface water from flowing into the excavations. All material excavated from trenches and piled adjacent to the trench shall be piled and maintained so that the toe of the slope is at least 2 feet from the edge of the trench. This material shall be piled to cause a minimum of inconvenience to public travel, and provision shall be made for merging traffic where necessary. Clear access shall be provided to all fire hydrants, water valves, and meters. Surface drainage and runoff along gutters to storm drain facilities and along natural watercourses shall not be blocked. See Section 1-07 for other requirements. Suitable excavated material for reuse as backfill shall be stockpiled in an acceptable manner and shall be protected from becoming unsuitable. Unsuitable material, or suitable material in excess of project needs, shall be disposed of by the Contractor (see Section 2-01.2).

Excavation for valve chambers and other Water Main Structures shall be sufficient to provide a minimum of 12 inches between their exterior surfaces and the sides of the excavation.

Prior to installation of bedding, when required in the Contract, and installation of pipe, the trench bottom shall be brought to grade as indicated for the type of bedding specified and if disturbed, compacted to 90% as specified in Section 2-03.3(14)E to provide a foundation Capable of supporting the pipe full length in its proper position.

All ledgerrock, boulders, stones, and any object larger than 3 inch in any dimension shall be removed within 6 inches in any direction from the pipe. The maximum size of aggregate within 6 inch of the pipe shall not exceed 1 inch per foot of pipe diameter and in no case shall exceed 3 inch.

The Contractor shall remove any protective system in such a manner as to not disturb bedding or backfill. Where bedding or backfill is disturbed, the Contractor shall reconsolidate the material as specified.

7-10.3(7)B EXTRA EXCAVATION

The requirements of Section 7-17.3(1)A2 shall apply. All references to Standard Plan nos. 284 and 285 shall mean Standard Plan no. 350.

7-10.3(7)C DEWATERING

In addition to the requirements of Section 7-17.3(1)A3, during the installation of Water Main, jointing, coating, cathodic and electrolysis protection, and the placement of bedding and trench backfill, excavations shall be kept free of water. All references to Standard Plan nos. 284 and 285 shall mean Standard Plan no. 350.

At all times, all non-potable water and any other debris shall be prevented from entering Water Main. At the end of each day's work on any portion of Water Main, the Contractor shall provide a temporary seal ensuring nothing can enter the Water Main or any new construction for the Water Main.

Also see Section 7-11.3(1) for additional requirements.

7-10.3(7)D UNEXPECTED OBJECTS

The requirements of Section 7-17.3(1)A4 shall apply. All references to Standard Plan nos. 284 and 285 shall mean Standard Plan no. 350.

7-10.3(7)E TRENCH EXCAVATION IN SOLID ROCK

See Section 7-17.3(1)A5. All references to Standard Plan nos. 284 and 285 shall mean Standard Plan no. 350.

7-10.3(7)F SURPLUS MATERIAL

The requirements of Section 7-17.3(1)A6 shall apply. All references to Standard Plan nos. 284 and 285 shall mean Standard Plan no. 350.

7-10.3(7)G PROTECTIVE SYSTEMS

7-10.3(7)G1 TRENCH SAFETY SYSTEMS

The Contractor shall comply with the requirements of Section 7-17.3(1)A7a. All references to Standard Plan nos. 284 and 285 shall mean Standard Plan no. 350.

7-10.3(7)G2 SUPPORT SYSTEM

The requirements of Section 7-17.3(1)A7b shall apply. All references to Standard Plan nos. 284 and 285 shall mean Standard Plan no. 350.

7-10.3(8) MATERIAL FROM TRENCH EXCAVATION

7-10.3(8)A REMOVAL AND REPLACEMENT OF UNSUITABLE MATERIAL

See Sections 7-10.3(7)B and 7-10.3(7)F.

7-10.3(8)B SURPLUS MATERIALS

See Section 7-10.3(7)F.

7-10.3(9) BEDDING THE PIPE**7-10.3(9)A RIGID PIPE****7-10.3(9)A1 GENERAL**

All distribution Water Main shall have either Class D bedding, or Class B bedding with either of Mineral Aggregates Type 6 or Type 7. All transmission Water Main shall have Class B bedding with Mineral Aggregate Type 9. See Standard Plan no. 350. Allowance for excavation to accommodate pipe bells and any fittings shall be made to provide uniform support along the pipe barrel.

Care shall be taken to prevent any damage to the pipe, to any protective coating, and to any electrolysis monitoring system.

7-10.3(9)A2 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 shall be Mineral Aggregate either Type 6 or Type 7 in accordance with Section 9-03. Class B bedding consisting of Mineral Aggregate Type 6 or Type 7 shall be compacted by tamping.

Bedding of specially protected pipe shall be conducted at all times in such manner as to prevent damage to the protective coating or wrap.

Placing of Class B bedding around wrapped or coated or specially protected pipe shall be done in a manner acceptable to the Engineer. Any damage to the special protection or coating or wrap shall be repaired by the Contractor at the Contractor's sole expense in a manner acceptable to the Engineer.

7-10.3(9)B FLEXIBLE PIPE**7-10.3(9)B1 BEDDING FOR FLEXIBLE PIPE**

Bedding for flexible pipe, when flexible pipe is permitted for use, shall be Class B with Mineral Aggregate Type 22 placed in lifts as shown on Standard Plan no. 350. Care shall be used in installing flexible pipe to prevent vertical pipe deflection.

The first bedding lift thickness shall be placed, spread and compacted across the width and length of the trench bottom at the required grade to support the pipe. Allowance shall be made for pipe bell and any other fitting. Pipe is then installed and the next lift of bedding Material carefully placed and compacted evenly along both sides of the pipe up to the crown, being careful not to 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, the final bedding lift over the pipe shall be placed.

7-10.3(10) BACKFILLING TRENCHES

Prior to backfilling, all form lumber and debris shall be removed from the trench. The protective system used by the Contractor shall be systematically removed to allow for acceptable backfilling. Where Class D bedding is required, backfill up to 6 inches over the top and both sides of the pipe shall be evenly and carefully placed, but not until all material, such as rock not Capable of passing a 3 inch sieve or similar objectionable material, Capable of damaging the pipe or its coating or its electrolysis monitoring system have been removed from the backfill Material.

In backfilling the trench, the Contractor shall take all necessary precautions to protect the pipe from any damage or shifting. The Contractor shall backfill to a uniform depth of 1 foot above ductile iron pipe before starting compaction, and to a uniform depth of 2 feet above concrete pipe before starting compaction.

During all phases of the backfilling operations and testing as outlined herein, the Contractor shall protect the pipe installation, provide for the maintenance of traffic as may be necessary, and provide for the safety of property and persons.

See Section 7-10.3(8)A for unsuitable material and replacement Material requirements.

The Contractor shall protect suitable excavated material from becoming contaminated or excessively moist.

Where it is required that a blanket of selected Material or bank run gravel be placed on top of the native backfill, the backfill shall be placed to such elevation as shown on the Drawings, and shall be leveled to provide for a uniform thickness of the selected Material. Compaction is required, and it shall be performed prior to placing the selected Material.

The Contractor shall use suitable native excavated Material for trench backfill unless notified by the Engineer that the native Material is unsuitable. The Engineer will examine excavated native Material at the time of excavation to determine its suitability for use as backfill (see Section 2-03.3(10)). Native Material will be considered suitable for trench backfill if it is:

1. Capable of attaining the degree of compaction specified in Section 7-17.3(3)B;
2. Within reasonable tolerance of optimum moisture content; and
3. Reasonably free of organic material, clay, frozen lumps, rocks or pavement chunks more than 6 inches in maximum dimension, or other deleterious matter.

Unsuitable backfill Material shall be removed from the site, disposed of per Section 1-07.3, and replaced with selected Material, Mineral Aggregate Type 17 or such other imported Material as designated by the Engineer.

Pipe trenches shall be backfilled as soon as possible after the pipe installation. See Section 7-10.3(7)A for length of trench limitations. Backfilling of trenches in the vicinity of catch basins, manholes, or other appurtenances will not be permitted until new cement in the masonry has become thoroughly hardened.

Walking on the pipe shall not be allowed until at least 1 foot of cover has been placed upon the pipe.

7-10.3(11) COMPACTION OF BACKFILL

The Contractor shall place the initial lift of loose backfill to a uniform depth of 2 feet above the crown of concrete pipe and to a uniform depth of 1 foot above the crown of ductile iron pipe before starting compaction. Trench backfill shall continue in uniform lifts not exceeding 1 foot loose thickness and be compacted by impact type mechanical tampers approved by the Engineer. Water settling will not be permitted. Degree of compaction shall meet Section 2-03.3(14)E requirements as follows:

1. Improved areas such as street and sidewalk areas, compaction shall be 95% of maximum dry density.
2. Unimproved areas or landscape areas shall be compacted to 90% of maximum dry density.

The procedure and equipment to be used for backfill compaction shall be demonstrated on a test section of Water Main backfill at a location designated by the Engineer. The Contractor shall excavate test pits as directed by the Engineer for the purpose of testing the backfill compaction. The Contractor shall make these arrangements prior to backfilling.

If the required compaction density has not been obtained, the Contractor shall remove the backfill from the trench and recompact using an improved technique, heavier compaction equipment or more passes. This process shall 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 the remainder of the Water Main under the approved compaction procedure.

In the event routine field densities taken during the course of construction show the specified compaction is not being obtained because of changes in soil types or for any other reason, the Contractor will be required to reestablish the compaction procedure. In no case will excavation and pipe installation operations be allowed to proceed until the specified compaction is attained.

7-10.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Solid Rock Excavation" will be in accordance with Section 2-03.4.

Measurement for "Mineral Aggregate, (Type)" will be in accordance with Section 4-01.4.

Measurement for "Extra Excavation" will be by the cubic yard of in-place material actually removed beyond the neatlines indicated on Standard Plan no. 350.

Measurement for "Bedding, (Class), (Size) Pipe" for Water Main will be in accordance with Section 7-17.4.

Measurement for "Safety Systems in Trench Excavation, Minimum Bid = \$0.40 per Square Foot" will be in accordance with Section 7-17.4.

7-10.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-10 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

Imported Material when ordered in lieu of native backfill material by the Engineer will be paid for as "Mineral Aggregate, (Type)" in accordance with Section 4-01.5.

Payment for "Extra Excavation" and for "Bedding, (Class), (Size) Pipe" shall be in accordance with Section 7-17.5.

Payment for "Solid Rock Excavation" shall be in accordance with Section 2-03.5.

Foundation Material, when required in the Contract, will be paid for as "Mineral Aggregate, (Type)" in accordance with Section 4-01.5.

If no Bid item is in the Bid Form for Mineral Aggregate of the Type designated by the Engineer, or for "Solid Rock Excavation" or for "Extra Excavation", the Contractor shall perform the work as directed by the Engineer, and payment will be made in accordance with Section 1-04.1(2).

No separate payment will be made for excavating the trench, placing and compacting the native backfill material, hauling and placing excess suitable native material elsewhere on the project, or hauling and disposing of excess materials offsite whether suitable or unsuitable. These costs shall be considered as being included in the Bid item prices for each class, size, and type of pipe in accordance with Section 7-11.5.

Payment for "Safety Systems in Trench Excavation, Minimum Bid = \$0.40 per Square Foot" will be in accordance with Section 7-17.5.

Where unexpected objects, such as stumps, railroad ties, etc. are encountered in the trench excavation, and such unexpected objects cause the Contractor delays or require extra work or equipment for its removal, payment will be in accordance with Section 1-09.4. When the presence of these objects is indicated in the Contract, and is not included as a Bid item in the Bid Form, the removal of these objects shall be considered included in the Bid item prices of the applicable Bid items and no separate or additional payment will be made.

No separate payment will be made for furnishing and installing sand cushion and protection of existing utilities and services. These items shall all be included in the Bid item prices of the Water Main Bid items.

All costs for plugging ends of abandoned Water Main shall be included in the Bid item prices of the applicable Bid items.

Payment for bedding for Water Main will be in accordance with Section 7-17.5.

All costs incurred by the Contractor in providing temporary water service, when deemed necessary by the Engineer, shall be considered included in the Bid item prices for the applicable Bid items and at no additional or separate cost to the Owner.

In the event the Contractor elects to use pipe bedding or Mineral Aggregate of any Type below the pipe to facilitate dry construction, all costs for furnishing and placing these materials shall be borne by the Contractor.

Any material that becomes unusable due to the Contractor's failure to take adequate measures to provide protection from moisture shall be replaced at the Contractor's expense with Mineral Aggregate Type 17 or such other Material as the Engineer will accept.

All costs in connection with excavating test pits and from standby time during field density tests shall be considered as incidental to the backfill.

All costs for removing or salvaging existing Water Mains and fittings as specified in Section 7-10.3(6) shall be considered incidental to the various Bid items comprising the Contract.

The cost for cutting and reconnecting water services by the SPU Water Operations as requested by the Contractor for his work as specified in Section 7-10.3(6) will be charged to the Contractor. Also see Section 7-15.5.

The hauling away of surplus material from the excavation to other areas of the project or disposing of the material offsite shall be considered as incidental to the Bid item price of pipe installed.

SECTION 7-11 PIPE INSTALLATION FOR WATER MAINS

7-11.1 DESCRIPTION

Section 7-11 describes work consisting of installing Water Main pipe in accordance with the manufacturer's printed specifications and instructions and with the AWWA standards for installing the type of pipe proposed.

Pipe sections shall be joined in such a manner as not to damage the lining or coating. The method of pulling or jacking the pipe home shall allow for both vertical and horizontal movement of the pipe for protection of the gasket.

Water Main installation shall not proceed until line and grade hubs have been set and measurements for connection fittings have been made in accordance with Section 7-10.3(5).

Clearances shall be maintained between Water Mains and other utilities per Section 1-07.17(2).

7-11.2 MATERIAL

7-11.2(1) GENERAL

Material shall meet the requirements of Section 9-30 and Section 9-04.

Pipe and Pipe Coatings	9-30.1
Fittings	9-30.2
Valves, Valve Boxes, and Valve Chambers	9-30.3
Hydrants	9-30.5
Service Connections and Service Pipe or Tubing	9-30.6
Bedding, Foundation Material and Gravel	9-30.7
Joint Bond Cable	9-30.10
Thermite Weld Materials	9-30.11
Electrolysis Test Station	9-30.12
Turbine Meters (sizes 2" – 12")	9-30.13
Locating Wire	9-30.14
Coating for Bolts and Shackle Rods	9-30.15
Backflow Prevention Assemblies	9-30.16

7-11.2(2) PRE-INSTALLATION TASTE AND ODOR TESTING

All Water Main manufactured of any material and all Water Main lining material shall either:

1. satisfactorily pass an Engineer conducted SPU Taste And Odor Rating Test, or
2. be a product of a material person pre-approved by the Engineer in accordance with SPU's Taste And Odor Rating Test Program.

The Contractor shall allow for Taste And Odor Rating Testing as follows:

Material	Time for Testing and Reporting Results
Water Main	Up To 30 Working Days ¹
Water Main Lining Material	Up to 30 Working Days ¹

Note 1 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 one 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.

Materialmen with Taste And Odor Rating Test Program pre-approved Water Main and Water Main lining material can be obtained by contacting 206-684-7834.

Materialmen 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 reserves the right to perform post installation Taste And Odor Rating Testing on any portion of the Work prior to or after connection to existing Water Main. Such retesting may be performed as part of bacteriological sampling and testing during flushing and testing (see Sections 7-11.3(12)L and 7-11.3(12)M), and may include sampling and testing of mortar and lining materials. Post-installation Taste and Odor Rating Testing shall require 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 not more than 15 Working Days.

If results of additional Taste and Odor Tasting Rating Testing are determined unacceptable, the Contractor shall be prepared to 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 of the new Water Main under test.

7-11.3 CONSTRUCTION REQUIREMENTS

7-11.3(1) DEWATERING OF TRENCH

In addition to the requirements of Section 7-10.3(7)C, where water is encountered in the trench, the water shall be removed during pipe installation operations and trench dewatering shall be maintained until the ends of the pipe are sealed and provisions are made to prevent floating of the pipe. Trench water or other deleterious materials shall not be allowed to enter the pipe at any time.

7-11.3(2) HANDLING OF PIPE

7-11.3(2)A GENERAL

All types of pipe shall be handled in a manner that prevents damage to the pipe, and pipe lining or coating. Pipe and fittings shall be loaded and unloaded using hoists and slings in a manner to avoid shock or damage, and under no circumstances shall they be dropped, skidded, or rolled against other pipe. Damaged pipe will be rejected, and the Contractor shall immediately place all damaged pipe apart from the undamaged and shall remove the damaged pipe from the Project Site within 24 hours.

Threaded pipe ends shall be protected by couplings or other means until the pipe is installed.

The pipe and fittings shall be inspected for defects.

Ductile iron and cast iron pipe, while suspended above grade, shall be rung with a light hammer to detect cracks. Dirt or other foreign material shall be prevented from entering the pipe or pipe joint during handling or installing operations, and any pipe or fitting that has been installed with dirt or foreign material in it shall be removed, cleaned, and reinstalled. A clean whisk broom shall be used for this purpose and for brushing to remove foreign matter prior to joining of pipe ends. At times when pipe installation is not in progress, the open ends of the pipe shall be closed by a watertight plug or by other means approved by the Engineer to ensure cleanliness inside the pipe.

Pipe shall be stacked in such a manner as to prevent damage to the pipe, to prevent dirt and debris from entering the pipe, and to prevent any movement of the pipe. The bottom tiers of the stack shall be kept off the ground on timbers, rails or other similar supports. Pipe on succeeding tiers shall be alternated by bell and plain end. Timbers 4-inch X 4-inch in size shall be placed between tiers and chocks shall be placed at each end to prevent movement. Each size of pipe shall be stacked separately.

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 shall be in accordance with AWWA C214, and as specified herein.

Pipe, at all times, shall be handled 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 shall not be permitted to come in contact with the lining or coating. When shipped by rail, all pipe shall be carefully loaded on properly padded saddles not less than 12 inches in width. Pipe sections shall be separated so that they do not bear against each other and the whole load shall be securely fastened together and to the cars to prevent movement in transit.

In truck shipments, the pipe shall be supported 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 shall be carefully padded.

The Engineer will inspect the pipe and coating after delivery to the Project Site prior to installation by the Contractor. The Contractor shall allow inspection of the coating on the underside of the pipe while suspended from the sling, before the pipe is lowered into the trench.

Pipe stored along the trench side shall be supported by 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 shall be in accordance with AWWA C214 and Section 7-11.3(6)C. Repair of thermoplastic powder coated pipe shall be per manufacturer's written instructions. The Contractor shall submit at least 3 Working Days in advance the manufacturer's recommendations for thermoplastic coating repair.

7-11.3(3) CUTTING PIPE

Whenever it becomes necessary to cut a length of pipe, the cut shall be made by abrasive saw or by a special pipe cutter. All pipe ends shall be square with the longitudinal axis of the pipe. The outside of slip joint pipes shall be beveled and smoothed so that good connections can be made without damage to the gasket. Threads shall be cleanly cut. Torch cutting of ductile iron pipe will not be allowed.

Restrained joint pipe shall be cut in accordance with the pipe manufacturer's recommendations. The Contractor shall 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.

7-11.3(4) 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 shall not exceed the manufacturer's printed recommended deflections. The Contractor shall submit to the Engineer the pipe manufacturer's joint deflection recommendations prior to pipe installation indicating deflections are within allowable AWWA specification tolerances.

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 shall be jointed in a straight alignment and then deflected to the curved alignment. Trenches shall be made wider on curves for this purpose.

Maximum deflections at pipe joints and installation radius for various pipe lengths shall conform to the manufacturer's and AWWA specifications for the given type of pipe.

Where pipe installation on curves requires the use of special fittings, concrete blocking shall be used per Section 7-11.3(13).

Where restrained joint pipe is installed on a curve, the Contractor shall submit the pipe manufacturer's recommendations to the Engineer for approval at least 3 Working Days in advance.

7-11.3(5) CLEANING AND ASSEMBLING JOINTS

All parts of the pipe ends, couplings, fittings, and appurtenances shall be cleaned to remove oil, grit, or other foreign matter from the joint. Care shall be taken to keep the joint from contacting the ground.

Pipe not furnished with a depth mark shall 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 shall be in accordance with 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

Pipe with polyethylene (film wrap) encasement shall be installed in accordance with AWWA C105. The method used for encasing the pipe shall be approved by the Engineer. All damage to the polyethylene encasement shall be repaired at the Contractor's sole expense. Bedding and backfill shall be in accordance with Sections 7-10.3(9), 7-10.3(10), and 7-10.3(11).

7-11.3(6)C INSTALLING AND JOINTING MULTI-LAYERED POLYETHYLENE TAPE COATED PIPE

Pipe shall be hoisted from the trench side into the trench by means of 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 will not be permitted. Dragging or skidding the pipe will not be permitted. The Contractor shall allow inspection of the coating on the underside of the pipe while suspended from the sling. Any damage to the coating shall be repaired to a condition meeting the specified requirements before the pipe is lowered into the trench. Bedding and backfill shall be in accordance with Sections 7-10.3(9)A2, 7-10.3(10), and 7-10.3(11).

At all times during construction of the Water Main, the Contractor shall use every precaution to prevent damage to the protective coating on the pipe. No metal tools or heavy objects shall be unnecessarily permitted to come in contact with the finished coating. Workers will be permitted to walk on the coating only when necessary, in which case they shall wear shoes with rubber or composition soles and heels. This shall apply to all surfaces whether bare, primed or coated. Any damage to the protective coating from any cause, prior to final acceptance of the Water Main, shall be repaired as directed by the Engineer and at the Contractor's expense.

Cutbacks on the spigot end shall be 6 inches or less and shall be made with a cutting device that is guided from the end of the pipe to ensure a straight, uniform cutback. No cutback shall be made on the bell end of the pipe.

Following the application of the outerwrap, the coating shall be electrically tested for holidays with a pulse tape holiday detector. The detector voltage range for this coating is 7000 to 9800 volts. The testing shall conform to NACE RP-02-74.

All holidays detected in the field shall 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 shall be outerwrapped after patching.

If the outerwrap is damaged and a holiday is not found in this area, the damaged outerwrap area shall be repaired by applying a patch as recommended by the manufacturer and approved by the Engineer.

If the outerwrap is damaged and a holiday is found, the damaged outerwrap shall be removed, taking care not to damage the inner coating. Before new outerwrap is placed, a holiday detector shall be applied to the exposed innerwrap to determine if it has been damaged during removal of the outerwrap. The outerwrap shall be installed as recommended by the manufacturer and approved by the Engineer.

After electrical bonds are installed and tested, the entire pipe joint and electrical bond strap shall be protected with a heat shrink joint sleeve. See Section 9-30.1(6)E Heat Shrink Joint Sleeve.

7-11.3(6)D INSTALLING RESTRAINED JOINT PIPE

The restrained joint Water Main to be installed shall be fully extended by pulling on the joint after the installation of the pipe segments as recommended by the manufacturer of the restrained joint pipe. When this newly installed Water Main is charged, bending or buckling of newly installed restrained joint Water Main will not be accepted. The Contractor shall submit the restrained joint manufacturer's recommendations to the Engineer at least 5 Working Days prior to pipe installation.

Restrained joint Water Main shall be installed as located on the Drawings. This work shall include all hardware and as necessary to perform this work.

7-11.3(7) INSTALLING STEEL PIPE

7-11.3(7)A THREADED STEEL PIPE LESS THAN 4 INCHES IN DIAMETER

Steel pipe in sizes up to and including 3-1/2 inches shall be connected with malleable iron screwed couplings. Couplings shall be galvanized. Unions or flanges shall be used at all equipment and valves. Cut ends shall be reamed and threads cleanly cut. Exposed threads, after jointing, shall be brush-coated with an asphalt varnish, Royston Roskote Mastic R28 or approved equal.

7-11.3(7)B COUPLED PIPE 4 INCHES IN DIAMETER AND LARGER

Steel pipe 4-inch and larger, for use in underground services, shall be coupled as specified in the Contract.

Any welding of steel pipe shall be in accordance with AWWA C206.

Bell and spigot joints shall be thoroughly cleaned before assembly, and a lubricant suitable for potable water meeting the approval of NSF shall be brushed on the inside of the bell just prior to assembly.

7-11.3(7)C STEEL CASING PIPE

All joints shall be welded by operators who have been qualified by tests as prescribed by the AWS in Standard Qualifications Procedure to perform the type of work required. The quality of welding shall conform to the current edition AWS D1.1 Structural Welding Code, Section 3, Workmanship.

Contractor shall submit to the Engineer for approval, an outline of the proposed construction procedure together with a listing of the equipment. In the event that the pipe is damaged during the installation and the defects cannot be corrected to a condition meeting the required Specifications, the Contractor shall be required to remove and replace the pipe.

7-11.3(7)D STEEL CASING PIPE FOR UNDERGROUND AND TRENCHLESS CONSTRUCTION

7-11.3(7)D1 GENERAL

Where shown on the Drawings, the Contractor shall install steel casing pipe for the Water Main by an underground or trenchless construction method other than directional drilling as specified in Section 7-17.3(2)J, and if by directional drilling then in accordance with Section 7-22.

All joints shall be welded by operators who have been qualified by tests as prescribed by the AWS in "Standard Qualifications Procedure" and are certified to perform the type of work required. The quality of welding shall conform to the current edition AWS D1.1 Structural Welding Code, Section 3, Workmanship.

The Contractor shall submit to the Engineer for approval, an outline of the proposed construction procedure together with a listing of the equipment and Supplies for the work.

7-11.3(7)D2 SEALS AND SPACERS BETWEEN CASING AND WATER MAIN

Casing end seals shall meet the requirements of Section 9-30.2(15)A, shall completely seal the annular space at each end of the casing pipe, and shall be installed in accordance with the manufacturer's instruction.

Casing spacers shall electrically isolate the outer casing pipe from the inserted Water Main. The spacers (also known as "casing insulators", "crossing insulators", and "casing isolators") shall meet the requirements of Section 9-30.2(15)B. There shall be a minimum of two spacers per length of pipe, and the spacing between any two (2) spacers shall not exceed 10 feet. For 4 inch through 12 inch diameter pipe, each spacer shall have at least four (4) runners. For 14 inch through 36 inch diameter pipe, each spacer shall have at least six (6) runners. At least 2 runners shall be located on the upper half of the spacer for all diameter Water Main. At least 2 runners shall be located on the lower half of the spacer for 4 inch through 12 inch diameter Water Main, and at least 4 runners shall 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 shall be as recommended by the manufacturer. Casing spacers shall first be installed on the Water Main and then the Water Main inserted in the casing pipe in accordance with the manufacturer's instructions.

The Contractor shall 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**

Wax tape coating (see Section 9-30.1(6)F) shall be field applied to Water Main including pipe, fittings, valves, couplings, bolts, flanges, shackle rods, other appurtenance, and as indicated in the Contract.

Preparation for wax tape coating shall be one of the following, as applicable:

- 1) On Water Main without a coating, the surfaces shall be cleaned 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. The Contractor shall be prepared to employ sandblasting methods for stubborn rust and other deleterious coating removal. The surface shall be dry, have no loose particles of any kind, and shall be in a prepared condition as recommended by the wax tape Supplier.
- 2) On Water Main with a coating, the surfaces shall be cleaned with Supplies and means that do not injure or harm the existing coating; however, 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 shall be "complete" meaning full contact with all Water Main Material and no voids. Where voids, or gaps, or irregular surfaces and transitions in the Water Main exist, joint filler, compatible with the wax tape coating product as recommended by the wax tape Supplier, shall be applied "complete". Outerwrapping without being complete is unacceptable.

Coverage shall extend to a minimum 1 pipe diameter length beyond the wax tape limits indicated in the Contract.

Coverage thickness shall be a minimum 70 mil.

Wax tape application on prepared surfaces typically include:

1. initial coating with a petrolatum primer,
2. wrapping with wax tape, and
3. outer wrapping with fiberglass mesh.

All products in the wax tape application shall be compatible with each other and with the Water Main prepared surfaces. The Supplier may recommend an alternate component(s) to provide an acceptable protective coating.

Submittal: The Contractor shall 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 applied, any alternate component(s) and the reason(s) for, Supplier recommendations with sufficient detail indicating an acceptable finished product, and Supplier contact information.

7-11.3(9) CONNECTIONS**7-11.3(9)A CONNECTIONS TO EXISTING WATER MAINS****The Contractor shall not operate any valve on an existing Water Main.**

The SPU Water Operations will make all connections to charged Water Mains and will operate all valves to accomplish shutdowns and subsequent reactivation. Draining of existing Water Mains will be done by Water Operations staff. See Section 7-10.3(5) for verification of existing Water Main grade and alignment. The Contractor shall match the grade and alignment of the new Water Main to the existing Water Main. The excavation shall be sufficiently large to accommodate connection work as approved by the Engineer.

Connection points shall be verified in accordance with Section 7-10.3(5)B.

The Contractor shall 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.

After all tests, flushing, and disinfection have been successfully completed and the installed Water Main and appurtenances, including hydrants and valves, have been approved by the Engineer, it shall be the Contractor's responsibility to request the Engineer to schedule the shutdown(s) and connection(s) prior to surface restorations.

Approval is contingent on the Water Main and appurtenances being completely installed and tested per Contract but does not require completion of street, sidewalk and planting strip restorations. Water Main and appurtenances include all pipe, fittings, all blocking except temporary blocking, all hydrants, hydrant pads, blowoff assemblies, valves, flowmeters, chambers, corrosion protection, and coating systems.

Newly installed Water Main shall be pressure tested and found acceptable in accordance with Section 7-11.3(11) Hydrostatic Pressure Test; shall be flushed, disinfected, tested, and found acceptable in accordance with Section 7-11.3(12) Flushing and Disinfection of Water Mains before making any connection; and when required shall be found acceptable for Taste and Odor Rating Testing before and/or after making any connection as specified in Section 7-11.2(3).

After all tests, flushing, and disinfection have been successfully completed and the installed Water Main and appurtenances, including hydrants and valves, have been approved by the Engineer, it shall be the Contractor's responsibility to request the Engineer to schedule the shutdown(s) and connection(s) prior to surface restorations. In general, the Contractor's request for shutdown(s) and connection(s) shall be submitted to the Engineer at least 5 Working Days in advance of the desired date of the connection. 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 and other needs,
3. End user needs and coordination, and
4. SPU Water Operation's workforce availability.

The Contractor's scheduling of connections requires the Engineer's approval. The excavation for the connection shall be completed, shored and dewatered, and all required materials and equipment shall be available at the time of shutdown. Notifications of the scheduled shutdown will be made by SPU Customer Service / Inspection Services personnel to the affected consumers a minimum of 2 Working Days in advance of the scheduled shutdown. Connections must be made within 2 weeks of bacterial acceptance or the pipe must be retested.

The SPU will furnish connection fittings when specified in the Contract; otherwise, the Contractor shall furnish and install the connection fitting (see Standard Plan nos. 300a, 300b, and 300c). In addition, prior to and after connection of the new Water Main, SPU Water Operations will:

- a. Deactivate Water Main;
- b. Cut, remove, and dispose of pipe sections as necessary to install the new Materials;
- c. Dewater existing pipe, as required, to perform SPU Water Operations connections;
- d. Swab all connecting pipe and fittings with chlorine solution (5-6% Cl₂); and
- e. Reactivate and flush the Water Main.

All fittings and other Materials and equipment not specifically called out in the Contract as being furnished by SPU Water Operations, required to complete the connection shall be furnished by the Contractor. The Contractor shall coat, wrap and joint bond the connection to conform with the requirements of the new Water Main.

The Contractor shall make all necessary excavation, protective measures, and backfill, and provide any equipment and operators required to move and lower the component parts of the connection into position. All temporary and permanent blocking shall be done by the Contractor.

In addition to those connections shown on the Drawings, segments of a new Water Main may be placed in service prior to 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 therefore are not shown. All Materials for such connections shall be furnished by the Contractor.

7-11.3(9)B MAINTAINING SERVICE

Where existing services are to be transferred from old to new Water Mains, the Contractor shall plan and coordinate the Work with that of SPU Water Operations so that service is resumed with the least possible inconvenience to customers.

To supply customers with water during the construction of a project, where any section of pipe has passed the required hydrostatic and bacteriological tests, SPU Water Operations reserves the right to tap corporation stops into a section of a new Water Main and install corporation stops and service connections at such locations as SPU Water Operations deems necessary, at no expense to the Contractor. The attaching of any such service connections by the SPU Water Operation's shall not be construed by the Contractor as any acceptance by the Owner of any part of the Work required under the Contract.

7-11.3(9)C WATER SERVICE CONNECTIONS

See Section 7-15.

7-11.3(9)C1 INSULATED COUPLINGS AND FLANGE KITS

Insulated couplings and flange kits shall be installed to electrically isolate the Water Main from other Structures. Insulated joints shall be located at the locations indicated on the Drawings.

The Contractor shall carefully align and install insulating couplings and flange kits according to the manufacturers 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. The Contractor shall submit to the Engineer for review, the manufacturer's installation recommendations at least 3 Working Days prior to use.

7-11.3(9)D TEMPORARY WATER MAINS AND SERVICES

When called for in the Contract, SPU Water Operations will install and maintain temporary Water Mains and services in such a manner as to provide constant adequate water supply to consumers and to avoid impeding traffic and access to abutting properties.

The Contractor's critical path schedule shall allow adequate time for SPU Water Operations to install these facilities. A minimum of 2 weeks advance written notice shall be provided to the Engineer for scheduling of the temporary Water Main and service work.

SPU Water Operations will make all required excavation, backfill, and compaction as well as furnishing the necessary equipment and pipe for temporary Water Mains.

All temporary Water Mains will be disinfected, flushed, and sampled for bacteriological testing by the SPU Customer Service / Inspection Services. If found acceptable, the temporary Water Mains will be placed in service.

7-11.3(10) LOCATING WIRE

Locating wire shall be installed 6 inches directly above the centerline of all non-metallic pipe, except that the locating wire shall be bonded by exothermic welds to all metallic fittings, valves and valve boxes to form an electrically continuous system.

7-11.3(11) HYDROSTATIC PRESSURE TEST

7-11.3(11)A GENERAL

All Water Mains and appurtenances shall be hydrostatically pressure tested. Once the new Water Main has passed the hydrostatic pressure test, the Water Main shall be flushed, disinfected, and bacteriologically sampled in accordance with Section 7-11.3(12), and may be required to pass additional post-installation Taste and Odor Taste Rating Testing in accordance with Section 7-11.2(3).

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, shall be furnished and operated by the Contractor.

Pressure recorders and charts used to record the tests will be furnished and operated only by the Engineer.

The Contractor, prior to notifying the Engineer to witness and record the pressure test, shall have set up beforehand and successfully performed the pressure test to make certain that the pipe is in acceptable condition. The Contractor shall then notify the Engineer at least 2 Working Days before recording and conducting the test.

The Contractor shall furnish and install temporary blocking as required for pressure testing. Upon successful testing, temporary blocking shall be removed.

To protect existing Water Mains from contamination by backflow of test water during filling operations, a WSDOH approved reduced pressure principle backflow prevention assembly shall be temporarily installed between the test and supply Water Main. See Section 1-07.28 item 7D for notification requirements regarding BPA inspection. A current BPA performance test report shall be provided by the Contractor and shall be on the Project Site for the assembly being used. Prior to hydrostatic testing, the temporary backflow protection shall be installed and the Water Main under test isolated from the supply Water Main.

7-11.3(11)A1 TEST PRESSURE FOR FIELD TESTING WATER MAIN PIPE

Field hydrostatic testing of various diameter ductile iron Water Main pipes and appurtenances shall be as indicated in the following table:

Diameter Pipe (inches)	4	6	8	10	12	16 and larger
Test Pressure (psi)	300	300	300	300	300	250

Test pressure for pipe other than ductile iron will be indicated in the Contract.

The indicated test pressure shall be at the lowest elevation of the section of Water Main being tested. All air in the pipe shall be vented prior to test.

The hydrostatic test pressure shall be maintained until the Engineer has determined that the section of pipe, valves, and fittings are watertight. 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 short (less than 18 feet) lengths of Water Main pipe 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 shall be 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 in order to qualify the crew and the Material. Pipe installation shall not be continued more than an additional 1,000 feet until the first section has been tested successfully.

Hydrostatic tests shall be performed on every completed section of Water Main between valves. The pressure differential across closed valves shall not exceed the rated operating pressure of the valve.

All tests shall be made with the hydrant auxiliary gate valves open and with pressure exerted against the closed hydrant inlet valve. After the test has been completed, gate valves shall be tested 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. The Contractor shall verify that the pressure differential across the valve does not exceed the rated test pressure of the valve.

Any visible leakage detected shall be corrected by the Contractor regardless of the allowable leakage specified above. Should the tested section fail to meet the pressure test as specified, the defects shall be located and repaired and the Water Main retested at the Contractor's sole expense.

Defective materials or workmanship discovered as a result of a hydrostatic field test shall be replaced and remedied by the Contractor in accordance with Section 1-05.7. Whenever it is necessary to replace defective Material or correct the workmanship, the hydrostatic test shall 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 will be required. SPU Customer Service / Inspection Service shall be notified 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, the connection of the new pipe to existing pipe shall not be made until after hydrostatic tests have been made to the required pressure in both directions against the new valve. This shall be accomplished by a temporary cap or plug installed on the end of the new pipe, beyond the new valve, as close as possible to the existing pipe for testing purposes. Where a new valve is not part of the Work, the Contractor shall notify the Engineer at least 10 Working Days in advance to coordinate other arrangements for hydrostatic testing.

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, shall be subjected to the required test pressure. The same test shall be made 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 shall be made by the SPU Water Operations with pretested, pre-chlorinated pipe, and no hydrostatic test will be 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 shall be conducted in three separate tests as follows:

Test No. 1	Water Main gate valves and hydrant auxiliary gate valves closed, with the hydrant operating stem valves and hose ports wide open.
Test No. 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 No. 3	Each hydrant shall be tested to 200 psi with the hydrant auxiliary gate valve and hose ports closed and the hydrant operating stem valve wide open. Twenty-five pounds per square inch shall be 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, shall be installed with pretested Materials.

Before the hydrant connection is made to the existing Water Main, the hydrant installation shall be subjected to the hydrostatic Test No. 3 as specified in Section 7-11.3(11)C. Following an acceptable hydrostatic test, hydrants installed and connected to an existing Water Main shall 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 shall be flushed, disinfected, kept clean, and will be 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 a sample taken from each and every 500 foot interval, and at each end. For each hydrant lateral over 18 feet in length, a sample will be taken at the hydrant end. Hoses for sampling will not be allowed. On new Water Main without hydrant, temporary sampling taps shall be provided, and then removed and plugged after the Engineer notifies the Contractor of acceptable bacteriological results. Hydrant used for sampling shall be fitted with a sampling tap acceptable to the Engineer.

The Contractor shall 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 shall require the remedy specified in Section 7-11.3(12)M. Analysis of any sample indicating acceptable results shall require the new Water

Main be connected to existing Water Main within 14 calendar Days of the Date of written notice. Failure to make the connection within this time frame shall require additional disinfection, flushing, and additional sampling and testing for acceptable results. The Engineer reserves the right to perform additional bacteriological sampling and testing at any time.

7-11.3(12)B PRE-DISINFECTION FLUSHING

Sections of pipe smaller than 24-inch diameter to be disinfected by methods other than that found in Section 7-11.3(12)D, METHOD 1, shall first be flushed to remove any solid or contaminated material. If METHOD 1 is used, the 2-1/2 fps flushing shall be done after disinfection is complete (see Section 7-11.3(12)L, Final Flushing and Testing). If no hydrant is installed at the end of the new pipe, the Contractor shall provide a tap large enough to develop a velocity of at least 2.5 feet per second in the pipe. Flushing period shall 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"
42	11025	3 - 6", or 1 - 10"
48	14400	4 - 6", or 1 - 12"

Taps required for chlorination, flushing or temporary or permanent release of air shall be furnished and installed by the Contractor and are incidental to the construction of Water Mains. When a hose bib faucet is installed for bacteriological sampling, it shall be located 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 shall be responsible for disposing of treated water flushed from the Water Mains in a manner acceptable to state and local authorities. The water shall be neutralized before disposal into any natural drainage channel. The Contractor shall 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 being placed into service, all newly installed pipe shall be disinfected so that a chlorine residual of not less than 10 mg/L remains in the water after the retention period. Treated water shall be retained in the pipe at least 24 hours. If the water temperature is less than 41°F (5°C), the water shall remain in the pipe for at least 48 hours. After the retention period, chlorine residual shall be tested at all extremities of the pipe and shall measure 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

Chlorine shall be applied by one of three methods to give a dosage of not less than 25 mg/l of available chlorine:

METHOD - 1 Dry Calcium Hypochlorite

As each length of pipe is installed, sufficient high test calcium hypochlorite (65 -70% chlorine) shall be placed 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% 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 - 2 100% Gas Chlorine

A chlorine gas-water mixture shall be applied by means of a solution-feed chlorinating device. Chlorinating devices for feeding solutions of the chlorine gas shall provide means for preventing the backflow of water into the chlorine supply. See Section 1-07.28 item 7D regarding BPA notification and testing requirements.

METHOD - 3 Sodium Hypochlorite

Sodium Hypochlorite, commercial grade (12.5% Cl₂) or in the form of liquid household bleach (5 - 6% Cl₂), may be substituted for the chlorine gas-water mixture. 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 Cl₂.

7-11.3(12)E CHLORINE DOSAGE

The amounts of chlorine (Cl₂) required to give 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)	Cl₂ 100% (lbs)	Household Bleach 5-1/4% Cl₂ (gallons)	Commercial Bleach 12-1/2% Cl₂ (gallons)
4	65.3	.014	.03	.013
6	146.5	.031	.07	.03
8	261.0	.054	.13	.053
10	408.0	.085	.2	.08
12	588.7	.121	.3	.12
14	799.6	.167	.4	.16
16	1044.4	.22	.5	.21
20	1631.9	.34	.8	.33
24	2349.9	.49	1.1	.47
30	3671.7	.77	1.8	.75
36	5287.3	1.1	2.5	1.1
42	7196.6	1.5	3.5	1.44
48	9399.0	2.0	4.6	1.6

7-11.3(12)F POINT OF APPLICATION FOR LIQUID/GAS DISINFECTION

The preferred point of application of the chlorinating agent is at the beginning 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 shall 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, a disinfected WSDOH approved reduced pressure backflow assembly shall be used 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, the temporary connection between the new Water Main and the existing distribution system shall be removed. See Section 1-07.28 item 7D 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, shall be controlled for very slow flow into the newly installed Water Main during chlorine application. The rate of chlorine gas-water mixture or dry gas feed shall 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.

Sodium hypochlorite, commercial grade (12.5% Cl₂) or in the form of liquid household bleach (5-6% Cl₂), may be substituted for the chlorine gas-water mixture. This liquid chlorine compound may be used full strength or diluted with water and injected into the Water Main in correct proportion to the fill water so that dosage applied to the water is at least 25 mg/l.

7-11.3(12)I RESERVED**7-11.3(12)J RESERVED****7-11.3(12)K DISINFECTION OF CONNECTIONS TO EXISTING WATER SYSTEMS**

All connections shall be disinfected per the requirements of AWWA C651 section titled "Disinfection Procedures When Cutting into or Repairing Existing Main". All pipe and fittings shall be swabbed or sprayed with a chlorine solution at least as strong as liquid household bleach (5-6% Cl₂).

7-11.3(12)L FINAL FLUSHING AND TESTING

Following chlorination, all treated water shall be flushed 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 shall show a residual not in excess of that carried in the system.

Where dry calcium hypochlorite has been used for disinfection, flushing velocity shall be at least 2.5 feet per second in the Water Main. Flushing period shall 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 shall be flushed to remove excess chlorine from the hydrant and hydrant branch.

7-11.3(12)M REPETITION OF FLUSHING AND TESTING

Based on any unacceptable bacteriological sample results (see Section 7-11.3(12)A), the new Water Main or hydrant connection over 18 feet shall be either flushed and re-sampled, or re-disinfected, flushed and re-sampled. These procedures shall be repeated by the Contractor until acceptable bacteriological sample results are obtained.

7-11.3(13) CONCRETE THRUST BLOCKING

Concrete thrust blocking, as indicated on Standard Plan nos. 330a through 331b, shall be placed at bends, tees, deadends, and crosses as located on the Drawings. Blocking shall be Class 5 (1-1/2) (see Section 5-05.3) concrete mix poured in place.

Concrete blocking shall bear against solid undisturbed earth at the sides and bottom of the trench excavation and shall be shaped so as not to obstruct access to the joints of the pipe or fittings.

The Contractor shall provide the Engineer at least 1 Working Day advance notice for inspection and approval of all concrete blocking prior to backfilling. Unacceptable concrete blocking shall be replaced at the Contractor's expense.

7-11.3(14) BLOWOFF ASSEMBLIES

Water Main blowoff assemblies shall be constructed as shown on the Drawings or Standard Plan nos. 340a and 340b. A standard meter box shall be installed in non-traffic bearing areas; a Type 361 Frame and Cover shall be used for all other installations subject to vehicular traffic. Care shall be taken 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. Tops shall be set to conform to finished grade. Backfilling and compaction shall conform with Sections 7-10.3(10) and 7-10.3(11).

Drilling and tapping into the Water Main shall be performed by the Contractor except in the event of installation on a charged (in-use) Water Main, in which case SPU Water Operations will make the connection.

7-11.3(15) ELECTROLYSIS MONITORING SYSTEM FOR DUCTILE IRON PIPE**7-11.3(15)A GENERAL**

Where called out on the Drawings, the Water Main Contractor furnishing the pipe shall comply with the following:

1. **Install Electrical Continuity Bonds:** The Contractor shall furnish and install electrical joint bonds, as specified herein, at all mechanical coupling non-insulated flange joints and all rubber gasket joints. The Contractor shall 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:** The Contractor shall furnish and install the Electrolysis Test Stations where shown, and as detailed on the Drawings.

7-11.3(15)B ELECTRICAL JOINT BONDS FOR ALL DUCTILE IRON PIPES AND FITTINGS**7-11.3(15)B1 GENERAL**

Each length of ductile iron pipe in the Water Main, and each hydrant run, shall be electrically bonded together, and each mechanical joint shall be bonded to the pipe as shown on the Drawings. The Contractor shall make adhesion tests of all bonds and bonded joints in the presence of the Engineer. Any bonded joint which fails to meet the adhesion test shall be rebonded until an acceptable test is obtained. Bonding cable shall be as specified in Section 9-30.10.

Details of mechanical joint bonding shall be as shown in Standard Plan no. 362.

7-11.3(15)B2 JOINT BOND CABLE CONNECTIONS FOR DUCTILE IRON PIPE

Prior to making any bond connection to metal, a 2 inch x 2 inch section of coating materials shall be removed from the pipe surface to make the connection. Paint, primer, and coating material shall be removed from the pipe surface with clean rags and solvent prior to preparing the metal surface. The metal surface shall be cleaned to white metal by sandblasting, grinding, or filing prior to welding the conductor. Resin-base grinding disks shall not be used. Ceramic base disks are acceptable. Joint bonding cable shall be welded to the pipe or fitting by the exothermic process with a copper sleeve fitted over the exposed conductor. Only sufficient insulation shall be removed from the bonding cable to allow placing of the welding mdd. After the weld is completed it shall be tested in accordance with Section 7-11.3(15)D.

Defective welds shall be removed and replaced.

Exposed metal surfaces around the thermite weld including the end of the copper conductor, and the weld itself, shall be covered with coating material as shown on the Drawing or in accordance with Section 9-30.11(3).

The Contractor shall provide the Engineer sufficient advance notice so that all connections to pipe obtain inspection and approval prior to covering. Bond connections not receiving Engineer inspection prior to cover or backfill will be rejected.

7-11.3(15)B3 RESERVED**7-11.3(15)B4 TESTING ELECTROLYSIS TEST STATION**

The Contractor shall provide the Engineer written notice at least 72 hours 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**

Electrolysis Test Stations shall be installed as indicated on Standard Plan no. 360.

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. Reference electrodes shall be backfilled with suitable Material. Terminate wires in the test stations.

7-11.3(15)C3 TEST STATION

The test station shall 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 shall 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 shall be as shown on the Standard Plan no. 363.

7-11.3(15)D THERMITE WELD CONNECTIONS

Each bond connection shall be insulated thoroughly with a Royston Handy Cap or approved equal. The cap shall completely cover the cleaned area and provide insulation of the bond connection from the soil environment. The cap shall be attached by use of a bonding cement or primer and shall contain an elastomeric Material under a plastic dome. The elastomeric Material shall mold completely around the bond wire and weld area. The cap shall be a minimum of 4 inches x 4 inches x 125 mils thick. Caps are not required when the connection is covered by heat shrink joint wrapping.

7-11.3(15)D1 TESTING EXOTHERMIC WELD CONNECTIONS

After the exothermic weld has cooled, slag shall be removed and the weld tested with a glancing blow with a 16 ounce hammer to assure proper metallurgical bond.

7-11.3(16) ELECTRICAL INSULATION OF WATER MAIN**7-11.3(16)A GENERAL**

The Water Main shall be installed so as 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 shall be located and installed as shown on the Drawings. The Contractor shall install an electrolysis test station at each insulating device. The Contractor shall 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 shall be replaced at the Contractor's sole expense.

7-11.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Pipe, Water Main, (Material), (Class), (Size), including Fittings", will be per linear foot based on the slope distance from point to point. The point of beginning 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 beginning or ending of any new pipe installed. No deductions will be made for the linear length of fittings, valves, couplings, etc. 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 "Blowoff Assembly, (Size)" will be per each complete blowoff assembly installed which includes not in excess of 10 feet more than the length of blowoff connection pipe indicated on the Drawings as part of the each.

Measurement for "Steel Casing Pipe, (Class), (Size), (Underground Construction Method)" will be per linear foot actually installed and measurement shall not include directional drilling as specified in Section 7-22.4.

Measurement for "Station, Electrolysis Test" will be per each installed complete.

7-11.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-11 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

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" shall include all costs for the work required as follows:

- (1) Costs required for excavating, installing and joining pipe, backfilling and compacting native material, and disposing of and/or placing excess native material elsewhere;
- (2) 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 shall also be included;

- (3) 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;
- (4) Costs required to perform the "Taste Rating Test Procedures", "Procedures for Hydrostatic Pressure Testing", and "Procedures for Flushing, Disinfection and Bacteriological Sampling of New Water Mains";
- (5) Costs necessary for installing pipe on curves as shown on the Drawings, including field changes involving standard lengths of pipe deflected at the joints;
- (6) Costs of all Material, labor and equipment associated with making pipe connections unless otherwise specified; and
- (7) Costs of furnishing and installing service connecting tees 4-inches and larger.

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 prior to installation.

Payment for safety systems required for trench excavation work will be in accordance with Section 7-17.5.

Defective Material or workmanship discovered as a result of tests will be addressed in accordance with Section 1-05.7.

2. **"Blocking, Cement Concrete"**, per cubic yard.

The Bid item price for "Blocking, Cement Concrete" shall include all costs for the work required as follows:

- (1) Costs of placing concrete blocking including: excavation, turnbuckles, shackle rods, steel plates, concrete form work, finishing, removal and disposal of material not required for backfill; and
- (2) Other work that may be necessary for constructing the blocking in place as specified.

3. **"Blowoff Assembly, (Size)"**, per each.

The Bid item price for "Blowoff Assembly, (Size)" shall include all costs for the work required as follows:

- (1) Costs for furnishing and installing the complete assembly including corporation, fittings, pipes, valve, meter box or ring and cover, and all excavation, backfill with native material and compaction;
- (2) Costs to furnish and install the pipe between the corporation and the blowoff assembly including fittings; and
- (3) 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 in accordance with Section 1-09.4.

4. **"Steel Casing Pipe, (Class), (Size), (Underground Construction Method)"**, per linear foot.

The Bid item price for "Steel Casing Pipe, (Class), (Size), (Underground Construction Method)" shall include all costs for the work required as follows:

- (1) Costs for furnishing and installing the casing pipe by the underground construction method including but not limited to excavation and backfill of jacking pit(s); furnishing and placing sand filler, spacers, and sealing both ends with concrete; and installing, maintaining, and removing jacking pit support system; and
- (2) Costs to remove and replace damaged steel casing pipe deemed necessary by the Engineer.

Payment for directional drilling installation will be as specified in Section 7-22.5.

5. **"Pipe, Water Main, (Material), (Class), (Size), (Coating), including fittings, (Underground Construction Method)"**, per linear foot.

The Bid item price for "Pipe, Water Main, (Material), (Class), (Size), (Coating), including fittings, (Underground Construction Method)" shall include all costs for the work required to furnish and install the pipe, including placing the designated fill in the annular space when applicable.

Payment for directional drilling installation will be as specified in Section 7-22.5.

6. **"Station, Electrolysis Test"**, per each.

The Bid item price for "Station, Electrolysis Test" shall include all costs for the work required as follows:

- (1) Costs of furnishing and installing water meter box, test box, terminal blocks, wires, zinc reference electrodes, removal and restoration of sidewalks; and
- (2) All other Materials and labor required to complete this construction.

7. **"Bedding, Water Main, (Class), (Size) Pipe"**, per linear foot.

The Bid item price for "Bedding, (Class), (Size) Pipe" shall include all costs for the work required to furnish and install bedding to the cross section shown in Standard Plan no. 350. Cost of Class D bedding shall be included in the Bid item price for pipe Bid item and therefore no separate or additional payment will be made for Class D bedding.

8. **Other payment information.**

No separate payment will be made for electrical joint bonds. Costs for labor, material and equipment required to acceptably bond across mechanical couplings and across rubber gasket joints, and all incidentals required to provide acceptable and complete bonding shall be included in the Bid item price for "Pipe, Water Main, (Material), (Class), (Size), including Fittings".

Joint bonding Material shall include without being limited to 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 consists of furnishing and installing all Water Main valves and valve accessories as indicated in the Contract, and supplying all materials, tools and appurtenances needed to complete the installation.

7-12.2 MATERIALS

Materials shall meet the requirements of Section 9-30.3.

Valves for Water Mains shall 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****The Contractor shall not operate any valve on an existing Water Main.**

All valves shall be inspected upon delivery in the field to ensure proper working condition before installation and to verify free of rust and dirt. The valves shall be set and jointed to the pipe according to the AWWA Standards, unless indicated otherwise in the Contract, for the type of connecting ends furnished. The valves shall be carefully inspected for damage to the outer protective coating(s) and verified damage free prior to installation.

An operating nut extension shall be installed 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 shall extend into the top section of the standard valve box (see Standard Plan nos. 315a and 315b). In vaults, which contain valves greater than 12 inch, the operating nut extension shall extend into the upper section of the vault and shall clear the bottom of the lid within a range of 24 to 30 inches. The Contractor shall be prepared to furnish and install an operating nut extension when required. Upon delivery at the Project Site, all valves shall be opened to prevent the collection of water in the valve. Valves shall have the interiors cleaned of all foreign matter and shall be inspected both in open and closed position prior to installation. Valves shall be set perpendicular to the Water Main. Valve boxes shall be placed 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)). The lower casting of the valve box shall be installed first, so as to be supported by backfill and a polyethylene foam collar not less than 2 inches in thickness. The casting shall not rest directly upon the body of the valve or upon the Water Main. Backfill shall be carefully tamped 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. The cast iron valve box cover shall be set flush to finished grade.

The combination air release/air vacuum valves shall be installed as shown on the Drawings. All piping shall be sloped to permit escape of any entrapped air. Backfilling and compaction shall be as specified in Section 7-10.

After installation, all valves shall be tested and disinfected in accordance with Sections 7-11.3(11) and 7-11.3(12). Should any defects in design, Materials installation, or workmanship appear during these tests, the Contractor shall correct such defects to an acceptable condition as determined by the Engineer.

7-12.3(2) VALVE CHAMBERS**7-12.3(2)A GENERAL**

This Section deals with the construction of valve chambers and special valve chambers.

Where shown on the Drawings, valve shall be enclosed in a valve chamber.

Valve chambers may be either precast or cast in place. The use of solid concrete blocks or concrete brick will be allowed only when indicated in the Contract.

Valve chambers and the casting assembly for valves larger than 12 inch shall make no 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 shall be poured-in-place or precast. Poured-in-place base shall be allowed to attain sufficient strength to support the chamber (usually 2 or 3 Days), as approved by the Engineer. Precast chambers shall be set on the concrete base in cement mortar. The vault chamber shall have adequately sized and located openings for chamber installation adequately clear of the Water Main.

The Water Main shall be wrapped with 2inch thick plastic foam Material at those areas where the Water Main intersects the chamber walls. The plastic foam Material shall cover the Water Main the full width of the chamber wall. Any remaining space between the chamber wall and the plastic foam Material shall be filled with cement mortar, and when the opening is large enough, brick and mortar. In no case shall the Water Main 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. The base shall first be poured 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.

Circular chambers shall be constructed with curved manhole blocks. The chamber top shall be tapered in to the dimensions shown on the Standard Plans, unless the Contract specifies otherwise.

Chambers shall have a cast-in-place or precast concrete top slab suitable for H20 traffic loading.

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 other than the patching of porous spots (rock pockets) and bolt holes. Forms shall be removed for inspection of concrete.

7-12.3(3) SETTING FRAME AND COVER

The cast iron frame and cover (see Standard Plan no. 361) shall be set to grades furnished by the Engineer. Provisions for future adjustment of frame to changes in grade shall be made 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 shall 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 shall in accordance with Section 5-05.3(9).

7-12.3(4) SETTING VALVE BOX

Cast iron valve boxes shall be positioned during backfilling operations to be in vertical alignment with the gate valve operating stem. The lower casting of the unit shall be supported by a plastic foam collar not less than 2 inches thick, and shall be held in place by carefully compacted backfill. The casting shall not rest directly upon the body of the gate valve, operating nut extension, or upon the Water Main. The upper casting of the valve box shall 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.

Compaction shall be as specified in Section 7-10.3(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, shall be polyethylene encased, epoxy coated, or special coated the same as the Water Main.

7-12.3(6) LADDERS

Refer to Section 7-05.3(1)Q.

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 shall be painted inside and out with two coats of asphalt varnish, Federal Specification TT-V-51A or approved equal.

7-12.3(7)B PAINTING IN THE FIELD

The valve shall be carefully inspected for injury to the outer protective coatings. At all places where the coating has been ruptured or scraped off, the damaged area shall be thoroughly cleaned to expose the iron base, and the cleaned area shall then be recoated with the manufacturer's recommended primer and the entire valve shall be field painted with two or more coats of Royston Roskote 612XM, or equal, per manufacturer's instructions.

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, shall also have a coating equivalent such as fusion bonded epoxy, or polyurethane, or approved equal.

All bolts, nuts, followers, and similar shall be wax tape coated (see Section 9-30.1(6)F).

Substitute Material requires the Contractor to submit the sufficient information and a Manufacturer's Certificate of Compliance stating that the proposed substitute Material shall perform at least as well as that specified.

7-12.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

7-12.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-12 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "Valve, Gate, (Size)", per each.
2. "Valve, Butterfly, (Size)", per each.

The Bid item price for "Valve, (Type), (Size)" shall include 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 shall 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)" shall include 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” shall include 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 2-07.3 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 installing and setting and adjusting hydrant; and furnishing, installing and setting the 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, and other pertinent Work as specified in other Sections of this Specification. The work also includes flushing, hydrostatic pressure testing and disinfecting of furnished hydrants and hydrant barrel extensions. The Contractor shall check and tighten any loose bolts on the hydrant prior to installation.

Hydrants will be furnished by SPU Water Operations. When required by the Engineer, hydrant barrel extensions kits will be furnished by SPU and installed by the Contractor prior to hydrant pressure testing. The Contractor shall take delivery of, and responsibility for, hydrants and extension kits provided at the Water Operations Center (2700 Airport Way South, Seattle) and shall transport them to the Project Site. The Contractor shall notify the Engineer at least 5 Working Days in advance to schedule hydrant pick-up and extension kit pick-up, and at least 2 Working Days in advance for hydrant installation. One hydrant extension kit, sized as determined by the Engineer, will be provided for each hydrant requiring adjustment. The Contractor shall flush, test and disinfect furnished hydrants and hydrant barrel extensions according to Section 7-11.3.

7-14.2 MATERIAL

Materials shall meet the requirements of Section 9-30.

Hydrants will be furnished by SPU. Arrangements for hydrant pickup will be addressed per Section 1-08.1(2).

7-14.3 CONSTRUCTION REQUIREMENTS

7-14.3(1) SETTING HYDRANTS

Where shown on the Drawings, hydrants shall be installed in accordance with the detail shown on Standard Plan nos. 310a through 314. Hydrants shall not be installed within 3 feet of a traveled roadway. In addition, a minimum 4-foot radius unobstructed working area shall be provided around all hydrants. The bottom surface of the breakaway flange shall be set 2-inches minimum and 7-inches maximum above the sidewalk or shear pad finished grade.

For each hydrant requiring vertical adjustment, see Section 7-14.1.

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 is to be positioned on the valve stem immediately below the stem section contained within the hydrant curb stand or discharge section.

After installation hydrants shall be subjected to a hydrostatic test as specified in Section 7-11.3(11).

The hydrant excavation shall be backfilled when installation and testing are complete and accepted by the Engineer.

A concrete shear block, as shown by the hydrant details on Standard Plan nos. 310a through 311b, shall be constructed if the hydrant is not in a concrete sidewalk. Construction, Materials, and finishing of the concrete shear block shall conform with Section 8-14, Cement Concrete Sidewalk. The shear block shall be set flush with the immediately surrounding finish grade.

After all installation and testing is completed, the hydrants shall be painted in accordance with Section 7-14.3(11).

Any hydrants not in service shall be identified by covering with a burlap or plastic bag.

7-14.3(2) HYDRANT CONNECTIONS

7-14.3(2)A GENERAL

Hydrant laterals shall consist of a section of 6-inch ductile iron pipe from the Water Main to the hydrant and shall include an auxiliary gate valve set vertically and placed in the line as indicated in the Standard Plans.

7-14.3(2)B HYDRANT RESTRAINT

Hydrant assemblies constructed with ductile iron pipe shall be restrained with mechanical joint restraint gland such as EBAA Iron Megalug Series 1100 or approved equal.

Hydrant assemblies that modify existing cast iron hydrant branch pipe shall be restrained with two ¾ inch diameter steel shackle rods as shown on Standard Plan nos. 310a and 311a.

Threads shall be cut at the ends or where rod couplers are needed. Slip joint pipe and fittings will not be allowed.

Shackle rods , nuts, washers, and couplers shall be completely coated pursuant to Section 9-30.15.

7-14.3(2)C AUXILIARY GATE VALVE AND VALVE BOX

Auxiliary gate valves and boxes shall be installed in accordance with Section 7-12 . When an auxiliary valve called for in a 311b installation is located within an area subject to lawful vehicle parking, a second auxiliary valve shall be used in place of the MJ x flange adapter at the inlet of the hydrant. See Standard Plan nos. 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, the hydrant shall be reset without disturbing the location of the hydrant lateral tee at the Water Main.

The hydrant shall be shackled as specified in Section 7-14.3(2)B.

This work shall be in accordance with Section 7-14.3(1).

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.

7-14.3(5) RESERVED

7-14.3(6) HYDRANT BARREL EXTENSIONS

The minimum requirements for hydrant barrel extensions, operating stems, and flanged adapters shall conform to AWWA C502 in design, Material, and workmanship. The drilling of the flanges on the extensions shall 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 shall engage the flanges through drilled bolt holes. Slotted bolt holes shall only be used on above-grade breakaway flange connections when the function of the breakaway feature requires their use.

7-14.3(7) RESERVED

7-14.3(8) RESERVED

7-14.3(9) RETAINING WALLS FOR HYDRANTS

Where indicated on the Drawings, the Contractor shall furnish and place a broken concrete slab wall around hydrants in accordance with Standard Plan no. 313 and Section 8-15.3(5)A. The broken concrete slabs shall be a minimum of 3-1/2 inches in thickness and not less than 3 feet x 1.5 feet in size. The slabs shall be set in level layers of the same thickness, and the exposed faces shall be as smooth as the shape and size of the slabs permit. The backfill behind the wall shall be Mineral Aggregate Type 2, in accordance with Section 9-03.

Rock facing rock may be used in place of broken concrete slab (see Standard Plan no. 141 and Section 2-08.3(5)). The depth of keyway shall be as shown in Standard Plan no. 141.

Ecology blocks may also be used in place of broken concrete slab. The keyway, Mineral Aggregate Type 2 filter Material, and geotextile shall be as shown in Standard Plan no. 313.

7-14.3(10) 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, the following shall be required:

1. Hydrant Connections up to and not including the hydrant (See Section 7-14.3(2)) shall have the same coating as the Water Mains to which they are connected, and shall have Class B bedding in accordance with Section 7-10.3(9);
2. Hydrant barrels below ground shall 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 shall have the hydrant barrel below ground polyethylene encased. Thermoplastic coating of the hydrant will not be allowed; and
4. Hydrant connection shall be installed as specified in Section 7-11.3(6).

7-14.3(11) HYDRANT FIELD PAINTING

7-14.3(11)A BELOW GROUND COATING

Following hydrant installation and prior to backfill, any damaged coating on the below-ground portion of the hydrant shall be repaired with the same coating as recommended by the coating manufacturer and approved by the Engineer.

7-14.3(11)B ABOVE GROUND COATING

After shear pad construction or final surface restoration, the hydrant curb stand section including all exposed surfaces of the sidewalk flange shall receive two coats of oil based gloss enamel paint (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 shall be painted with two coats of oil based gloss enamel paint (Kelly-Moore Luxlite or approved equal) as indicated by the notes on Standard Plan nos. 310a and 311a.

7-14.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for rock facing and for ecology block hydrant walls will be in accordance with Section 2-08.4 as for the Bid item "Rock Facing".

Measurement for concrete slab hydrant wall will be in accordance with Section 8-15.4.

Measurement for hydrant and hydrant connection will be per each.

Measurement for Mineral Aggregate for hydrant walls will be in accordance with either Section 4-01.4 by the ton.

7-14.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-14 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **"Hydrant, 6-Inch Connection (Type)", per each.**

The Bid item price for "Hydrant, 6-Inch Connection (Type)" shall include all costs for the work required to pickup, deliver and install a Type 310 or Type 311 hydrant, and furnish and install on new Water Main (or existing Water Main with existing tee) complete including but not limited to excavation; backfill with suitable material; disposal of material; furnishing and installing auxiliary valve, valve box, restraint system and shackles, barrel extension, gravel drain, concrete blocks, bleeder, special coating, field painting, shear block, marker posts, the 6-inch ductile iron pipe connection between the hydrant and the Water Main, any hydrant marker or quick connect adapter required; and obtaining the hydrant and hydrant extension.

2. **Other payment information.**

Payment for rock facing, for ecology block hydrant walls, and for filter drainage Material will be as specified in Section 2-08.5.

Payment for concrete slab hydrant wall and for filter drainage Material will be as specified in Section 8-15.5.

All costs in connection with furnishing and installing coatings and field painting as specified in this 7-14 Specification Section shall be included in the hydrant Bid item price(s).

Payment for bedding for polyethylene encased, multi-layered polyethylene encased, or special tape coated hydrant connection pipe will be in accordance with Section 7-11.5.

All costs associated with installing and removing temporary blocking, and removing existing blocking when indicated in the Contract shall be incidental to the various Bid items and no separate or additional payment will be made therefore.

SECTION 7-15 WATER SERVICE CONNECTION TRANSFERS

7-15.1 RESERVED

7-15.2 RESERVED

7-15.3 CONSTRUCTION REQUIREMENTS

The Contractor shall provide the Engineer at least 10 Working Days advance notice when transfer of existing water service is required.

Service transfers may not be done until the new Water Main has been tested and accepted, and then connected.

Unless the Contract specifies otherwise, SPU Water Operations will, at no cost to the Contractor:

1. Mark the exact field locations of service taps and tees on services 2 inch and smaller. Locations of services larger than 2 inch will be identified in the Contract,
2. Make all excavations for the water service connections, and
3. Furnish and compact backfill including furnishing and placing temporary pavement patch.

The Contractor shall not remove or abandon existing pipe until either all existing service connections have been transferred to the new Water Main or temporary service has been provided, and the Engineer approves. The Contractor shall maintain the temporary pavement patch until completion of all work by SPU Water Operations. Adequate provisions shall be made by the Contractor during construction for the care and protection of both Water Mains and water services in use.

Actual scheduling of water service connections and related work will be addressed at the Preconstruction Conference to take into account the actual number of connections required, least inconvenience to existing water service customers, sequencing of work, and other operation and construction activity needs.

Where the Contract indicates 4 inch, 6 inch, or 8 inch service connections, the Contractor shall furnish and install tees, valves, plugs, and valve boxes. A 3 inch water service shall be considered a 4 inch water service. The tees shall be mechanical joint (MJ) x mechanical joint x flange (FLG). Valves shall be MJ x FLG, and removable plugs shall be MJ for the service connection. The MJ plugs will be returned to the Contractor after SPU Water Operations completes the service connections.

Upon completion of work by SPU Water Operations, the Contractor shall make all final adjustments of valve boxes, water meter boxes, and rings and covers to final grade at no cost to the Owner, and shall then make the final surface restorations in accordance with the Contract.

7-15.4 RESERVED

7-15.5 PAYMENT

All costs associated with water service connection transfers shall 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 SYSTEMS

7-16.1 DESCRIPTION

Section 7-16 describes work consisting of excavation, shoring, foundation preparation, bedding, jointing, backfilling and compacting for the construction of a flow control structure and detention pipe for storm water storage. The flow control structure shall consist of manhole structure with a flow control device.

Trenching and excavating for flow control systems are subject to the provisions of Section 7-17.3(1)A. Trench safety shall comply with 7-17.3(1)A7a, Trench Safety Systems.

7-16.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Flow Control Structure, Conduit, Fittings, and Related	9-05
Manhole Components	9-12
Non-Shrink Cement Sand Grout	9-04.3(2)

Corrugated metal pipe (CMP) flow control systems and detention systems will not be allowed in any landslide-prone area as defined in SMC 25.05.908.

Corrugated metal pipe flow control systems and detention systems which are to be owned, or to be maintained, by the City will not be allowed.

Flow control systems to be owned, or to be maintained, by the City shall be concrete.

7-16.3 CONSTRUCTION REQUIREMENTS

7-16.3(1) GENERAL

All work including excavation, foundation preparation, bedding, pipe installing and jointing, and backfilling for the construction of detention pipe and flow control Structure shall be in accordance with Sections 7-05 and 7-17.

7-16.3(2) FLOW CONTROL STRUCTURE

The PVC orifice plate shall be fusion-welded to the PVC cross or tee with an orifice of the diameter indicated on the Drawings drilled in its center.

The PVC shear pin shall be 3/4-inch in diameter and shall be fastened with a PVC cotter pin and stainless steel washer.

One end of the shear gate chain shall be attached to the shear gate and the other end shall be attached to a galvanized anchor bolt embedded in the leveling block. The chain shall be slack when the gate is closed.

After pipes have been placed in their final positions, openings in the walls of the flow control structure shall be grouted in place to present a smooth, flush with inner and outer surfaces of walls.

7-16.3(3) DETENTION PIPE

Seams in pipes and bands shall be gasketed in accordance with AASHTO M 196.

The end plate shall be welded to the end of the detention pipe with a watertight continuous weld.

The end of the detention pipe inside the flow control structure shall be ground smooth of all burrs and sharp edges.

Aluminum that is to be in contact with a Portland cement product (controlled density fill, concrete, grout, mortar, and other similar products) shall be protected as specified in Section 9-05.6(1).

See Section 7-16.2 regarding limitations on uses of several Materials.

Bedding for the detention pipe shall be Class B, using Mineral Aggregate Type 22 as indicated on the Drawings.

Coupling bands for steel detention pipes shall be Type "D" per WSDOT Standard Plan no. B-13a.

7-16.3(4) TEE CONNECTION TO CORRUGATED PIPE

Drainage pipes connected to corrugated detention pipe shall be made through a shop fabricated tee as shown on the Drawings and shall be installed in accordance to Section 7-17.3(2)C2. Tee shall be made to conform to size of detention pipe and sized to accept only rubber joint pipe.

7-16.3(5) TESTING

Testing of flow control systems for leakage shall be in accordance with Section 7-17.3(4)B.

All detention systems shall be tested in accordance with Section 7-17.3(4)B. Approval will not be given unless the detention system passes this test. The Contractor shall notify the Engineer at least 5 Working Days in advance of testing.

7-16.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Flow Control Structure, (Diameter)" will be by each Structure 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 end plate. No separate or additional measurement will be made for the air vent when applicable.

Measurement for outlet pipe will be in accordance with Section 7-08.4.

Measurement for trench safety systems will be in accordance with Section 7-17.4.

7-16.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-16 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **"Flow Control Structure, (Diameter)"**, each.

The Bid item price for "Flow Control Structure, (Diameter)" shall include all costs for the work required to furnish and construct the flow control Structure and internal appurtenance complete in-place including excavation, backfill and compaction with suitable native material, gravel bedding or foundation Material, 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)" shall include all costs for the work required to furnish, install, and test for leakage the detention pipe and end plate, grinding smooth the end of the detention pipe in the flow control structure, cleaning and painting the aluminum or steel surfaces as specified and all applicable work listed for the Bid item "Pipe, (Use), (Material), (Class), (Size)" of Section 7-17.5.

If an air vent is required by the Contract, all costs for fabricating and installing it shall be included in the Bid item price Bid for "Pipe, Detention, (Material), (Size)" And no separate or additional payment will be made.

3. **Other payment information.**

The outlet pipe of the flow control structure will be paid as "Pipe, Catch Basin Connection (Material), (Class), (Size)" per Section 7-08.5.

Tees required outside the flow control Structure will be paid as specified in Section 7-17.5.

Payment for trench safety systems will be as specified in Section 7-17.5.

SECTION 7-17 STORM DRAINS AND SANITARY SEWERS

7-17.1 DESCRIPTION

Section 7-17 describes work consisting of trench excavation, protective systems, foundation preparation, bedding, cut-in tees, pipe installing, jointing, backfilling, compacting and testing for the construction of Storm Drain, and sanitary and combined Sewer.

All reference to "Sewer" in Specification Section 7-17 shall apply equally to construction of sanitary Sewer, combined Sewer, and Storm Drain. Side Sewer is addressed in Section 7-18.

7-17.2 MATERIALS

7-17.2(1) GENERAL

Pipe Material used for sanitary Sewers, combined Sewers, and Storm Drains will be specified 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)	

Aluminum or steel corrugated pipe may be used for Storm Drain when specified in the Contract.

Pipe shall have flexible gasketed joints unless otherwise specified in the Contract.

It is not intended that Materials listed be 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.

Materials shall meet the requirements of the following sections:

Joint Materials and Non-Shrink Cement Sand Grout	9-04
Pipe	9-05
Controlled Density Fill (CDF) - Pipe Bedding & Trench Backfill	9-01.5

All pipe shall be clearly marked with type, class, date of manufacture, location of manufacturing plant, and thickness. Lettering shall be legible and permanent under normal conditions of handling and storage. Concrete pipe with elliptical reinforcement shall be clearly marked on the inside and outside of the pipe along the minor axis to identify top and bottom.

After installation, pipe shall be tested for leakage in accordance with Section 7-17.3(4).

7-17.2(2) PROOF TESTS (PREQUALIFICATION)

The intent of this requirement is to pre-qualify a joint system, components of which meet the above requirements, as to the water tightness of that joint system. This proof test shall apply to all pipes which are to be tested for water tightness prior to acceptance. Materials and test equipment for proof testing shall 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 the following Sections:

Joints	9-04
Pipe	9-05

7-17.2(3) MATERIAL CERTIFICATION

The manufacturer or fabricator shall furnish a Manufacturer's Certificate of Compliance, based on manufacturer's routine quality control tests, that the pipe meets or exceeds the requirements of the pertinent ASTM or ANSI specification.

7-17.3 CONSTRUCTION REQUIREMENTS

7-17.3(1) EXCAVATION AND PREPARATION OF TRENCH, PIPE BEDDING, AND CLAY DAM

7-17.3(1)A TRENCH EXCAVATION

7-17.3(1)A1 GENERAL EXCAVATION REQUIREMENTS

All open excavations including trenches shall comply with the requirements of WAC Chapter 296-155.

The length of Sewer trench excavation in advance of pipe installation shall be kept to a minimum and in no case shall exceed 150 feet.

Sidewalk, pavement, appurtenant structure, adjacent improvement and underground installation shall not be undermined or disturbed.

The maximum trench width between the bottom of excavation and the top of the pipe shall be in accordance with Standard Plan no. 284. If the maximum trench width is exceeded without written authorization of the Engineer, the Contractor as directed by the Engineer shall provide pipe of higher strength classification and shall provide a higher class of bedding.

Trench width above the top of pipe in the Right Of Way within paved roadway, sidewalk, or other improved area and where near to structure or underground installation or other improvement, shall not exceed the maximum neatline trench width as indicated on Standard Plan no. 284. Outside the Right Of Way and in unimproved areas, trench width above the top of pipe may at the Contractor's option exceed the maximum trench width indicated on Standard Plan no. 284 by sloping or benching. However, all requirements for excavating, handling and disposing of excavated material, and placing and compacting replacement suitable backfill, outside of Standard Plan no. 284 neatline trench limits shall be at the Contractor's sole expense.

All ledgerock, boulders, stones, and any other object larger than 3 inch in any dimension shall be removed where within 6 inches in any direction from the pipe. The maximum size of aggregate within 6 inch of the pipe shall not exceed 1 inch per foot of pipe diameter and in no case shall exceed 3 inch.

Prior to installation of bedding and pipe, the trench bottom shall be brought to grade as indicated in the Contract for the type of bedding specified and if the trench bottom is disturbed, compacted to 90% as specified in Section 2-03.3(14)E for a one (1) foot depth to provide a foundation Capable of supporting the pipe in its proper position. Bedding and backfill Material shall be placed as indicated on Standard Plan nos. 285 and 284. Where Class D bedding is specified in the Contract, additional trench bottom preparation shall comply with Section 7-17.3(1)B.

Excavation for manholes and other Structures connected to the pipelines shall be sufficient to provide a minimum of 12 inches between the side surface of the Structure and the sides of the excavation.

All material excavated from trenches and piled adjacent to the trench shall be piled and maintained so that the toe of the slope is at least 2 feet from the edge of the trench. This material shall be piled to cause a minimum of inconvenience to public travel, and provision shall be made for traffic where necessary. Clear access shall be provided to all fire hydrants, water valves, and water meters. Surface drainage and runoff along gutters to storm drain facilities and along natural watercourses shall not be blocked. See Section 1-07 for other requirements.

The Contractor shall remove any support system or shield system or related system in such a manner as to not disturb bedding or backfill. Where bedding or backfill is disturbed, the Contractor shall reconsolidate these materials to specified requirements.

7-17.3(1)A2 EXTRA EXCAVATION

When, after excavating to the specified foundation level, if the material remaining in the trench bottom is determined unsuitable by the Engineer, then excavation shall be continued to such additional depth as directed by the Engineer.

All additional excavation directed by the Engineer or indicated in Contract which is beyond neatline limits indicated on Standard Plan nos. 284 and 285 will be considered "Extra Excavation".

Where foundation Material is required, it shall consist of Mineral Aggregate Type 2, unless the Contract or Engineer specifies otherwise.

7-17.3(1)A3 DEWATERING

During excavation, installation of pipeline, and placement of bedding and trench backfill, excavations shall be kept free of water. The Contractor shall control surface run-off so as to prevent entry or collection of water in excavations. The static water level within the excavation shall be drawn down a minimum of 1 foot below the bottom of the excavation so as to maintain the undisturbed state of the foundation soils and allow acceptable placement of any bedding or backfill to the required density.

At least 10 Working Days before dewatering is started, the Contractor shall submit to the Engineer, the method and installation including details of the dewatering system and groundwater recharge system as necessary, indicating number and type of equipment and pipelines including capacity(ies), dewatering pits and locations, water discharge locations, groundwater recharge locations and means of recharging the groundwater table where necessary, groundwater monitoring systems where necessary, an estimate of advance time to dewater the trench prior to work in the trench when necessary, filter systems and locations as necessary, and such other information to verify acceptable control and performance. Open and cased sumps shall not be used as primary dewatering for excavations deeper than 3 feet below the static water table.

The Contractor shall furnish, install, and operate all necessary equipment to keep excavations free from water during construction. The control of groundwater shall prevent softening of the bottom of excavations, or formations of "quick" or heaving conditions, or "boils". Dewatering systems shall be designed and operated so as to prevent any removal or flowing of native soils. Disposal of the water shall not cause injury to public or private property, or nuisance to the public. Sufficient pumping and power equipment in good working condition shall be available at all times for all emergencies, including power outage, and competent workmen shall be available at all times for the operation of the dewatering and recharge system.

The dewatering system shall 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 shall be installed and operated so that the groundwater level outside the excavation is not drawn down to the extent that would damage or endanger adjacent structure, underground installation, sidewalk, pavement, other improvement, or property.

The release of groundwater to its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils and supported soils, prevent disturbance of compacted bedding and backfill, and prevent flotation or movement of Structures, pipelines, Sewers, and Storm Drains.

All costs associated with dewatering the trench excavation and controlling groundwater shall be included in the various Bid Items and no separate or additional payment will be made therefore, unless the Contract specifies otherwise.

The Contractor is fully responsible for controlling groundwater.

7-17.3(1)A4 UNEXPECTED OBJECTS

Unexpected objects, such as stumps, railroad ties, buried pavement, etc., encountered in the trench excavation shall be removed and disposed of by the Contractor. Removal of unexpected objects will be considered incidental to pipe installation unless one or more of the following conditions are met:

1. The object(s) cannot be removed by the equipment or excavation method at hand; or
2. The trench width or depth must be increased.

In the event the Contractor meets condition 1 or condition 2 or both conditions listed immediately above, removal of the object will be paid in accordance with Section 1-04.7.

7-17.3(1)A5 TRENCH EXCAVATION IN SOLID ROCK

Solid Rock Excavation shall cover the removal and disposal of solid rock as defined in Section 2-03.1(2).

Materials removed shall be replaced with suitable excess excavated native Materials from adjacent trenches or roadway excavations, or from imported Mineral Aggregate Type or selected Material as specified by the Engineer.

7-17.3(1)A6 SURPLUS MATERIAL

Surplus Material obtained from trench excavation and determined to be suitable Material for use elsewhere on the Project Site by the Engineer shall be used as selected Material in accordance with Section 2-03.3(10).

Surplus Material obtained from trench excavation and not needed elsewhere on the project, and unsuitable material obtained from the trench excavation shall be disposed of in accordance with Section 1-07.3.

7-17.3(1)A7 PROTECTIVE SYSTEMS**7-17.3(1)A7a TRENCH SAFETY SYSTEMS**

Where trench excavation is deeper than 4 feet, the Contractor shall construct and maintain safety systems that meet the requirements of the Washington Industrial Safety and Health Act (RCW Chapter 49.17) including compliance with WAC

Chapter 296-155. Ditches, channels, and similar earth openings over 4 feet in depth may be considered trench excavation over 4 feet deep and may be subject to the requirements of the Washington Industrial Safety and Health Act (RCW Chapter 49.17, including WAC Chapter 296-155).

Protective systems for use in excavations more than 20 feet in depth shall be designed by a registered professional engineer (see Section 1-05.3(12)).

The Contractor's trench safety system shall be a protective system designed and maintained by a competent person and shall meet accepted engineering requirements or practices. This trench safety system may require the use of a support system in locations not designated in the Contract as requiring a support system.

The trench safety system shall protect the Work, existing property, utilities, underground installation, pavement, improvement, etc., and shall provide safe working conditions in the trench. The Contractor may use a shield system; however, all Work required by the Engineer outside neatline trench width indicated on Standard Plan no. 284 including but not limited to:

- 1) handling and disposal of excavated material;
- 2) additional backfill beyond neatline trench limits;
- 3) additional surface restoration beyond limits indicated in the Contract; and/or
- 4) repair of damage to adjacent structure, improvement, or underground installation,

caused by the Contractor's operations shall be at the sole expense of the Contractor and at no additional or separate cost to the Owner.

The Contractor shall control water to protect employees from potential hazards posed by water.

The protective system shall be removed from the trench, once the work in the excavation is complete, in a manner which provides an acceptable means of reconsolidating the bedding, backfill, or side support Material without disturbance to the pipe.

The use of horizontal strutting below the pipe barrel or the use of the pipe as support for trench bracing will not be permitted.

7-17.3(1)A7b SUPPORT SYSTEM

In addition to worker safety requirements specified in Section 7-17.3(1)A7a, where trench excavations are to be laterally supported as required in the Contract at locations indicated on the Drawings, the lateral support shall be a support system as defined in WAC 296-155-650. 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 shall also include the control of groundwater as specified in Section 7-17.3(1)A3. The Contractor shall employ methods of installing, maintaining, and removing the system causing the least disturbance. During installation of the system, and when the system is installed, the Contractor shall fill all voids behind the support system as necessary and when necessary to prevent loss of native soils or loss of soil support. When removing the support system, the Contractor shall coordinate reconsolidation of bedding as necessary, and with backfilling to minimize disturbance.

All costs for this work will be paid by the Bid item "Support System".

The Contractor shall submit Shop Drawings (Section 1-05.3) and design calculations (Section 1-03.5(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.

7-17.3(1)B PIPE BEDDING

7-17.3(1)B1 GENERAL

Bedding, of the class or classes shown on the Drawings, shall be installed in accordance with Standard Plan no. 285, and shall include all the Materials and work within the limits of the bedding zones indicated on Standard Plan no. 285.

Unless otherwise specified in the Contract, bedding for rigid and flexible pipe shall be Class B except bedding for ductile iron pipe shall be Class D.

All classes of bedding shall provide uniform support along the entire pipe barrel, without load concentration at joint collars or bells. No blocking of any kind shall be used to adjust the pipe to grade except when used with embedment concrete. Bell holes shall be excavated as required to ensure uniform support along the pipe barrel. Bedding disturbed by pipe movement or by removal of shoring or movement of a trench shield or box shall be reconsolidated prior to backfill. Special care shall be taken to provide adequate bedding support at wye or tee connections and adjacent to manholes or other Structures, so as to avoid bending or shearing stresses at these critical points.

7-17.3(1)B2 BEDDING FOR RIGID PIPE

Bedding shall be classified as Class A, Class B, Class C and Class D. The requirements and limits for the various classes of bedding are as shown on Standard Plan no. 285 and are described as follows:

1. **Class A Bedding:** Concrete for Class A bedding shall be Class 5 (1½) (see Section 5-05.3) and shall be a 4 sack minimum Portland cement concrete mix with 1½ inch maximum size aggregate. When placing the concrete bedding, the pipe shall be prevented from floating. Concrete shall be allowed to cure for a minimum of 12 hours prior to placing the Type 9 Mineral Aggregate bedding Material. Mineral Aggregate bedding shall then be placed in lifts of not more than 6 inches to a point 6 inches above the top of the pipe. Compaction of Mineral Aggregate Type 9 shall be to 90% as specified in Section 203.3(14)E. Before beginning work on concrete bedding, the Contractor shall submit a mix design for 1-1/2 inch maximum size

- aggregate concrete with a 28 day strength of 4,000 psi to the Engineer for approval at least 5 Working Days in advance. It shall have a sufficiently fluid consistency to readily fill all voids around and under the pipe.
2. **Class B Bedding:** Class B bedding of Type 9 Mineral Aggregate shall be placed in at least three lifts. The first lift shall be placed before the pipe is installed and shall be a minimum of 4 to 6 inches in thickness (see dimension "A" on Standard Plan no. 285). The Material shall be spread smoothly so that the pipe is uniformly supported along the barrel. Subsequent lifts of not more than 6 inches shall be brought up to a point 6 inches above the top of the pipe. Each lift shall be brought up on both sides of the pipe and shall be carefully worked under the pipe haunches by means of slicing with a shovel, vibration, or other procedures approved by the Engineer. Compaction of bedding shall be to 90% maximum dry density as determined by methods specified in Section 2-03.3(14)E.
 3. **Class C Bedding:** Requirements for Class C bedding shall be the same as for Class B except that the Type 9 Mineral Aggregate shall extend only to the springline of the pipe. Selected native Material shall then be placed in 6 inch lifts to 6 inches above the pipe, using the same methods as those required for Class B bedding. Compaction of Mineral Aggregate Type 9 shall be to 90% maximum dry density as determined by methods specified in Section 2-03.3(14)E. Compaction of native Material shall be as specified in Section 7-17.3(3).
 4. **Class D Bedding:** Class D bedding shall be attained by carefully excavating the trench to proper grade, overexcavating at the bell sections, and placing and compacting selected Material around the pipe. Class D bedding and backfill shall be in accordance with Section 7-17.3(3).

Where unauthorized excavation has been made below the established grade, the Contractor shall provide, place, and compact suitable bedding Material to the proper grade and elevation. If the Engineer substitutes imported Mineral Aggregate Type in lieu of the selected native Material shown for Class C and for Class D bedding on Standard Plan no. 285, the bedding will be measured and paid for as "Bedding, Class B, (Size) Pipe".

7-17.3(1)B3 BEDDING FOR FLEXIBLE PIPE

All references to this Specification Section regarding Water Main trench excavation shall make reference to Standard Plan no. 350 unless specified otherwise in the Contract, and any Water Main reference to Standard Plan nos. 284 and/or 285 shall be interpreted as reference to Standard Plan no. 350 unless the Contract specifies otherwise.

Bedding for flexible pipe shall be Class B bedding with Mineral Aggregate Type 22 placed in several lifts in accordance with Standard Plan no. 285. Before installing the pipe, a first bedding lift of 4 or 6 inch thickness, depending on pipe size, shall be placed. Then the pipe is installed. The bedding shall be spread smoothly so that the pipe is uniformly supported along the barrel. Subsequent lifts of not more than 6 inches thickness shall be installed to the crown of the pipe and individually compacted to 90% density as determined in Section 2-03.3(14)E. A further 6 inch lift of moderately compacted Material shall be placed over the crown of the pipe in a manner not to crush or disturb the pipe.

7-17.3(1)C CLAY DAM

Clay dam shall be as specified in the Contract.

7-17.3(2) INSTALLING SEWER PIPE

7-17.3(2)A SURVEY LINE AND GRADE

Pipe shall be installed to the true line and grade indicated in the Contract at the invert of the pipe. The limit of variance at the invert shall not exceed plus or minus 0.03 foot from true line and grade at the time of backfill, and in no case shall result in reverse flow or have 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 "swede line and batter board", "laser beam", etc., 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 the "swede line and batter board" method, the Contractor shall transfer line and grade into the trench where they shall be carried by means of a taut grade line supported on firmly set batter boards at intervals of not more than 30 feet. Not less than three batter boards shall be in use at one time. Grades shall be constantly checked and in the event the batter boards do not line up, the work shall be immediately stopped, the Engineer notified, and the cause remedied before proceeding with the work.

When using a laser beam to set pipe alignment and grade, the Contractor shall constantly check position of laser beam from surface hubs provided by the Engineer to verify laser beam alignment and grade. In the event the laser beam is found out of position, the Contractor shall 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, the pipe shall be installed in the properly dewatered trench. Mud, silt, gravel, and other foreign Material shall be kept out of the pipe. Pipe joints shall be kept clean and protected at all times, and shall be lubricated as recommended by the pipe manufacturer before joining.

All pipe installed in the trench shall be kept in longitudinal compression until the bedding has been placed and compacted around and over the pipe.

The Contractor shall exercise care in matching pipe joints for concentricity and compatibility. In no case shall two pipes be joined together with ends exceeding the maximum manufacturer's tolerance.

The pipe shall be installed in the up-grade direction from the point of connection from either the existing pipe or the designated Structure as the starting point. The pipe shall be installed with the bell end forward or upgrade.

When pipe installation is not in progress, any open end of the pipe shall be sealed with an approved temporary watertight plug.

7-17.3(2)B2 JOINTS – HAND MORTARED AND ON CURVES

Where pipelines are to 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 shall be achieved with a series of tangents and shop-fabricated bends complying with the pipe manufacturer's recommendations as approved by the Engineer. The Contractor shall submit the pipe manufacturer's recommendations for approval at least 5 Working Days in advance. Pipe invert shall comply with the requirements of Section 7-17.3(2)A.

Hand mortared pipe joints will not be allowed. All joints shall be water tight and meet the applicable test requirement(s) of Section 7-17.3(4).

See Section 7-17.3(2)E for gasketed jointing.

7-17.3(2)C PLUGS AND CONNECTIONS

7-17.3(2)C1 GENERAL

All fittings shall be capped or plugged with a plug of an approved Material gasketed with the same gasket Material as the pipe unit; or shall be fitted with an approved mechanical stopper; or shall have an integrally cast knock-out plug. The plug shall be able to withstand all test pressures without leaking, and when later removed, shall permit continuation of piping with jointing similar to joints in the installed line.

Should testing or television inspection indicate installed pipe is damaged or does not pass testing, the Contractor shall remove and replace the failed or damaged section of pipe. Should the Contractor believe the pipe which is damaged, or which failed the test, can be repaired by other than remove and replace, the Contractor shall submit a repair method for approval by the Engineer at least 5 Working Days in advance (see Section 1-05.7). The replaced, or repaired pipe, shall again be inspected and tested. Repairs using rubber boot type methods, such as FERNCO type coupler repairs, will not be allowed unless approved otherwise by the Engineer. See Section 7-17.3(4).

7-17.3(2)C2 FITTINGS

Unless otherwise specified in the Contract, tee fittings shall be provided in the Sewer and Storm Drains for side Sewers, catch basin connections and service drains. Tees shall be 8 inches inside diameter, except tees for side Sewers shall be 6 inches inside diameter unless indicated otherwise in the Contract. All fittings shall be of sufficient strength to withstand all handling and load stresses normally encountered. All fittings shall be of the same Materials as the pipe, except when core drilling to insert a tee, which shall be per Section 7-17.3(2)C3. Material joining the fittings to the pipe shall be free from cracks and shall adhere tightly to each joining surface. Fittings shall make for a water tight connection meeting the requirement(s) of Section 7-17.3(4).

All tees on new pipe less than 24 inch inside diameter shall be prefabricated.

7-17.3(2)C3 CUT-IN TEE ON EXISTING OR NEW PIPE

Unless the Contract indicates otherwise, the Contractor shall locate and cut a hole in the existing or new pipe centered at 30 to 45 degree angle to the springline. Springline is defined as the widest cross-section of the host pipe measured horizontally. Coring shall be done such that the cored out piece or other materials do not drop into the pipe. The Contractor shall notify the Engineer at least 2 Working Days in advance of cut-in tee operation.

Coring shall be performed in accordance with 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. The Contractor shall 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. Both surfaces shall first be coated with a concrete bonding agent submitted for review and accepted by the Engineer. The annular space between the tee and the core-drilled surfaces shall then be tightly packed with non-shrink cement sand grout meeting the requirements of Section 9-04.3(2). The connection shall be neatly finished inside and outside the existing concrete pipe.
2. **Ductile Iron Tee To Existing Concrete Pipe:** The existing concrete pipe shall be core-drilled 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. A length of ductile iron pipe shall be cut 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. The Contractor shall 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 shall be rough and clean. Both surfaces shall be coated with a bonding agent submitted for review and approved by the Engineer. The annular space between the pipe and core drilled surfaces shall

be tightly packed with non-shrink cement sand grout meeting the requirements of Section 9-04.3(2). The connection shall be neatly finished inside and outside the existing concrete pipe.

3. **Saddle-Type Tee to Existing Ductile Iron Pipe:** The ductile iron pipe shall have a full-sized hole cut into it by core drilling or by the arc-weld flame cutting method. The Contractor shall obtain approval of the method from the Engineer at least 2 Working Days in advance. A saddle-type tapping tee, manufactured to fit the receiving pipe, shall be mounted after the contact area between tee and pipe has been cleaned of all dirt, sand, grit, grease and other foreign matter to ensure continuous contact by the straps.
4. **Corrugated Metal Tee To Corrugated Metal Pipe:** In corrugated steel and aluminum pipes, a hole shall be sawcut to match a shop fabricated tee as indicated in Standard Plan no. 279.
The flange plate of the fabricated tee shall be corrugated to match corrugation of the pipe to which it is attached. A neoprene gasket or approved equal shall be inserted between the outside face of the existing pipe and the flange plate of the tee and connected by bolting. Corrosion protection shall be provided if the pipe section of the tee is non-corrugated aluminum pipe.
The incoming pipe and the tee shall be connected with stainless steel rigid walled flexible coupling. If the pipe section of the tee is aluminum, corrosion protection shall be provided by isolating the aluminum from the steel by extending the gasket 1 inch beyond the edge of the stainless steel coupling.
5. **Inserta Tee To Clay Pipe:** The Contractor shall submit the method and type tee recommended by the tee manufacturer to the Engineer for approval at least 5 Working Days in advance.
6. **Inserta Tee to Concrete Pipe:** The Contractor shall core drill a full size hole in one operation to accommodate an Engineer approved PVC tee insert with a coupling fitting.

All existing pipe, 18 inch and smaller diameter, made of non-reinforced concrete or vitrified clay shall be fully exposed for inspection.

The excavation shall be backfilled and compacted per Section 7-17.3(3).

The Contractor shall notify the Engineer at least 2 Working Days before beginning cut-in operations (Note - The Engineer will notify the SPU Drainage and Wastewater Division @ 206-386-1230 for the South District or 206-684-7506 for the North District). The existing pipe shall be inspected by the Engineer 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 Contractor has requested the Engineer to core drill the hole, the Contractor shall provide a tee made of the same Material and with the same corrugations as the cored pipe.

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 PIPE MARKINGS

On elliptically reinforced concrete pipe, the markings indicating the minor axis of the reinforcement shall be placed in a vertical plane (top or bottom) when the pipe is installed.

7-17.3(2)E GASKETED JOINTS

Pipe handling after the gasket has been affixed shall 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 shall be removed, cleaned, replaced, and relubricated before joining the sections.

Care shall be taken to properly align the pipe before joints are entirely forced home. During insertion of the tongue or spigot, the pipe shall 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 gasketed joints tend to creep apart when the end pipe is deflected and straightened, such movement shall be held to a minimum once the joint is home.

Sufficient pressure shall be applied in making the joint to ensure that it is home, as described in the standard installation instructions provided by the pipe manufacturer. Sufficient restraint shall be applied 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 work Day, the last pipe shall be blocked in an effective way to prevent creep.

Where pipe must be deflected to accommodate required horizontal or vertical curvature, it shall 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)F JOINTING – BREAK-OUT AND RECONNECT & MISMATCHED WALL THICKNESS

Where it is necessary to break out or connect to an existing pipe, only new pipe having the same inside diameter shall be used in reconnecting the pipeline. Inverts, grade, and alignments are to match. Where joints must be made between pipes with a mismatched wall thickness, the Contractor shall use a flexible gasketed coupling, adapter or coupling-adapter to make a watertight joint. Couplings shall be those manufactured by "Romac", "Smith-Blair", or approved equal.

7-17.3(2)G STORM DRAIN AND SEWER CONNECTIONS

Catch basin, service drain, or side Sewer connections to Sewer and Storm Drain trunks, mains, or laterals, shall be left uncovered until after the Engineer has inspected and approved the work. After approval of the connection, the bedding and trench backfill work shall be completed.

7-17.3(2)H SIDE SEWER CONNECTION – OVERSIZED AND CLEARANCE REQUIREMENTS

Where a side Sewer is as large as or larger than the trunk, main, or lateral Sewer or Storm Drain to which it is to be connected, the connection shall be made only at a manhole unless otherwise provided in the Contract. The capacity of the proposed connection and capacity of existing trunk, main, or lateral Sewer or Storm Drain shall be verified and submitted to the Engineer for approval at least 15 Working Days in advance.

Side Sewers shall be installed below Water Main and shall meet the clearance requirements indicated on Standard Plan nos. 286a and 286b, and as specified in Section 1-07.17(2).

7-17.3(2)I PROTECTION OF EXISTING SEWER FACILITIES

All existing live Sewers including septic tanks and drain fields shall be kept in service at all times. Provision shall be made for disposal of sewage flow if any existing Sewer is damaged.

Water accumulating during construction shall be removed from the new pipeline but shall not be permitted to enter the existing system. The Contractor shall be 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 shall repair lift stations or other facilities damaged by his/her operations.

The physical connection to an existing manhole or pipeline shall not be made 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)J UNDERGROUND CONSTRUCTION

Directional drilling shall be in accordance with Section 7-22. Trenchless construction other than directional drilling shall be as specified in the Contract.

Where indicated on the Drawings, the Contractor shall install pipe by underground construction methods including jacking, augering, tunneling, microtunneling, or any other trenchless technology method or use of rapid excavation machine other than directional drilling, including installing the pipe in a casing pipe, or by any combination of these methods.

When casing pipe is required, and the size and gauge of pipe has not been specified in the Contract, the Contractor shall select the gauge and size of the casing pipe compatible with the underground construction operation and surrounding loading conditions. The Contractor shall take care to prevent caving ahead of the casing which would create voids outside the casing pipe. When the casing is in place, the carrier pipe shall be carefully skidded through the casing pipe and adjusted to the line and grade shown on the Drawing. The annular space between the casing and carrier pipes shall be filled with Material specified in the Contract.

Ground support in portal areas, shafts, and pits, whether launch, intermediate, or receiving, shall be designed to support adjacent structure, underground installation, the sides of excavation, and withstand all forces from jacking and other operations.

At least one designated person shall be on duty above ground whenever any employee is working underground. The Contractor shall have in place communications, hoisting equipment, emergency provisions, air quality monitoring, and ventilation equipment as necessary.

For other than directional drilling per Section 7-22, at least 20 Working Days in advance of underground construction activities, the Contractor shall submit 8 sets of Shop Drawings and all necessary calculations describing these activities, including dimensioning of shaft, pit, or portal; method of shaft excavation; method of underground construction; size of underground construction; staging and surface support; waste disposal particular to a specific underground construction; control equipment; qualifications of underground construction Contractor; a complete description of shoring including installation, maintenance, and removal; and a complete description of slurry handling and disposal system when applicable; in accordance with the requirements of Section 1-05.3. The submittal shall include the name of the designated person.

The material, procedure, and equipment employed by the Contractor shall not relieve the Contractor of responsibilities nor waive or modify any provisions of the Contract.

7-17.3(2)K TEMPORARY SEWER BYPASS

The Contractor shall install a temporary bypass to maintain uninterrupted Sewer service on projects calling for reconstruction of existing Sewer mains or on projects where construction Work will interfere with sewage flow in the existing Sewer. The bypass shall be made by diverting the effluent flow at an upstream access manhole and pumping it through a separate conduit to a downstream reentry point or to an adjacent Sewer system. The pump and bypass conduit shall be of adequate size and capacity to handle the flow. The effluent level in the bypass pumping manhole shall not be allowed to rise more than 1 foot above the crown of the incoming Sewer pipe. Work shall be conducted in such a manner as to comply with the requirements of Section 1-07.

A written proposal for bypassing the remaining portion of the Sewer system and the list of all equipment to be used for the Work shall be submitted by the Contractor to the Engineer, allowing at least 10 Working Days for review and return of comments. The Engineer's review shall not relieve the Contractor of its responsibilities or of any public liability for sewage spills under this Contract.

7-17.3(3) BACKFILLING TRENCHES**7-17.3(3)A GENERAL**

In backfilling the trench, the Contractor shall take all necessary precautions to protect the pipe from any damage or shifting. The Contractor shall backfill from the side of the trench to a uniform depth of 2 feet above the crown of the pipe, including the bedding, before starting compaction. See Section 7-17.3(3)B for Compaction Requirements.

During all phases of the backfilling operations and testing as outlined herein, the Contractor shall protect the pipe installation, provide for the maintenance of traffic as may be necessary, and provide for the safety of property and person.

The Contractor shall use suitable native excavated Material for trench backfill unless notified by the Engineer that the native Material is unsuitable. The Engineer will examine excavated native Material at the time of excavation to determine its suitability for use as backfill. Native Material will be considered suitable for trench backfill if it is:

1. Capable of attaining the degree of compaction specified in Section 7-17.3(3)B;
2. Within reasonable tolerance of optimum moisture content; and
3. Reasonably free of organic material, clay, frozen lumps, rocks or pavement chunks more than 6 inches in maximum dimension, or other deleterious matter.

Unsuitable backfill Material shall be removed from the Project Site, disposed of per Section 1-07.3, and replaced with Mineral Aggregate Type 17, selected Material, or such other imported Material as designated by the Engineer.

The Contractor shall take any necessary steps to protect the excavated Material from becoming contaminated with excessive moisture.

Where it is required that a blanket of selected Material or bank run gravel be placed on top of the native backfill, the backfill shall be placed to such elevation as shown on the Drawings, and shall be leveled to provide for a uniform thickness of the borrow Material. Compaction shall be required.

Pipe trenches shall be backfilled as soon as possible after the pipe installation. The Contractor shall not have more than 200 feet of trench open in which the pipeline has been completed, except by permission of the Engineer. Backfilling of trenches in the vicinity of catch basins, manholes, or other appurtenances will not be permitted until the cement in the masonry has become thoroughly hardened.

Walking on the pipe shall not be allowed until at least 1 foot of backfill has been placed upon it.

7-17.3(3)B COMPACTION OF TRENCH BACKFILL

Trench backfill shall be spread in lifts and be compacted by mechanical tampers of the impact type approved by the Engineer. The backfill Material shall be placed in successive lifts with the first lift not to exceed 2 feet above the pipe, and the following lifts not exceeding 12 inches in loose thickness, with each lift being compacted to the density specified as follows:

1. Improved areas such as street and sidewalk areas shall be compacted to 95% of maximum dry density; or
2. Unimproved areas or landscape areas shall be compacted to 90% of maximum dry density.

Compaction control tests shall be performed as specified in Section 2-03.3(14)E.

The procedure and equipment to be used for backfill compaction shall be demonstrated on a test section of pipeline to be located by the Engineer at the beginning of this work. The Contractor shall make these arrangements with the Engineer at least 2 Working Days prior to beginning this work.

The Contractor shall excavate test pits in the backfill as directed by the Engineer for the purpose of testing the backfill compaction.

If the required compaction density has not been obtained, the Contractor shall remove the backfill from the trench and recompact using heavier compaction equipment or more passes. This process shall be repeated until the Contractor has established a procedure that provides the required field density. The Contractor will then be permitted to proceed with backfilling and compacting the remainder of the pipeline under the approved compaction procedure.

In the event routine field densities taken during the course of construction show the specified compaction of backfill is not being obtained because of changes in soil types which are identified as suitable by the Engineer, the Contractor will be required to reestablish the compaction procedure. In no case will excavation, backfill, and pipe installation operations be allowed to proceed until the specified compaction of backfill is attained. Water settling will not be allowed as a method for compaction of backfill.

7-17.3(4) CLEANING AND TESTING**7-17.3(4)A GENERAL**

Pipelines and appurtenances shall be cleaned and tested, after backfilling, by the exfiltration or low pressure air method, at the Contractor's option, or by infiltration test if the ground water table is such that the Engineer may require it.

All work involved in cleaning and testing pipelines between manholes or rodding inlets as required herein shall be completed within 15 Working Days after backfilling of pipelines and Structures. Any delay shall be submitted to the Engineer well in advance and requires the written consent of the Engineer. The Contractor shall furnish all labor, Materials, tools, and equipment necessary to make the test, clean the lines, and perform all Work incidental thereto. The Contractor shall perform the tests in the presence of the Engineer. Precautions shall be taken to prevent joints from drawing apart during tests. Any damage resulting from these tests shall be repaired by the Contractor. The manner and time of testing shall be subject to approval by the Engineer.

All wyes, tees, and stubs shall be plugged using test tees, or acceptable alternate, securely fastened to withstand the internal test pressure. Such test tees shall be readily removable, and their removal shall provide a socket suitable for making a flexible jointed lateral connection or extension.

Testing of side Sewers including runoff and downspout connections shall comply with the requirements of Section 7-18.3(6).

7-17.3(4)A1 PIPE NOT PASSING TESTING

If any pipeline installation fails to meet the requirements of the test method used, or is indicated as defective by television inspection, the Contractor shall determine the source or sources of leakage and shall replace all defective pipe. Where the Contractor believes a repair can be made without removal, the Contractor shall submit to the Engineer for approval at least 5 Working Days in advance, the proposed repair. See Section 7-17.3(2)C1 for damaged connections or failed connections or plugs. The complete pipe installation shall meet the requirements of the test method used before being considered acceptable. Replacement or repair of defective pipe shall not commence until the Contractor has received approval of the method from the Engineer. Retest will be required for acceptance.

All lateral or side Sewer branches included in the test section shall be taken into account in computing allowable leakage.

Upon final acceptance of the Work, all Sewers, side Sewers and fittings shall be open, clean, and free draining.

7-17.3(4)B EXFILTRATION TEST

Prior to making exfiltration leakage tests, the Contractor may fill the pipe with clear water to permit normal absorption into the pipe walls, provided that after filling the pipe the leakage test is completed within twenty-four hours. When under test, the allowable leakage shall be limited according to the provisions that follow. Specified allowances assume pre-wetted pipe.

Leakage shall be no more than 0.28 gallons per hour ("gph") per inch inside diameter ("inch dia") per 100 linear feet ("LF") 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 at the time of test, whichever is higher. The length of pipe tested shall be limited so that the pressure at the lower end of the section tested does not exceed 16 feet of head above the invert, and in no case shall the length be greater than 700 linear feet or the distance between manholes when greater than 700 linear feet.

Where the test head is other than 6 feet, the measured leakage shall 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.

$$\text{Leakage maximum} = 0.28 \times \frac{\sqrt{H}}{\sqrt{6}} = 0.114 \times \sqrt{H} \quad \text{where leakage is in gph/inch dia/100 LF.}$$

When the test is to be made one joint at a time, the leakage per joint shall not exceed the computed allowable leakage per length of pipe.

An allowance of 0.2 gallons per hour per foot of head above invert shall be made for each manhole included in a test section.

All pipe and detention systems in, or near as indicated in the Contract, Environmentally Critical Areas designated geologically hazardous areas, shall require exfiltration testing. Approval will not be given unless the detention system passes this test. The Contractor shall notify the Engineer at least 5 Working Days in advance of proposed testing.

7-17.3(4)C INFILTRATION TEST

Infiltration test leakage shall not exceed 0.16 gallons per hour (gph) per inch inside diameter (inch dia) per 100 linear feet (LF) of pipe tested, when the natural groundwater head over the pipe is 2 feet or less above the crown of the pipe at the upper end of the test section. The length of pipe tested shall not exceed 700 linear feet or the distance between manholes when greater than 700 linear feet.

Where the natural groundwater head is more than 2 feet, the measured leakage shall not exceed 0.16 gph per inch inside diameter per 100 linear feet times the ratio of the square root of the natural groundwater head to the square root of 2.

$$\text{Leakage maximum} = 0.16 \times \frac{\sqrt{H}}{\sqrt{2}} = 0.114 \times \sqrt{H} \quad \text{where leakage is in gph/inch dia/100LF.}$$

When a suitable head of groundwater exists above the crown of the pipe and when the pipe is large enough to perform work inside it, acceptance may be based on there being no visible leakage. Where leakage is indicated, the repair methods shall be submitted in writing to the Engineer by the Contractor for approval (see Section 7-17.3(4)A1).

7-17.3(4)D AIR PRESSURE TEST FOR SEWERS CONSTRUCTED OF AIR-PERMEABLE MATERIALS

Vitrified clay pipe shall be air tested as specified in Section 9-05.4. For all other pipe Material:

1. Pipelines may be tested with low pressure air by the pressure drop method, in lieu of water infiltration or exfiltration. The pressure drop shall be from 3-1/2 to 2-1/2 psi greater than the average back pressure of groundwater above the springline of the pipe. At the Contractor's option, pipe may be tested without pre-wetting; however, the test allowances herein assume pre-wetted pipe.
2. The allowable rate of air loss shall be .003 cubic feet per minute (cfm) per square foot of internal pipe surface; however, the total air loss shall not exceed 3.50 cfm.

3. The test equipment to be used shall be furnished by the Contractor and shall be inspected and approved by the Engineer prior to use. The Engineer may at any time require a calibration test of gauges, other instrumentation, and equipment that is used for this test.
4. Safety Provisions. Plugs used to close the Sewer pipe for the air test shall be securely braced to prevent the unintentional release or loosening of a plug. Gauges, air piping manifolds, and valves shall be located at the ground surface. No person shall be permitted to enter a manhole 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 a plug failure may result in injury.) Air testing apparatus shall be equipped with a pressure release device designed to relieve pressure in the pipe at a pressure recommended by the pipe manufacturer. The Contractor shall submit the pipe manufacturer's recommendations to the Engineer including the safety precautions for pipe testing.
5. Pipe with inside diameter less than 36 inches may be tested from manhole to manhole or on shorter lengths at the Contractor's option. Pipe 36 inches in diameter and over shall have all joints tested individually and in consecutive order along the entire line. The void volume around the joint shall be pressurized to 3.5 psi above that of the average groundwater pressure above the springline of the pipe. The Contractor shall allow the air pressure and temperature to stabilize before shutting off the air supply and start of test timing. Joint or joints will be determined acceptable if a pressure loss not exceeding 1.0 psi occurs over a 30 second test interval.

If a pipe joint fails to pass this pressure test or also fails a retest, it shall be repaired in a manner acceptable to the Engineer. If not repairable, the damaged pipe section shall be replaced with a new one and the joints tested as specified above.

7-17.3(4)E AIR PRESSURE TEST FOR PIPES CONSTRUCTED OF NON AIR-PERMEABLE MATERIALS

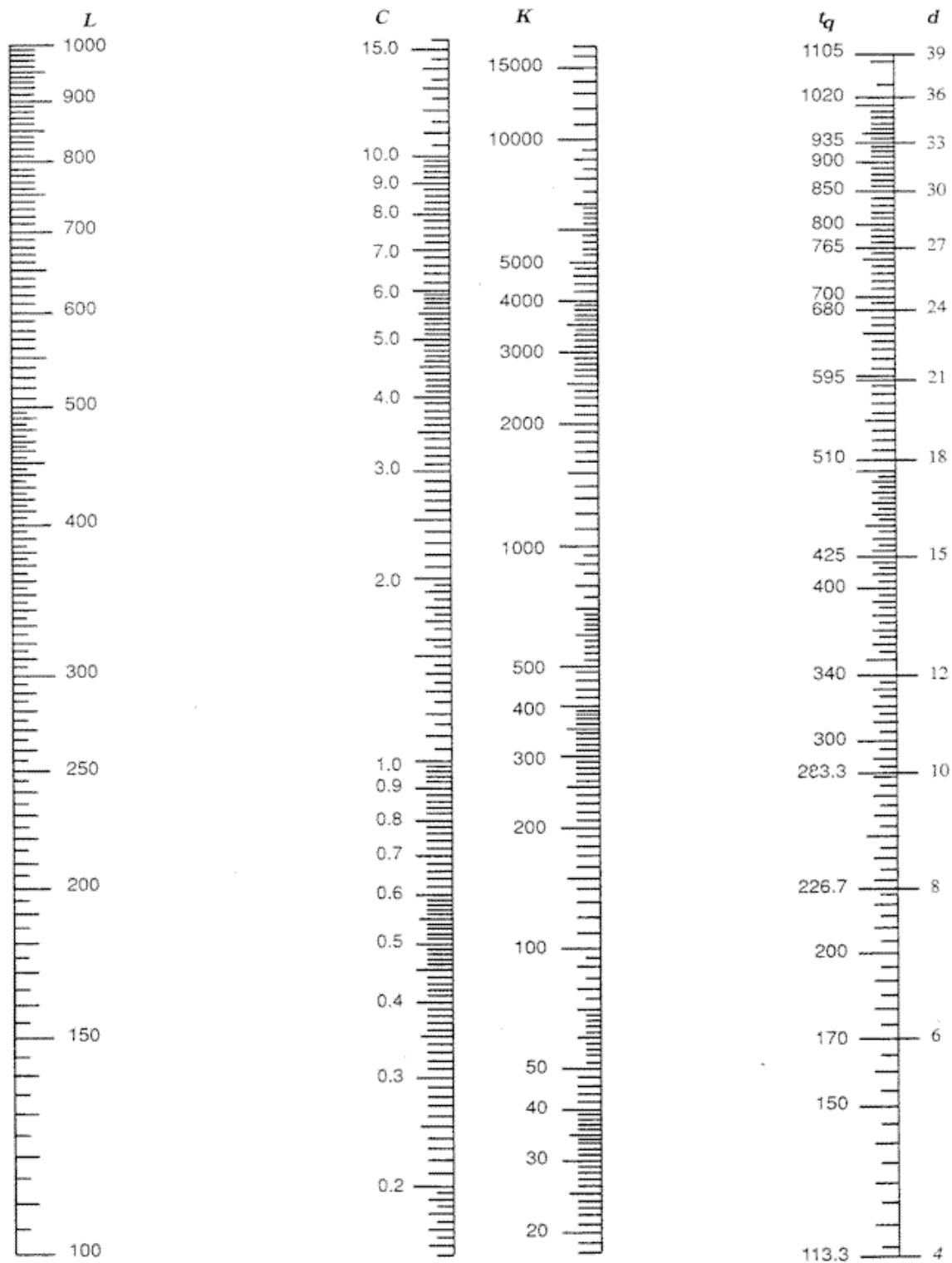
7-17.3(4)E1 GENERAL

Vitrified clay pipe shall be air tested as specified in Section 9-05.4.

For all other material pipe, when non air-permeable pipelines are subjected to the low pressure air test, all of the provisions of Section 7-17.3(4)D shall apply except that the pressure drop shall be from 3.5 to 3.0 psig greater than the average back pressure above the center of the pipe, and the minimum time shall be twice that computed as specified under Section 7-17.3(4)D.

7-17.3(4)E2 RECOMMENDED 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 should 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 should then be compared with the time required by Specification computed as follows.
7. List size and length of all portions of pipe under test in table similar to the one that follows. The maximum reach to be tested in one operation shall be the reach between two consecutive manholes.
8. By the use of Nomograph, compute K and C. Use scales d and L, read K and C, and enter these values in the table.
9. Add all values of K and all values of C for pipe under test.
10. If the total of all C values is less than one, enter the total of all K values into the space for "Time Required by Specification".
11. If the total of all C values is greater than one and less than 1.75, divide the total of all K values by the total of all C values to get t_q .
12. If the total of all C values is greater than 1.75, divide the total of all K values by 1.75 to get "Time Required by Specification" t_q .



NOMOGRAPH for the solution of $K = 0.011d^2L$, $C = 0.0003882dL$, $t_q = K \cdot C$

7-17.3(4)F HYDROSTATIC TEST FOR SANITARY SEWER FORCE MAINS

7-17.3(4)F1 GENERAL

All sanitary force mains and appurtenances shall be subjected to hydrostatic pressure testing as soon as possible after they are installed and backfilled.

The hydrostatic pressure tests shall be conducted in accordance with provisions of sections 7-17.3(4)F2 through 7-17.3(4)F8.

7-17.3(4)F2 EQUIPMENT

The Contractor shall 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 shall be calibrated within 6 months of hydrostatic testing. The Contractor shall provide a Manufacturer's Certificate of Compliance stating the date of calibration of the pressure gauge to be used within 2 Working Days when requested by the Engineer.

7-17.3(4)F3 PROCEDURE

Clean water or approved reclaimed water shall be used as the hydrostatic test fluid. All parts of the piping system shall 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 shall 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(4)F4 DURATION

The duration of each pressure test shall be a minimum of 1 hour. A leakage test of at least 2 hours duration shall immediately follow the pressure test.

7-17.3(4)F5 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 prior to testing.

7-17.3(4)F6 PRESSURE TEST

Test pressures shall be applied by means of 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.

Before applying the specified test pressure, expel all air from the pipe by slowly filling the section of pipe to be tested with water and allow to stand for 48 hours prior to the start of testing under slight pressure. The duration of each pressure test shall be 1 hour. A leakage test of 2 hours duration shall immediately follow the pressure test.

7-17.3(4)F7 LEAKAGE TEST

For the leakage test, the pump suction shall be in a barrel or similar device or metered so that 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 shall be 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:

$$L = \frac{ND(P)^{1/2}}{1850}$$

In the above formula:

- 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.

Should any test of pipe disclose leakage greater than that allowed, locate and repair the defective joints or pipe until the leakage from subsequent testing is within the specified allowance. The Contractor shall submit the method of repair to the Engineer for approval at least 3 Working Days in advance.

7-17.3(4)F8 CORRECTION OF EXCESSIVE LEAKAGE

Should any test of pipe disclose leakage greater than that allowed, locate and repair the defective joints or pipe until the leakage from subsequent testing is within the specified allowance. The Contractor shall submit the method of repair to the Engineer for approval at least 3 Working Days in advance.

7-17.3(4)G PLUGGING EXISTING PIPE

Where indicated on the Drawings, existing pipes shall be plugged on the inlet end as specified in Section 2-02.3(5).

7-17.3(4)H DEFLECTION TEST FOR FLEXIBLE PIPE

For pipes nominally 24-inch and larger inside diameter, deflections shall be determined by a method submitted to and approved by the Engineer. If a mandrel is selected, the minimum diameter, length and other requirements shall conform to the dimensions and requirements in this Specification.

All Sewer and Storm Drain constructed of flexible pipe shall be tested for vertical deflection no less than 30 Days after trench backfill and compaction have been completed. No diameter of the installed pipe shall exceed a tolerance of more than 5 % for 12 inch and smaller nominal diameter pipe, and by no more than 3% for all larger than 12 inch nominal diameter pipe and less than or equal to 30 inch nominal diameter pipe. For pipes less than or equal to 30 inches nominal diameter, a mandrel shall be pulled through the pipe by hand to ensure that the maximum allowable deflection has not been exceeded. Prior to use, the mandrel shall 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, shall be submitted to the Engineer at least 1 Working Day prior to the test. The use of an uncertified mandrel or a mandrel altered or modified after certification will invalidate the test, and a 2 Working Day advance notification to the Engineer of a retest with a certified mandrel shall be complied with. If the mandrel fails to pass through the pipe, the pipe will be deemed overdeflected and unacceptable.

Testing shall be conducted on a manhole-to-manhole basis after the line has been thoroughly flushed with water. If testing reveals an overdeflected pipe, it shall be uncovered and, if not damaged from overdeflection or from excavation activities, the pipe may be corrected and reinstalled. If the pipe requires repair, the Contractor shall submit the proposed repair to the Engineer for approval at least 3 Working Days before making the repair. The Contractor shall also provide prior to performing the repair, a Manufacturer's Certificate of Compliance stating that the overdeflected pipe as repaired shall acceptably perform as required by the Specifications. If no repair is recommended, the Contractor shall state that the pipe requires no repair including the reason why the pipe requires no repair, and shall also provide a Manufacturer's Certificate of Compliance stating that the pipe without repair shall acceptably perform as required by the Specifications. Any pipe damaged beyond reasonable repair, due to overdeflection or from any other cause, shall be uncovered and removed from the Project Site and replaced with a new pipe at no cost to the Owner. Pipe large enough for a person to work inside it may be accepted on the basis of direct measurements rather than using a mandrel. The Contractor shall submit a method for making deflection measurements including the measurement device(s), how the measurement device(s) 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. The Engineer reserves the right to determine the number of measurements and the orientations of each measurement at each test location. The minimum number of orientations per test location shall be 3 in equal angle projections (3 orientations at 0°, 60°, and 120°). The Engineer also reserves the right to determine the number of test locations. The minimum number of test locations on any single section of pipe shall be no less than 2, and in no case shall there be less than 3 pipe sections tested, and no less than 3 pipe sections tested per any 100 foot length of pipeline.

The mandrel shall:

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:

Minimum Mandrel Diameter (inches)	Pipe Material	Nominal Size (Inches)
5.619	PVC ASTM D 3034 (SDR 35)	6
7.524		8
9.40		10
11.91		12
13.849		15
16.924	PVC ASTM F 679 (T-1 Wall)	18
19.952		21
22.246		24
25.29		26
28.502		30

3. Be fabricated of steel, be fitted with pulling rings at each end, be stamped or engraved on some segment other than a runner indicating the pipe Material, Material specification, nominal pipe size, and mandrel OD (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(4)I TELEVISION INSPECTION WITH AUDIO ASSESSMENT

Once during the final inspection process and after all manholes have been rechanneled, the Contractor in the presence of the Engineer, shall television inspect the interior of all mainline Sewer and Storm Drain pipe 6 inches through 48 inches in diameter to determine acceptance of this portion of the Work. Pipe larger than 48 inches in diameter will be inspected visually by the Engineer after cleaning and successful testing by the Contractor. Side Sewer, catch basin and inlet connection pipe, and other non-mainline pipe will not require television inspection.

Personnel Qualifications: Personnel performing television inspection shall have completed the Pipeline Assessment and Certification Program (PACP), and shall have adequate experience and working knowledge of the entire television inspection systems and processes. Contractor shall submit said certification to the Engineer at least 3 Working Days in advance of the first television inspection.

Camera Equipment: The camera shall be a 360-degree radial view color television camera (also known as "pan and tilt") with a mechanical footage counter calibrated to indicate video footage consistent with distance traveled in the pipe. Footage shall be zeroed at centerline structure (manhole, vault, etc.) where the video begins and footage shall increase as it travels forward, and decrease when backward camera movement is required. Footage shall be displayed on the video recording and be mentioned on the audio portion (see "audio commentary on recording").

Light Source: The camera shall have a light source providing adequate illumination to clearly identify invert, crown, joints, sides, connections, infiltration/exfiltration, and as may be necessary. Illumination shall be Capable of providing adequate illumination to at least 15 feet in front of the light.

Camera travel in the pipe: The camera shall travel along the invert of the pipe invert to provide the best view of the crown, invert, connections and sides of the pipe, and shall travel at a speed no faster than 30 feet per minute.

Audio commentary on recording: Commentary shall be objective and shall be based on PACP defined assessment conditions. Audio shall be intelligible and shall be as free from interference and background noise as can reasonably be done. Subjective comment (such as "the fault of", "caused by", and opinion, etc.) shall not be used. Comment shall include the footage location of the comment. At each of connections, the beginning structure, the ending structure, indicated flaws, areas of infiltration/exfiltration, open joints, outfall, and at other features as may be necessary, the footage location shall be mentioned on the audio.

Required Labeling on recording and in audio commentary: Each recording shall have audio accompaniment and shall address a single run of pipe between two (2) structures (manholes, vaults, or ending in an outfall, etc.) on a single recording. Where relatively short runs exist (defined as 100 or fewer feet between centerlines of structures, or to end of outfall), more than one run may be allowed on a single recording when approved by the Engineer at least 3 Working Days in advance. The recording shall contain a legible label that clearly states the following, and the audio commentary shall begin with the following:

- a. Date and time of day television inspection performed;
- b. Names of television inspection crew members;
- c. Project name, vault plan number listed on Drawings, and Drawing sheet number;
- d. Location with structure labels (for example – manhole 25, vault 2, outfall, etc.), camera travel direction, size of pipe, pipe material (such as "Broad Street, 5th Ave west to midblock, manholes 24 to 25, going downstream, 24 inch reinforced concrete pipe"); and
- e. a unique identification number, with these numbers being in consecutive sequence on all videotapes of project pipe.

If more than one run is on a recording, such information shall clearly be shown on the label and stated on the audio accompaniment.

Recording quality and characteristics: Television inspections shall be on compact discs (CD). If CD not possible or compatible with camera equipment or system, then a Standard Grade, 60-minute VHS tapes taped at SP speed, shall be of a quality that completely and clearly shows that listed in "required extra inspection".

Recordings not meeting the requirements of this Specification will be determined to be defective work. Upon written notice by the Engineer, the Contractor shall promptly conduct a second television inspection meeting specified requirements, and shall submit a second recording at no additional or separate cost to the Owner.

Required Pre-Notification: The Contractor shall notify the Engineer at least 3 Working Days in advance of the first television inspection.

Pre television inspection preparation: Unless the Contract specifies otherwise, the pipeline system to be inspected shall be successfully pressure tested and then flushed clean prior to beginning inspection. Television inspection shall be performed prior to allowing mainline flow into the pipe from upstream sources. Upstream bypass, when used, shall accommodate television inspection to afford full visibility of pipe inverts (see Section 7-17.3(2)K).

Required Extra Inspection: At all lateral connections, areas of indicated infiltration/exfiltration, open joints, indicated pipe deflection, defects of any kind, and as the Engineer may require, shall require the camera to slow down and fully focus on such areas including having the camera slowly travel backward and forward for multi-directional views. Said areas shall require focused video inspection of not less than 5 seconds. Cameras with telescoping ability shall view the area by telescoping in and out as appropriate for the Engineer to evaluate the condition with certainty.

Reinspection: Should television inspection reveal defective work, the Contractor shall, upon written notice from the Engineer, correct said defects. An additional television inspection ("reinspection") shall then be taken of the corrected pipe run to verify the corrected pipe meets Specifications. Such reinspection shall be considered in accordance with Section 1-05.7.

Reverse travel runs: The Engineer may require a second television inspection including audio accompaniment run along a pipe by having the camera travel in the direction opposite the previous inspection ("reverse direction"). Such reverse inspection shall be on the same video tape with the footage counter beginning at the upper number and as the camera travels, decreasing in footage count. The audio portion shall include at the beginning of this reverse run, a statement to the effect that "a second view is about to begin of the same length of pipe in the reverse direction".

Temporary breakdowns: Should an occurrence such as camera breakdown or inability to perform as specified, or other condition arise where no camera or television or audio progress can be made, after the initial 30 seconds of such condition, the operator shall make comment on the audio of such condition and the footage location, then shall shut down the camera and the

audio. Upon fixing such a condition, the video and audio shall be restarted and the audio shall include a comment to the effect "_____ condition fixed and video and audio restarting at _____ footage location".

Contractor to provide: Compact disc shall be furnished to the Engineer within 10 Working Days of each television inspection, and shall become the property of the Engineer. The Engineer may agree to other arrangements.

Additional television inspection: Six to eleven months after the Physical Completion Date, the pipes may, at the option of the Engineer, be television inspected again. Videotaping may be done by Owner's forces or, at the Engineer's option, by the Contractor. The Contractor shall schedule such inspection within 10 Working Days after the date of written notice by the Engineer. The audio portion on this recording shall indicate the same information as specified in "Required Labeling on recording and in audio commentary" also stating "this is an additional television inspection". This additional inspection will then be compared with the prior recording to determine whether or not any change has occurred in the condition of the pipe. Should there be evidence of changed conditions that warrant correction, the Contractor shall, upon written notice of the Engineer, correct those defects pursuant to Section 1-05.10. After the necessary corrections have been made by the Contractor, the corrections shall be verified in compliance with the Contract at the Contractor's sole expense.

Pipes that are submerged: New pipe that is submerged (for example – Storm Drain that outfalls below the surface of a body of water), do not require television inspection, unless the Contract specifies otherwise.

7-17.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Extra Excavation" will be by the cubic yard of Material actually removed beyond the standard trench neat lines shown on Standard Plan nos. 284 and 285.

Measurement for "Bedding, (Class), (Size) Pipe" and for "Bedding, CDF, (Size) Pipe" for Sewer, Culvert, and Storm Drain as shown on Standard Plan no. 285, and for Water Main as shown on Standard Plan no. 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 manholes 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 neatlines shown on the Standard Plans will not be measured.

Measurements for "Pipe, (Use), (Material), (Class), (Size)", for "Steel Casing Pipe, (Class), (Size), (Underground Construction Method)", and for "Pipe, (Material), (Class), (Size), (Underground Construction Method)" for other than directional drilling will be by the linear foot of pipe actually installed and successfully tested, and shall 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 manhole or rechanneled existing manhole; or to the inside face of Structure or existing manhole not rechanneled; or to the end of pipe where it meets a manhole 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 no. 010. All incidental to Sewer and Storm Drain pipe measurement will be measured within Standard Plan no. 284 neatlines, and for Water Main will be measured within Standard Plan no. 350 neatlines.

No measurement will be made for trench excavation, trench backfill, and selected Material for trench backfill, except for foundation Material, for extra excavation, and for non-native and non select backfill Material including CDF.

Measurement for foundation Material will be by the cubic yard of Mineral Aggregate required to fill the void made by extra excavation and shall be based on neat line width of trench and depth and length as computed by the Engineer.

Measurement for "Mineral Aggregate, (Type)" and for "Controlled Density Fill" trench backfill will be by the cubic yard based upon the neat line trench pay width as specified in Section 7-17.3(1) and the Standard Plan, or other neatline dimensions when designated by the Engineer. Imported Mineral Aggregate and CDF used beyond these neat line limits shall be at the Contractor's sole expense.

Measurement for "Safety Systems in Trench Excavation, Minimum Bid = \$0.40 per Square Foot" and for "Support System" will be 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 four or more feet deep. Depth is measured from existing surface grade at the time of excavation to pipe invert. No measurement will be made for support system beyond designated locations indicated in the Contract where the Contractor determines a support system is required. See Section 2-09.4 for measurement of a trench safety system where a trench is created in a structural excavation.

Measurement for "TV Inspection" will be for the linear feet of installed 6" - 48" diameter mainline pipe videotaped once during (1) final inspection and (2) such re-videotaping done six to eleven months after the Physical Completion Date. Measurement will be made along the pipe centerline through tees from (1) center to center of new or rechanneled manholes, or (2) to the inside face of Structures or manholes not channeled, or (3) to the end of pipe where it dead ends beyond manholes.

Measurement for "Clay Dam, (Size) Pipe" will be per each.

Measurement for "Tee, (Material), (Size)" 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 no. 010, and "Material" is the Material of the mainline pipe with the branching tee.

Measurement for "Controlled Density Fill" will be by the cubic yard of material actually placed for pipe bedding or trench backfill.

Measurement for "Dam, Clay Trench" will be per each.

7-17.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-17 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **“Extra Excavation”**, per cubic yard.

The Bid item price for “Extra Excavation” shall include all costs for the work required to remove; haul and dispose of the excavated material.

2. **“Bedding, (Class), (Size) Pipe” and “Bedding, CDF, (Size) Pipe”**, per linear foot.

The Bid item price for “Bedding, (Class), (Size) Pipe” and for “Bedding, CDF, (Size) Pipe” shall include all costs for the work required to furnish and install bedding. Cost of Class D bedding shall be included in the Bid item for the pipe Bid item and therefore no separate or additional payment will be made for Class D bedding.

3. **“Pipe, (Use), (Material), (Class), (Size)”**, per linear foot.

The Bid item price for “Pipe, (Use), (Material), (Class), (Size)” shall include all costs for the work required to furnish and install the pipe of the type and size specified, and including the following:

- a. trench excavation (except “Extra Excavation”); haul, stockpile, backfill, and compact suitable native Material backfill,
- b. handling; hauling, storage, removal; off-site disposal of excess suitable and unsuitable excavated native material, or hauling, storage, placement of suitable excess excavated native material or selected Material elsewhere on the project except where designated for embankment construction,
- c. dewatering of the trench,
- d. required trench excavation, backfill, and compaction,
- e. cleaning and testing per Section 7-17.3(4),
- f. Class D bedding,
- g. pipe coupling, and
- h. removal and disposal of existing pipe within trench neatline 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 shall be considered as included in the Bid item prices for the applicable pipe Bid items.

Unauthorized excavation below the established trench grade shall be made good by the Contractor at the sole expense of the Contractor by providing, placing and compacting suitable bedding Material to the proper grade elevation.

The work of cleaning and testing, except TV inspection, and furnishing caps and plugs for the tests shall be considered as included in the Bid item prices of the pipe Bid items.

Costs for the work required in proof testing the pipe shall be considered included in the Bid item prices for the appropriate pipe Bid items.

Any damage resulting from testing of the Sewers and appurtenances specified in Section 7-17.3(4)A shall be made good by the Contractor at the Contractor's sole expense.

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(4), shall be borne by the Contractor in accordance with Section 1-05.7

If the pipe fails the deflection test as specified in Section 7-17.3(4)H, all costs to locate and repair the failed sections and retest the pipe shall be borne by the Contractor in accordance with 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)F shall be considered as included in the Bid item prices for the pipe Bid items.

4. **“Casing Pipe, (Material), (Class), (Size), (Underground Construction Method)”**, per linear foot.

The Bid item price for “Casing Pipe, (Material), (Class), (Size), (Underground Construction Method)” for other than directional drilling shall include all costs for the work required to furnish and install casing pipe as specified in Section 7-17.3(2)J, including installation and removal of shoring of the jacking pit. All cost for filling the annular space when required in the Contract shall be incidental to this Bid item and no separate or additional payment will be made therefore.

Payment for directional drilling installation will be as specified in Section 7-22.5.

5. **“Pipe, (Material), (Class), (Size), (Underground Construction Method)”**, per linear foot.

The Bid item price for “Pipe, (Material), (Class), (Size), (Underground Construction Method)” for other than directional drilling shall include all costs for the work required to furnish and install the pipe as specified in Section 7-17.3(2)J.

Payment for directional drilling installation will be as specified in Section 7-22.5.

6. **“Tee, (Material), (Size)”**, each.

The Bid item price for “Tee, (Material), (Size)” shall include all costs for the work required to furnish and install the tee including plug when required.

7. **“Tee, (Size), Cut-In Existing (Material) Pipe”**, each.

The Bid item price for “Tee, (Size), Cut-In Existing (Material) Pipe” shall include all costs for the work required to furnish and install the tee as specified in Section 7-17.3(2)C3. If Drainage and Wastewater Utility installs a pipe with a tee, no payment will be made.

8. **“Safety Systems in Trench Excavation, Minimum Bid = \$0.40 per Square Foot”**.

The minimum Bid item price for "Safety Systems in Trench Excavation, Minimum Bid = \$0.40 per Square Foot" shall be forty cents (\$0.40) per square foot. Should the Contractor determine that the cost for this work is greater than \$0.40 per square foot, the Contractor may Bid a higher Bid item price by crossing out the minimum Bid item price and extension shown in the Bid Form, writing in a higher Bid item price and extension in the Bid Form, and initialing the change. Should a Contractor write in a Bid item price less than the minimum \$0.40 per square foot, the \$0.40 Bid item price shall govern and become a part of the Bid.

The Bid item price for "Safety Systems in Trench Excavation, Minimum Bid = \$0.40 per Square Foot" shall include all costs for the work required to provide, construct, maintain and remove safety systems for trench excavations equal to or exceeding a depth of 4 feet as specified in Section 7-17.3(1)A7a. All costs for support system beyond the designated locations in the Contract where a support system may be required as determined by the Contractor shall be included in the Bid item price for the Bid item "Safety Systems in Trench Excavation, Minimum Bid = \$0.40 per Square Foot".

9. **"Temporary Sewer Bypass"**, per lump sum.

The Bid item price for "Temporary Sewer Bypass" shall include all the work required to bypass Sewer flow around the construction work.

10. **"Television Inspection"**, per linear foot.

The Bid item price for "Television Inspection" shall include all costs for the work required for CCTV inspection of all Sewer and Storm Drain pipe 6" through and including 48" diameter and furnishing an acceptable videotape of a Sewer or Storm Drain pipe to the Engineer. Payment will be for one complete videotaping session made during (1) the final inspection process and (2) one complete re-videotaping, if videotaping is requested by the Engineer, six to eleven months after the Physical Completion Date. Costs for additional videotaping sessions and tapes necessary to verify corrections or replacement of pipe or done solely for the Contractor's convenience shall be borne by the Contractor.

11. **"Support System"**, per square foot.

The Bid item price for "Support System" shall include all costs for the work required to furnish, install, maintain, and remove the support system for trench excavations at the designated locations on the Drawings as specified in Section 7-17.3(1)A7b. No separate or additional payment for "Support System" will be made for the use of support system as part of the Contractor determined trench safety system outside of the locations specified on the Drawings and all costs for such support system shall be included in the Bid item price for the Bid item "Safety Systems in Trench Excavation, Minimum Bid = \$0.40 per Square Foot".

12. **"Clay Dam, (Size) Pipe"**, per each.

The Bid item price for "Clay Dam, (Size) Pipe" shall include all costs for the work necessary to excavate, handle spoils as specified in item 3b this Section, furnish and install the clay dam.

13. **"Backfill, CDF, (Size) Pipe"**, per cubic yard.

The Bid item price for "Backfill, CDF, (Size) Pipe" shall include all costs for the work necessary to furnish and place the specified backfill.

14. **"Controlled Density Fill"**, per cubic yard.

The Bid item price for "Controlled Density Fill" shall include all costs for the work required to furnish and place the CDF as specified.

15. **"Dam, Clay Trench"**, per each.

The Bid item price for "Dam, Clay Trench" shall include all costs for the work required to furnish and install the clay dam as specified.

16. **Other payment information.**

See Section 2-09.5 for payment of a trench safety system where trench is created in a structural excavation.

Where unauthorized excavation has been made which increases the established trench depth beyond 4 feet, the Contractor shall meet the requirements specified for Trench Safety Systems in Section 7-17.3(1)A7a at no additional cost to the Owner.

Payment for imported Material when ordered in lieu of native backfill Material by the Engineer will be paid as "Mineral Aggregate, (Type)", or other imported Material acceptable to the Engineer.

Foundation Material when required will be paid as "Mineral Aggregate, (Type)" per cubic yard, per 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 in accordance with Section 1-04.1(2).

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 additional television inspection, and cleaning in preparation for television inspection, to verify repairs or replaced pipe shall be borne by the Contractor. The Contractor shall also be responsible for all costs incurred in any television inspection performed solely for the benefit of the Contractor.

If the Contractor calls for an initial TV inspection, and the pipe is not clean or has so many deficiencies that the line cannot be fully inspected, the reinspection will be charged to the Contractor, and the cost withheld from money due to the Contractor.

The Contractor shall provide all necessary water for construction and testing purposes (see Section 2-07).

No separate or additional compensation 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 in accordance with Section 2-02.5.

Payment for selected Material used for embankment compaction will be in accordance with Section 2-03.5.

The Contractor shall, at the Contractor's sole expense, provide pipe of increased strength classification or place a class of bedding of higher load bearing capacity, as required by the Engineer, when the maximum trench width specified in Section 7-17.3(1)A1 is exceeded by the Contractor without prior written approval of the Engineer. The Contractor shall furnish and install any approved imported backfill Material required outside the trench neat line limits.

SECTION 7-18 SIDE SEWERS

7-18.1 DESCRIPTION

Section 7-18 describes work consisting of locating and placing side Sewer, locating tees, and testing of side Sewer. This Section also accommodates private construction in the Right of Way under permit by DPD and SDOT Street Use.

In the Right of Way, a side Sewer, with a capital "S" in "Sewer" as defined in Standard Specification Section 1-01.3, is considered to be that portion of pipe that is constructed between a main Sewer or Storm Drain and the Right of Way margin and shall be constructed in compliance with this Section 7-18 as is reflected by Title 21 of the Seattle Municipal Code. All privately owned and operated drainage control facilities or service drain system, whether or not they discharge to a public drainage control system, Sewer, combined Sewer, or Storm Drain, shall be considered side Sewer where in the Right of Way. Side Sewer does not include any pipe not in the Right of Way and does not include internal building piping or connecting appurtenances, the installation of which is controlled by Seattle Municipal Code, ordinance or regulation.

In property not within Seattle's Right of Way, the term "side sewer", with no capital "s" in "sewer", shall be interpreted as pipe labeled as "side sewer" or "service drain" or "combined side sewer" as addressed in Title 21 Seattle Municipal Code and applicable Director's Rules.

7-18.2 MATERIALS

Materials for side Sewer shall meet the requirements of the following Sections:

Pipe	9-05
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Side Sewer in Right Of Way shall be not less than 6 inches in side diameter unless otherwise specified in the Contract.

All pipe shall be clearly marked with type, class, date of manufacture, location of manufacturing plant, and/or thickness, as applicable. Marking shall be legible and permanent on the outside surface of the pipe, and shall be able to withstand normal wear due to handling and storage.

Approved jointing shall be flexible gasketing. Flexible gasketing shall be construed to include rubber, synthetic rubberlike and plastic Materials specially manufactured for the joint, pipe size, and use intended and shall be furnished by the manufacturer of the pipe to be used.

Mortared joints will not be allowed.

Tees, wyes, couplers, and adapters shall conform to the requirements of this Section.

Bends, and transition sections shall be as specified in the Contract.

Couplings for dissimilar pipe shall be flexible gaskets with stainless steel shielding to provide shear control.

Side Sewer that may be exposed to hot sewage, steam, or other extreme exposure shall be of a Material and with joints as specified in the Contract, and shall meet 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

Trench excavation shall comply with the requirements of Section 7-17.3(1)A and trench excavation over 4 feet in depth shall comply with the trench safety requirements of Section 7-17.3(1)A7a.

Side Sewer work shall be performed by a registered side sewer contractor (RSSC) in accordance with SMC 21.16.060.

The Contractor or Subcontractor performing side Sewer work shall be an RSSC.

Where Section 7-18 does not address specific construction requirements, the construction requirements for Sewer in Section 7-17 of these Standard Specifications shall apply.

Side Sewer location shown on the Drawings shall be subject to relocation in the field after construction starts to accommodate site specific conditions. Regardless of the Drawing location, the Contractor shall 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 stake and indicate the depth for the invert elevation of side Sewer at the Right-of-Way margin.

Side Sewer shall be installed with existing, or with other project proposed, Water Main and other underground facilities, in accordance with the clearance requirements specified in Section 1-07.17(2) and other code, law, and regulation.

7-18.3(1)B RESERVED

7-18.3(1)C SIDE SEWERS SHOWN ON THE DRAWINGS

7-18.3(1)C1 PROTECTION OF EXISTING SIDE SEWER

See Section 1-07.16.

7-18.3(1)C2 REMOVE AND REPLACE EXISTING SIDE SEWER

When the Drawings call for removal and replacement of existing side Sewer, only new pipe shall be used to replace the removed pipe.

7-18.3(2) EXCAVATION, FOUNDATION PREPARATION, BEDDING, AND BACKFILL

Excavation, foundation preparation, bedding and backfill for side Sewer shall conform to the requirements of Section 7-17, except that bedding or backfill shall be limited to that required to hold the pipe in true alignment and to grade without covering the pipe. The Contractor shall give 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 hereinafter provided, shall conform to the requirements of Section 7-17 and Chapter 21.16 of the Seattle Municipal Code.

7-18.3(3)B LINE AND GRADE

Side Sewer shall be installed to a line and grade between the main Sewer or Storm Drain tee branch or wye branch, and the Right of Way margin, so as to best serve the property relative to the following conditions, as approved by the Engineer:

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 shall 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 no. 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%, 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 shall be not less than 6 inches. In either of these conditions, the end of the side Sewer at the Right of Way margin shall be placed 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. Where an occupied property is level with or lower than the street grade, side Sewer pipe shall be installed on a grade not less than 2%.

7-18.3(3)C PIPE INSTALLATION

Bell and spigot pipe shall be installed with the bell end facing up grade. All pipe installation shall start and proceed up grade from the point of connection at the Sewer or Storm Drain or other starting point.

Between fittings, pipe shall be installed in a straight line at a uniform grade.

7-18.3(3)D JOINTING – NEW PIPE TO EXISTING PIPE

Where it is necessary to break out an existing side Sewer during construction due to grade conflict with a newly constructed pipeline, only new pipe shall be used in reconnecting the side Sewer. Where joints cannot be made due to dissimilar pipe Material or mismatched wall thickness, the Contractor shall use a flexible gasketed coupling to make a watertight joint. **Couplings shall have flexible gaskets and stainless steel shielding.**

7-18.3(4) FITTINGS

All fittings shall be factory-produced and shall be designed for installation on the pipe to be used.

The maximum deflection permissible at any one fitting or joint shall not exceed the pipe manufacturer's recommendation, and in no case shall the deflection exceed 2 inches per foot at any joint or fitting. The maximum deflection of any combination of two adjacent fittings or joints shall not exceed 45 degrees (one-eighth bend). Should greater than 45 degree deflection be needed between adjacent joints or fittings, a straight pipe of not less than 2-1/2 feet in length shall be installed 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.

Side Sewer shall be connected to the tee or wye provided at the main Sewer or Storm Drain where such is available, utilizing approved fittings or adapters. Where no tee or wye is provided or available, connection shall be made by core drilling and installing an approved insert or saddle tee as specified in Section 7-17.3(2)C3. The installation of side sewer to a vertical connection at the main Sewer or Storm Drain shall be as shown on Standard Plan no. 234.

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 shall be uncovered for inspection inspection.

7-18.3(6)B TESTING

All newly installed side Sewer shall be tested after backfill. Side Sewer that is reconstructed or repaired to a length of 10 feet or more shall be tested for watertightness in accordance with Section 7-17.3(4)B. The only exceptions for no testing required shall be:

1. a new reconstruction of side Sewer consisting of a single length of pipe, and
2. existing side Sewer reconnected to the Sewer or Storm Drain.

Testing shall be performed in the presence of the Engineer in accordance with Section 7-17.3(4).

All side Sewer constructed in conjunction with main Sewer or Storm Drain construction, for purposes of testing as specified in Section 7-17.3(4), shall 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 no. 283. The tee opening shall be positioned 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, the Contractor shall 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 permit separate side Sewer and mainline tests.

When the new side Sewer is connected to an existing main Sewer or Storm Drain, the Contractor shall furnish and place 2 test tees as shown on Standard Plan no. 283 and as follows:

- a) one immediately adjacent to the main Sewer or Storm Drain, and
- b) a second at the Right of Way margin.

The ends of side Sewer and test tee openings shall be plugged watertight 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 DPD, shall not be 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 shall not be less than 6 inch inside diameter. Side Sewer and/or service drain on private property shall be not less than 4 inches inside diameter. No roof drain, area drain, or subsurface drain shall be connected to a side Sewer which is connected to a separate main line sanitary only Sewer.

Private property roof drains or service drains in areas of mainline combined Sewer shall 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 shall comply with WSDOH requirements and other applicable code and regulation.

In the Right of Way, side Sewer clearances shall be as specified in Section 1-07.17(2).

7-18.3(7)C PLUGS

In the Right of Way, unused side Sewer openings shall be securely sealed with a watertight plug fastened in place, as approved by the Engineer.

The only exception is private construction under permit from DPD and SDOT Street Use where unused side sewer openings in private property and side Sewer openings in the Right of Way, shall be closed with a watertight plug fastened in place as approved by DPD.

7-18.3(7)D SEPTIC TANKS AND CESSPOOLS – PRIVATE PROPERTY

No side sewer shall be constructed through or adjacent to an existing cesspool or septic tank. If site conditions prohibit any other location, the Contractor shall abate the cesspool or septic tank by such means as the DPD 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 DPD permit, shall comply with the Street and Sidewalk Pavement Opening and Restoration Rules.

7-18.3(9) EXTENDING SIDE SEWERSIDE SEWER INTO PRIVATE PROPERTY

Extending side Sewer into private property shall not be part of the Contract and no such work will be allowed.

Unless authorized by Section 21.16 of the Seattle Municipal Code, private property owners who wish to extend side sewer into the Right of Way or connect with Sewer or Storm Drain, shall do so under permit with DPD and SDOT Street Use.

7-18.3(10) END PIPE MARKER

At the Right of Way margin, a 4 foot long 2-inch x 4-inch stake shall be buried to a 3 foot depth directly over the side Sewer. The exposed 1 foot of stake shall be painted traffic white, and the depth to the invert of the side Sewer from finish grade shall be painted legibly and with black permanent ink or other durable marking agent, on the exposed white portion of stake. The bottom of the stake shall have a 2-inch x 4-inch cleat securely nailed to the stake to prevent withdrawal of the buried stake. In addition, a 12 gauge galvanized wire shall be attached to the tee on the side Sewer, or to the plugged end of the side Sewer if no tee, and shall extend to 6 inches above finished grade at the stake and not attached to the stake.

7-18.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Pipe, (Use), (Material), (Class), (Size)" will be to the nearest 0.10 foot 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 no. 010, or to the end of pipe when the Contract or Engineer requires.

Measurement for "Tee, Test, (Material), (Size)" shall be per each.

Measurement for trench safety system will be in accordance with Section 7-17.4.

7-18.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-18 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **"Pipe, (Use), (Material), (Class), (Size)",** per linear foot.

The Bid item price for "Pipe, (Use), (Material), (Class), (Size)", shall include 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 (except "Extra 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, balloon; and
- h. Class D Bedding.

2. **"Tee, Test, (Material), (Size)",** per each.

The Bid item price for "Tee, Test, (Material), (Size)" shall include all costs for the work required to furnish, install, and remove as necessary the test tee.

3. **Other payment information.**

Payment for "Safety Systems in Trench Excavation, Min. Bid = \$0.80 per Square Foot", for "Extra Excavation", for "Mineral Aggregate (Type)", for "Tee, (Material), (Size)", for "Clay Dam", for "Backfill, CDF, (Size) Pipe", for "Bedding, CDF, (Size) Pipe", and for "Bedding, (Class), (Size) Pipe" will be in accordance with 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 shall be at the Contractor's sole expense and no separate or additional payment will be made therefore.

Remove and re-install 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.

All costs relating to construction in private property, and to private construction in Seattle's Right of Way under the jurisdiction of DPD and SDOT Street Use, shall not be part of the Contract and no separate or additional payment will be made therefore.

SECTION 7-19 SEWER CLEANOUT

7-19.1 DESCRIPTION

Section 7-19 describes work consisting of the construction of sanitary Sewer cleanouts in accordance with Standard Plan no. 280 and as indicated in the Contract.

7-19.2 MATERIALS

All Materials incorporated into the total cleanout structure shall meet the requirements of the various applicable Sections of these Standard Specifications.

7-19.3 CONSTRUCTION REQUIREMENTS

A cleanout shall be provided for each total change of 90 degrees in grade or alignment. In no case shall the spacing of cleanouts exceed 100 feet. No cleanout will be 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 shall consist of a wye branch in the side Sewer. All cleanouts located in the Right Of Way shall be extended to finish grade.

The extension of cleanouts to finish grade on private property is optional with the property owner. When extended to finish grade, cleanouts shall be full side Sewer diameter and shall be extended to a point not less than 6 inches nor more than 12 inches below the finished ground surface with a removable stopper which prevents passage of dirt or water. When specified in the Contract, the Contractor shall install an approved casting to provide ready access to the cleanout stopper. An 1/8-bend shall be used to deflect the side Sewer upward as a cleanout where the terminal end of the side Sewer lies upstream from the last point of connection.

Pipe joints shall be the type specified in Section 7-17.3(2).

Trench excavation, bedding, and backfill requirements shall comply with the appropriate requirements of Section 7-17. The trench excavation shall be made in such a manner as to provide an undisturbed base upon which the pipe shall be placed. Bedding around the wye and under the pipe connecting to the wye shall be thoroughly compacted. Otherwise, construction shall conform to the requirements shown on Standard Plan no. 280.

7-19.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Sewer Cleanout, (Size)" will begin at the wye branch and extend through the casting, as shown on Standard Plan no. 280.

7-19.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-19 will be made at the Bid item price Bid only for the Bid item listed or referenced as follows:

1. "Sewer Cleanout, (Size)", per each.

The Bid item price per each for "Sewer Cleanout, (Size)" shall include 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 manholes, catch basins, inlets, valve chambers, water meter boxes, handholes, and similar utility Structures encountered during the Work to a new grade elevation. The work shall include adjustment by removing or installing ring extensions; 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.

Publicly-owned utility Structures shall be adjusted to finished grade by the Contractor. Privately-owned utilities are generally in the streets and road Rights of Way pursuant to franchises or to rights claimed under the laws of the United States of America, or the State of Washington and, therefore, these utility agencies are responsible for all adjustments and relocations of their own facilities. The Contractor shall schedule the Work so that 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.

7-20.2 MATERIALS

Material used in the adjustment of existing utility Structures shall meet the requirements for new construction specified in the Specification Section applicable to the item being adjusted.

Adjustment ring extensions shall meet the requirements of Section 9-12.8 and Standard Plan no. 231.

Epoxy used to secure manhole castings for ring extensions to existing frames shall be per epoxy manufacturer's recommendations for the material application. The Contractor shall submit at least 3 Working Days in advance, a Manufacturer's Certificate of Compliance and catalog cut stating the proposed epoxy provides acceptable bonding performance for the intended application.

7-20.3 CONSTRUCTION REQUIREMENTS**7-20.3(1) ADJUSTMENT OF MANHOLES, CATCH BASINS, AND SIMILAR STRUCTURES****7-20.3(1)A GENERAL**

The Engineer will establish approximate grade elevation for the tops of existing utility Structures requiring adjustment. The final alignment and grade elevation shall be established from adjacent roadway surfaces, forms, or such offset hubs as may be provided by the Engineer.

Except where adjustment is to be made by ring extension, the Contractor shall remove the pavement around the casting; remove the casting and install or remove leveling or adjustment brick or block; or shall excavate around the utility

structure, remove a portion of it as necessary and rebuild the structure to meet the new grade elevation. Pavement removal shall be kept to the minimum amount required to facilitate the adjustment. Adjustment of drainage Structure to finished grade elevation, by whatever method, shall result in a finished Structure meeting the requirements for new construction as specified in Section 7-05.3(1)P, except inlets which shall comply with Section 7-05.3(2)D. The overall distance between the top of the casting to the bottom of the adjustment brick shall be not more than 26 inches.

Where a Water Main casting adjustment is required and the concrete pavement or concrete rigid pavement base is to be made thicker, the Contract will specify whether or not a new Water Main casting is required. If a new Water Main casting is required, the Contractor shall comply with the requirements in Section 7-20.3(5); otherwise, adjustment of Water Main castings shall be by either brick or concrete block. The adjustment of Water Main castings with ring extensions will not be allowed.

When a ring extension is specified in the Contract, it shall be epoxied securely to the existing frame. All frame and ring extension surfaces to receive the epoxy shall be thoroughly cleaned with a wire brush prior to the application of epoxy.

When adjustment is made by adding or removing leveling bricks, all joints in the bricks shall be filled with mortar and the casting seated in mortar on the top brick course.

After the utility Structure has been adjusted to grade, and the Structure made watertight by plastering with a mortar cement, all voids around the Structure shall be backfilled and compacted with imported Mineral Aggregate Type 17. The casting shall then be secured in place with a tapered layer of concrete or asphalt, as applicable.

The Contractor shall adjust to finish grade, water meter boxes encountered in the planting strip and sidewalk area.

Should adjustment to a water meter box necessitate adjustment or relocation of the water meter, the Contractor shall notify the Engineer at least 3 Working Days in advance and the water meter will be adjusted or relocated by SPU Water Operations. The Contractor shall then make final adjustment of the meter box.

7-20.3(1)B UNPAVED STREET GRADING PROJECTS

New manholes, catch basins and similar Structures constructed in conjunction with street grading projects which are to be surfaced with gravel or crushed stone shall be constructed to a point approximately 8 inches below the subgrade and covered with a temporary wood cover. Existing manholes encountered shall be cut off and covered in a similar manner. The Contractor shall carefully reference all manholes so that they may be easily found upon completion of the street work.

After placing the gravel or crushed stone surfacing, the utility Structures and utility castings shall be constructed to the finished grade of the roadway surface. Excavation necessary for bringing utility castings to grade shall center about the utility structure and be held to the minimum area necessary. After completion of the utility structure adjustment, and after the structure is made watertight by plastering with mortar cement, the void around the manhole shall be backfilled with imported Mineral Aggregate Type 17 and thoroughly compacted.

Where bituminous surface treatment is to be placed, the manhole castings shall be installed from 1/2 inch to 1 inch higher than the rock surfacing so that the top of the casting matches the finished roadway surface.

7-20.3(1)C CEMENT CONCRETE PAVING PROJECTS

Manholes, catch basins and similar Structures shall be constructed or adjusted in the same manner as outlined in Section 7-20.3(1)A except that the final adjustment shall be made and the cast iron frame set after the forms have been placed and checked. In placing the concrete pavement, extreme care shall be taken not to alter the position of the casting in any way.

All Standard Plan nos. 230 and 361 castings (manholes and valve chambers) installed in and requiring new concrete pavement or rigid concrete base pavement, shall comply with the reinforcing requirements of Section 5-05.3(9).

See Section 7-20.3(1)A for Water Main casting adjustment requirements.

See Section 7-20.3(1)D for temporary transition tapers around exposed castings.

7-20.3(1)D ASPHALT CONCRETE PAVING PROJECTS

Utility Structures requiring adjustment of frames to match finish grade shall be adjusted prior to the start of the final paving operation.

The tops of existing utility Structure frames shall 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, the Contractor shall install temporary asphalt or temporary pavement patch transition tapers around the Structure frame to prevent a nuisance to traffic. The Contractor shall maintain the asphalt tapers and shall furnish, install, and maintain warning signs and barricades in accordance with Sections 1-07.23 and 1-10. The Contractor shall remove the asphalt tapers immediately prior to 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, shall be mortared to give a smooth, watertight surface.

7-20.3(1)E ASPHALT RESURFACING PROJECTS

Adjustment of manholes, catch basins, and similar Structures on asphalt resurfacing projects shall meet the requirements of Section 7-20.3(1)D.

7-20.3(1)F STORM AND SANITARY SEWER OR WATER PROJECTS

Manholes, catch basins, gate valve Structures and other similar type Structures being constructed in conjunction with Sewer or water projects on improved streets shall be brought to final grade as outlined in these Section 7-20 Specifications.

7-20.3(1)G ESTABLISHMENT OF GRADE FOR TOP OF MANHOLE

The Engineer will establish the grade for top of manholes, catch basins and similar Structures; however, these grades will be approximate only. The Contractor shall allow adjustment of frame and frame extensions in accordance with the Standard Plans. The Engineer assumes no responsibility in this regard, except when the final grade is set.

7-20.3(2) ADJUSTMENT OF INLETS

The final alignment and grade of frames for new and old inlets to be adjusted to grade shall be established from the forms or from adjacent pavement surfaces. The final adjustment of the inlet frame and frame extension shall be performed in similar manner to that described for manholes. On asphalt concrete paving projects using curbs and gutters, that portion of the frame not embedded in the gutter section shall be solidly embedded in concrete. The concrete shall extend a minimum of 6 inches beyond the edge of the frame and shall be left 1-1/2 inches below the top of the frame so that the wearing course of asphalt concrete pavement butts against the frame. The existing concrete pavement and edge of the casting shall be painted with hot asphalt cement.

Adjustments in the inlet structure frame and frame extension shall be made in the same manner and of the same Material as that required for new inlets. The inside of the inlet frame and frame extension shall be plastered smooth.

7-20.3(3) ADJUSTMENT OF MONUMENTS, AND FRAME AND COVER

Monuments and monument castings shall be adjusted to grade in the same manner as for manholes.

7-20.3(4) ADJUSTMENT OF VALVE BOX CASTINGS

Adjustment of valve box castings and Water Main castings shall be as specified in Sections 7-20.3(1)A and 7-20.3(5).

7-20.3(5) FURNISHING CASTINGS

Where adjustment of existing utility Structures is required and the Drawings indicate that the existing castings be replaced, the Contractor shall furnish new castings of the type specified on the Drawings with the exception of Water Main castings. Water Main castings requiring replacement will be furnished by SPU Water Operations. Casting shall include frame and grate, or ring and cover unless the Contract specifies otherwise. Salvaged castings shall be cleaned and delivered as specified in Section 2-02.3(7).

7-20.3(6) ADJUST BY SHAFTING

Adjustment of existing utility casting and Structure shall be by shafting when the casting remains the same and one of the following conditions exists:

1. The casting is to be raised, resulting in a total depth of the adjustment brick zone greater than the maximum allowable as indicated on the Standard Plans; or
2. The casting is to be lowered more than the depth of the existing adjustment brick or in excess of 16 inches.

Work required shall include excavation, removal of the existing frame and cover, leveling bricks, cone section or flat slab of the utility structure. The Contractor shall add to or remove from the utility structure as appropriate, the vertical riser section having the least dimension, unless otherwise indicated on the Drawings, to allow the structure to be adjusted to the new grade elevation. The cone section or flat slab shall be reinstalled, adjustment bricks installed, and the existing frame and cover reset. The surrounding void shall be backfilled and compacted in accordance with Section 7-17.3(3).

7-20.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Adjust by Shafting" will be by the vertical foot of adjustment, from original grade to finish grade.

7-20.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-20 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "Adjust Existing Manhole, 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)" shall include 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. "Adjust Existing Manhole, Catch Basin or Valve Chamber With Ring Extension", per each.
7. "Adjust Existing Inlet With Ring Extension", per each.
8. "Adjust Existing Monument Frame and Cover With Ring Extension", per each.
9. "Adjust Existing Valve Box With Ring Extension", per each.

The Bid item price for "Adjust Existing (Item) with Ring Extension" shall include all cost for the work required to furnish and install the required ring extension.

In the case where the Contractor is required to adjust a casting with ring extension as well as making an adjustment by removing or adding adjustment bricks, the Contractor will be compensated for the work under the Bid items "Adjust Existing (Item)" and "Adjust Existing (Item) with Ring Extension".

10. **“Adjust By Shafting”**, per vertical foot.

The Bid item price for “Adjust by Shafting” shall include the costs for all work required to modify the existing structure and complete the adjustment to the grade elevation as specified.

11. **“Utility Casting, (Type)”**, per each.

The Bid item price for “Utility Casting, (Type)” shall include 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 manhole is required to be rebuilt to accommodate a new casting, the cost of the utility casting shall be included in the price Bid for the Bid item “Rebuild (Item)” per Section 7-05.5 where “item” is “manhole”.

12. **Other Payment Information.**

Costs for adjustment to finish grade of water meter boxes excluding adjustment of the water meter itself; small castings other than inlet, catch basin, manhole, 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, shall be included in the Bid item prices for the applicable Bid items and no separate payment will be made.

Mineral Aggregate ordered as backfill in lieu of native Material will be paid as "Mineral Aggregate, (Type)".

Restoration of the roadway surface shall be in accordance with the applicable Section covering the work involved.

The costs for asphalt or cement concrete used to secure castings prior to paving shall be 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 shall be 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)E, 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.

7-21 NATURAL DRAINAGE SYSTEMS

7-21.1 DESCRIPTION

Section 7-21 describes work consisting of the construction of natural swales alongside vehicular and pedestrian traffic areas to receive surface runoff for infiltration.

7-21.2 MATERIALS

Materials for natural drainage systems will be specified in the Contract and may be one or more of the following:

Natural Drainage Soil and Amendment	9-14.1(3)
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7-21.3 CONSTRUCTION REQUIREMENTS

7-21.3(1) GENERAL

Natural drainage systems are to act both as a filter and to provide a medium for stormwater infiltrating into subsurface soils. When placed as a topping soil, or when placed and mixed with native soils, the Contractor shall employ methods limiting compaction of natural drainage soils to a relative density not exceeding the maximum specified.

Natural drainage soils shall be protected from all sources of additional moisture at the Supplier, in covered conveyance, and at the Project Site until incorporated into the Work. Natural drainage soil placement will not be allowed when the ground is frozen or excessively wet, or when the weather is too wet as determined by the Engineer.

When the Contract specifies testing by a Contractor provided testing laboratory, the laboratory shall be an AASHTO or ASTM or other designated recognized standards organization accredited laboratory with certification maintained current, and Capable of performing all tests to the designated recognized standards specified, and shall provide test results with an accompanying Manufacturer’s Certificate of Compliance.

7-21.3(1)A SUBMITTAL

At least 5 Working Days in advance of construction, the Contractor shall submit to the Engineer for approval, a Manufacturer’s Certificate of Compliance for the natural drainage soil and component parts demonstrating compliance with the Material Specifications including a 2 gallon minimum size sample provided in an impermeable container. The submittal shall also include an adequate description of the equipment and methods proposed to produce the specified construction.

When the Contract specifies the Contractor to provide a testing laboratory, the submittal shall also include the following information about the testing laboratory: name of laboratory including contact person, address, phone contact, e-mail address; qualifications of laboratory and personnel including date of current certification by ASTM, AASHTO, or approved equal; years in business; description of facilities, and a list of at least three (3) projects within one the year prior to Award of Contract (name of project, project owner, contact person, phone contact, and e-mail address) with the same or greater testing requirements as required in the Contract.

7-21.3(2) NATURAL DRAINAGE SOIL TYPE 1 CONSTRUCTION

At the locations shown on the Drawings, the Contractor shall excavate, grade, and shape to the contours indicated to accommodate the placing of Natural Drainage Soil Type 1 to the thicknesses required. Excavated soil shall be disposed of, or reused elsewhere as a selected material (see Section 2-03.3(10)) as the Contract may specify or the Engineer will allow.

Natural Drainage Soil Type 1 shall be placed in loose lifts not exceeding 6 inch thickness and compacted by proof rolling. The Contract may specify both a minimum and a maximum relative density as a compaction standard.

The minimum coefficient of permeability shall be minimum 1 inch per hour per ASTM D 2434 at a relative soil density adjusted to replicate 85% as determined by ASTM D 1557.

7-21.3(3) NATURAL DRAINAGE SOIL TYPE 2 CONSTRUCTION

At the locations shown on the Drawings, the Contractor shall excavate, grade, and shape to the contours indicated to accommodate the placing of Natural Drainage Soil Type 2 to the thicknesses required. Excavated soil shall be transported to an area where Natural Drainage Soil Type 2 may be prepared.

Natural Drainage Soil Type 2 shall be prepared by mixing 35% Bioretention Soil Type 2 with 65% excavated soils by volume and then thoroughly mixed to form a homogeneous blend. This soil shall then be returned to the excavated area and placed and compacted as a cover material to the thickness indicated. The excavated area shall be cleaned of debris and other deleterious material prior to placement of natural drainage system soil.

Natural Drainage Soil Type 2 shall be placed in loose lifts not exceeding 6 inch in thickness and compacted by proof rolling. The Contract may specify a relative density, or range of relative densities, to be obtained as a compaction standard for the placed soil. The Contractor shall be prepared to employ compaction methods limiting the upper range of compaction.

Prior to placement of Engineered soil, Contractor shall submit certified laboratory test results verifying organic content and permeability of the soil mixture. Organic matter shall range from 4% to 10% as determined by ASTM D 2974. The minimum coefficient of permeability shall be 4 inches per hour as determined by ASTM D 2434 at a relative density of 80%.

The coefficient of permeability shall be minimum 1 inch per hour as specified in ASTM D 2434 at a relative soil density adjusted to replicate 85% as determined by ASTM D 1557.

7-21.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for Natural Drainage Soil Construction (Type) will be by the cubic yard.

7-21.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-21 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "Natural Drainage Soil Construction (Type)", per cubic yard.

The Bid item price for "Natural Drainage Soil Construction (Type)" shall include all costs for the work necessary to furnish, place, compact, excavate, grade, shape, mix, dispose of, and as necessary.

7-22 DIRECTIONAL DRILLING

7-22.1 GENERAL

For underground construction or trenchless construction other than directional drilling, see Section 7-17.3(2)J.

Directional drilling is an underground excavation method using a steerable system for installing pipe, conduit and cable using a surface launched drill rig. A fluid-filled pilot bore is drilled using a fluid-driven motor, and the bore is then enlarged by pre-reaming when necessary, and back reaming to the size required for product pipe installation. The drill head steers the pilot boring. The location, depth, and dimension of existing underground facilities, including appurtenances as may exist, within and near the proposed bore path are identified and located, and the bore path alignment and profile through these underground facilities is planned. The location and depth of the drill head following this planned bore path is monitored and known at all times. Notifications and coordination with others whose underground facilities exist along the bore path are pre-arranged and timely made.

7-22.2 MATERIAL

Product pipe, and casing pipe when required, shall be as specified in the Contract.

The tensile strength of product pipe joints, and of casing pipe joints when casing is required or proposed, shall be of sufficient strength to withstand installation stresses and frictional resistances for the size, length, and curvature of the bore.

7-22.3 CONSTRUCTION REQUIREMENTS

7-22.3(1) EXPERIENCE AND QUALIFICATIONS

See the submittal requirement of Section 7-22.3(6)B.

In addition to requirements listed elsewhere in the Contract, the directional drilling crew, whether Contractor or Subcontractor, shall have acceptable training; operational experience; a thorough understanding and working knowledge of all functions of the drilling operation; the ability to promptly identify and correct anything out of the ordinary when it becomes obvious; experience in coordinating drilling operations with facility owners whose facilities may be near or along the bore path; and knowledge of all legal and regulatory requirements that apply to the entire drilling operation.

Acceptable experience shall be interpreted as the operator, and the locator tracking the drill head, each having no less than three (3) full years current directional drilling experience including working knowledge of any industry upgrades related to directional drilling. The crew shall have in-place a coordinated communications system and method of operations to, at all times, maintain control, and readily and promptly recognize and respond to problems.

The drilling Contractor or Subcontractor shall have written guidelines and procedures defining all crew members duties and responsibilities including procedure for identifying and avoiding "strikes" on any type underground facility including appurtenance. Such procedure may include a description of partnering with owners of underground facilities to prevent underground "strikes".

Acceptable training shall be interpreted as the following:

1. In possession of and following the "Horizontal Directional Drilling Good Practices Manual" as developed by a consortium of six (6) industry associations including the North American Society for Trenchless Technology (NASTT), or having and practicing directional drilling guidelines as developed by a consortium of designated and recognized industry organizations having expertise in horizontal directional drilling, drilling equipment, Supplies associated with drilling, and as may be applicable to directional drilling.
2. Attendance at seminars, meetings, and training sessions specific to, or including directional drilling.

The Contract may require additional evidence of experience be provided where drilling is required in sensitive areas (such as but not limited to critical habitat area with threatened or endangered species, wetland, under a river or stream, etc.); where existing underground infrastructure is dense or critical; and as may apply.

7-22.3(2) DRILLING EQUIPMENT

All drilling equipment, whether direct or supporting, shall be well maintained, kept reasonably clean, and have fresh oil, good working parts and packings. Hoses and hose connectors shall be in good working order and have no flaws, and hose connections shall be as recommended by the manufacturer. Flow meters and pressure reading gauges shall be calibrated in accordance with manufacturer's recommendations.

The drilling Contractor or Subcontractor shall have a preventative maintenance program in-place. Such a program shall address regular inspecting and maintaining the drill head, drill frame, engine, hydraulic system, drilling fluid pump, drill pipe and downhole tools, and walk-over tracking system. The drilling Contractor or Subcontractor shall also have a maintenance log showing dates and types of maintenance for the various components. This log shall also show repairs, if and when needed, which equipment part or parts were repaired, what the repair consisted of, and when the repair occurred.

A competent crew member shall inspect and verify each segment of drill string as structurally sound with no cracks, no excessive wear, continuous threads, and no flaws whatsoever before incorporating for use in the drilling operation. Defective drill string will not be allowed and will be considered unauthorized work.

The drilling Contractor or Subcontractor shall be qualified to perform necessary and reliable equipment operation and inspection including the reliability of the drill head locating system. The driller shall also be qualified or have ready access to qualified expertise as may be necessary, in maintaining and repairing the equipment.

7-22.3(3) PROPOSED BORE PATH - PREPARATORY REQUIREMENTS

7-22.3(3)A GENERAL

Before any directional drilling activity begins, the Contractor shall make preparatory measures as applicable and as described in Section 7-22.3(3) and as may be specified in the Contract.

The proposed bore path alignment and profile shall be shown on a plan and profile Shop Drawing including showing drill head and drill string clearances from all identified underground facilities (see Section 7-22.3(20) re: As-Built Drawings).

7-22.3(3)B EXISTING UNDERGROUND FACILITIES

The Contract will identify along and near the proposed bore path, the plan and profile locations of known existing underground facilities and their appurtenances, and other underground features and improvements as they relate to the proposed bore path.

When the Contract specifies a minimum depth of bore and indicates the proposed bore path is below existing underground facilities identified in the Contract, such information provided in the Contract will also identify locations, dimensions, depths, and lengths of permanent ground anchors and deadman systems as may exist.

7-22.3(3)C ONE NUMBER LOCATOR SERVICE – ADDITIONAL REQUIREMENTS

In addition to the requirements of Section 1-07.17, the excavator in its notification to One Number Locator Service, shall provide the following information:

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, and range of proposed depths of bore,
3. that the proposed bore path will be adequately surface marked its entire length to aid One Number Locator Service utility locators, and
4. as may be applicable, request "marking" of service laterals and appurtenance, as may be near or along the proposed bore path.

Before notifying One Number Locator Service, the proposed borepath shall be surface marked at regular and frequent intervals unless surface features require increasing or decreasing an interval spacing. These surface markings shall be in accordance with the APWA Uniform Color Code. In areas where surface markings cannot be accommodated or may not be allowed, stakes shall be used and the excavator shall alert One Number Locator Service of such staking.

7-22.3(3)D EXPOSING EXISTING UNDERGROUND FACILITIES

The Contractor shall be prepared to expose underground facilities along the proposed bore path, if the location and depth of facility is indicated near the proposed bore path as can reasonably be done. Such exposure may include a sufficiently sized excavation to allow adequate visual inspection of the underground facility and its environment including the determination of the utility's depth, dimensions, type bedding, appurtenances, and foundation support.

In addition, the Contractor shall be prepared to expose any portion of select underground facilities to a dimension to accommodate examination for damage as law may require.

Such exposure may be required in advance of the drill head reaching the vicinity of the facility such that the drill head can be visually verified complying with a specified clearance.

7-22.3(3)E UNDERGROUND FACILITIES – NO DEPTH INFORMATION OR UNLOCATABLE

For identified but unlocatable underground facilities, and where a facilities depth or its dimensions or appurtenances associated with the facility are unknown, the Contractor shall request the facility owner to provide the best available information.

Where an underground facility is identified and its depth or its dimension or appurtenances associated with the facility are unknown, the Contractor shall request the facility owner to provide the best available information.

The Contractor shall be prepared to expose by excavation, such facilities to verify as needed, location, depth, dimension of facility, appurtenance as may exist, and any bedding rigid and otherwise as they relate to the proposed bore path.

7-22.3(3)F SERVICE LATERAL CONSIDERATIONS

The Contractor shall be aware that an owner of underground facilities is not required to indicate the presence of existing service laterals or appurtenances if the presence of existing service laterals or appurtenances on the site of the construction project can be determined from the presence of other visible facilities, such as buildings, manholes, or meter and junction boxes on or adjacent to the construction site.

The Contract will show the existence of service laterals known to exist by the Engineer at the Project Site.

Proposed directional drilling shall require that identified service lateral facilities be visually identified if near the bore path (see Section 7-22.3(3)C).

The Contract may require advance notification and coordination with public and private underground facility owners with service laterals in the vicinity of proposed bores. In addition, underground facility owners may also require the excavator provide advance notification, coordination, and exposure of facility.

7-22.3(3)G SELECT UNDERGROUND FACILITIES – SPECIAL REQUIREMENTS

Unless the Contract specifies otherwise, in preparing for drilling and when advancing the drill head, it may be necessary that the following underground facilities, and appurtenance as may apply, be adequately exposed to verify the drill head safely clears the underground facility. These exposure locations shall be in alignment with the proposed borepath or advancing drill head. In addition, other underground facility owners may also request this exposure. Such exposure may also apply to service laterals.

Clearance requirements listed in this Specification may be greater than those listed in Section 1-07.7(2) and if such be the case, these listed clearances shall take precedence. If no clearance is specified in this Specification, the clearances specified in Section 1-07.17(2) shall apply.

Select underground facilities that may require such visual verification include, but not limited to, the following:

1. **Seattle City Light electrical transmission and distribution facilities:** No directional drilling will be allowed within the clearance limits of a Seattle City Light underground electrical facility as specified in Section 1-07.17(2) unless SCL has pre-approved such in writing. Should drilling be within or have the appearance of possibly being within said clearance, the Contractor shall make the notification required in Section 1-07.28 item 8C at least 10 Working Days in advance of entering said clearance. Unless the Contract specifies otherwise, the Engineer may require an Electrical Safety Observer be present when the drill head is within said clearance (see Section 1-05.2(2)).
2. **Fiber optic and other communications facilities:** Owners of fiber optic and other communication underground facilities will specify any clearance, notification, and other requirement when such facilities exist at the Project Site. Such communication facilities also include data transmission and control systems that may exist as appurtenance associated with pump stations, electrical stations, Water Main valves, and other type facilities.
3. **Gas facilities:** Other than "pipeline" or "pipeline system", the owner of underground gas facilities may specify clearance, notification, and other requirements regarding their facilities at the Project Site. Also see Sections 1-07.17(1), 1-07.17(2)D and 1-07.28 item 18 for Puget Sound Energy gas facility clearances and notifications, respectively.
4. **MetroKC Sewer and Storm Drain:** MetroKC will specify any clearance, notification, and other construction requirement when MetroKC Storm Drain, or Sewer exist at the Project Site.
5. **"Pipeline" or "pipeline system":** The Contractor shall comply with Ch 19.122 RCW.
6. **Water Main:** Clearance from Water Main, appurtenance, and surrounding bedding shall be a minimum three (3) feet beyond the neatline dimensions as indicated on the 300 series Standard Plans.
7. **Underground ground support systems:** Ground support systems and deadman anchor systems may exist within the Project Site and may be in the vicinity of a proposed bore path. Such ground support systems may be tiebacks, ground anchors, soil nails, deadperson systems, and other similar type systems. Such ground support

systems are used for permanent and for temporary purposes, and may be loaded or unloaded. The Contractor shall plan the bore path to avoid such ground support systems. Permanent ground support systems known by the Owner to exist at the Project Site will be shown in the Contract.

The Contract may specify clearances, notifications, and other requirements for other underground facilities not listed above.

The Contractor shall also be prepared to accommodate any request of the owner of an underground facility the Contract does not address where the proposed or actual bore path crosses or is within a clearance as defined by that facility owner. When such happens, the Contractor shall promptly notify the Engineer.

7-22.3(3)H VERIFICATION OF FACILITIES - EXISTING AND AS INDICATED IN THE CONTRACT

In preparing a drilling bore path alignment and profile, the Contractor shall verify and compare the as indicated in the Contract underground facility locations, depths, dimensions, and appurtenances, with the actual facility locations, depths, dimensions, and appurtenances, and with the proposed bore path alignment and profile.

Where conflict is indicated, such conflict shall be resolved before drilling can begin.

7-22.3(4) PROGRESS SCHEDULE CONSIDERATION

The Contractor's Progress Schedule shall take into consideration the two (2) phases of directional drilling as follows:

- | | |
|---------|--|
| Phase 1 | This preparatory phase shall accommodate exploration and discovery, and may require possible suspension for this portion of Work, or suspension of the Work to address a safe and coordinated, drilling operation and bore path alignment and profile, and |
| Phase 2 | The actual drilling operation. |

Drilling shall be completed in one continuous and uninterrupted operation, unless conditions arise that require interruption. Such conditions include, but are not limited to, health and safety, damage or the potential for damage, environment, permit, and "frac outs".

7-22.3(5) ACTIVE AND PASSIVE INTERFERENCES AND DRILLING EQUIPMENT

In preparing for the drilling, the Contractor shall "walk the proposed bore path" with locating equipment as it relates to tracking the drill head, and shall identify areas of active interferences and passive interferences that may impact location readings of the drill head by the Contractor's locating equipment.

Such interference areas shall be identified on the proposed bore path alignment and profile Shop Drawing.

The Contractor shall be prepared to discuss how the actual drill head location, depth, and direction shall be determined, and be kept on the proposed alignment and along the proposed profile where such interferences exist.

The Contractor locator shall "locate" the drill head in all indicated interference areas and shall record the readings in the Daily Log and as-Built Drawings.

7-22.3(6) SUBMITTAL

7-22.3(6)A GENERAL

Unless the Contract specifies otherwise, the submittal on Qualifications shall be returned from the Engineer to the Contractor (Section 7-22.3(6)B), before the Contractor submits the Preparations Required Before Beginning Drilling (Section 7-22.3(6)C). (NOTE – the Qualifications Submittal may be required as part of the pre-award information process (Section 1-03.1(4) and shall not be a substitute for this submittal requirement.)

7-22.3(6)B SUBMITTAL – QUALIFICATIONS

At least 10 Working Days in advance of beginning preparatory requirements, the Contractor shall submit information describing qualifications of crew, equipment, and drill head tracking, as follows:

1. Identify the directional drilling crew members including operator and locator, and mudperson as may apply, and include a description of directional drilling experience, training, and qualifications to perform a safe and acceptable installation. Unless the Contract specifies otherwise, a list of the most recent three (3) directional drilling projects for these crew members shall be included showing:
 - 1) each project's name and total price paid by the project owner for the drilling;
 - 2) the project owner, an owner contact person knowledgeable of the drilling, current contact phone number, and e-mail address;
 - 3) type and size of pipe installed, and if casing used, size and type of casing including annular space filler if used;
 - 4) length and range of depths of bore, and if any curvature in the bore path, why and what were the circumstances;
 - 5) site conditions for each project including underground infrastructure density and types, active and passive interferences and how dealt with, groundwater and controls, and a description of drill head depth and location verification procedure as it related to the proposed bore path alignment and profile;
 - 6) any specific constraints required of the drilling, such as drilling on a slope or in a critical habitat area or under a body of water or in a very dense underground infrastructure environment or near critical underground infrastructure, and how addressed; and

- 7) problems encountered including whether they were identified before the drilling began or were encountered during the drilling, and how resolved.

In particular, 1 of these projects shall be similar to site conditions and contractual constraints similar for this project to assist the Engineer in evaluating qualifications.

2. List and describe the equipment and Supplies as they relate to the directional drilling. The submittal shall indicate that all equipment is safe, fully operational, maintained as recommended by the equipment manufacturer, and is in a condition to acceptably and safely perform the drilling. Describe how the operator maintains control of the drill head and how the operator knows the condition and status of all associated with the drill head to maintain the proposed bore path alignment and profile. The submittal shall include the manufacturer, make, model, and year purchased for the drill rig, and parts thereof if not of the same manufacturer. The submittal shall also include the drilling equipment manufacturer's recommended as well as the actual maintenance and repair program.
3. Describe the "locate" equipment and procedure used by the locator to track the drill head. Describe how the Contractor ensures the "located" drill head location and depth readings match the actual location and depths in areas of passive interference, in areas of active interference, and in non-interference areas. Describe equipment or portion of equipment used by the operator to know the location, depth and attitude of the drill head, and how the drill head's projected bore path relates to avoiding identified underground facilities including clearances and appurtenances as may apply. Describe the type and strength of battery used in the drill head, the calibration of drill head transmitter with Contractor locator receiver, and how the Contractor evaluates these needs for Project Site conditions and proposed bore.

7-22.3(6)C SUBMITTAL - PREPARATIONS REQUIRED BEFORE BEGINNING DRILLING

After the Engineer returns the qualifications submittal to the Contractor without requiring resubmittal, and before beginning drilling, the Contractor shall submit it to the Engineer at least 10 Working Days in advance, the following information indicating a well-planned and safe drilling operation:

- 1) A plan and profile Shop Drawing of the proposed bore path alignment and profile full length showing all existing underground facilities as they relate to the drilling including appurtenance as may exist, clearances as may be required, areas of active and passive interference, locations of launch and receiving locations or pits, and safe working zone.
Also see Section 7-22.3(20)C for As-Built Drawing requirements.
- 2) In areas of active and passive interference, explain how these interferences may impact knowing where the drill head is, where the drill head is going, what the attitude of the drill head is, the degree of uncertainty, and explain how the Contractor intends to compensate for these interferences and uncertainty ensuring the drill head follows the proposed bore path alignment and profile.
- 3) Describe the bend radius Capability and limitations of the drilling equipment, including drill head, drill string, product pipe, casing if required, product pipe joints, and drill string joints. Also describe how the Contractor ensures stresses at pipe joints do not exceed joint strengths recommended by the drill string and product pipe manufacturer.
- 4) List all underground facilities' owners where notification, coordination, and uncovering arrangements have been arranged including who the contact is, how contact is made, and any pre-arranged requests of these owners.
- 5) Describe the drilling mud and component parts, and in particular, how monitor the mud quality, filter the mud, and how adjust the mud for filter cake and gel strength needs as the drill head advances and mud conditions indicate.
- 6) Describe the controls to prevent environmental pollution, to stay within environmental constraints where specified in the Contract (such as drilling under bodies of water or in wetlands or in critical habitat area or other area as defined in SMC 25.05.098, etc.), and how containment of drill waste is proposed in the launch and receiving locations or pits. If groundwater is indicated and may exit at the launch or receiving areas, describe proposed treatment facilities and how discharge.
- 7) Describe controls to maintain safe working conditions and conditions safe where the public may be at risk, such as at the launch location and receiving location.
- 8) If drilling on a slope, see Section 7-22.3(17).
- 9) Provide MSDS for all Supplies and materials as may be used.
- 10) If the proposed bore path is deep to avoid underground utilities, describe and show the locations of permanent ground support systems, underpinning, and deadman systems, and how the proposed bore path does not interfere with or damage such ground support systems.
- 11) Provide copies of all permits required and obtained for the drilling operation if not required by other Specifications.

No drilling will be allowed until the Engineer has reviewed and has returned this submittal, with no requirement for resubmittal.

7-22.3(7)C SUBMITTAL – REQUIRED AFTER COMPLETION OF DRILLING

Within 5 Working Days of completing the installation of product pipe in the bore, the Contractor shall submit a copy of the Daily Log and As -Built Drawing as specified in Section 7-22.3(20).

7-22.3(8) PRE-DRILL MEETING AND OTHER MEETINGS

Before the Contractor begins directional drilling, and on each day of directional drilling as may apply, a pre-drill meeting shall be held with the Contractor, drill operator and locator, and the Engineer. 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 verbally walk through the proposed bore path and drilling operation; notifications and coordinations; location specific controls and monitoring; open communication channels between the driller, Contractor and Engineer; required entries to the Daily Log and updating of the As-Built Drawings; ensuring the drilling is conducted safely and is under control; that the actual drilling alignment and profile matches the proposed submitted bore path alignment and profile; as the Engineer may determine; and as the Contractor may need to be made known.

7-22.3(9) MONITORING THE BORE

The Contractor shall verify to the Engineer that the Contractor's directional drilling results in the following:

1. the actual bore path of the drill head follows the proposed bore path in both alignment and profile, and
2. the indicated readings of depth and location of the drill head by the Contractor's locator match the actual location and depth of the drill head as verified by exploratory or other type excavation, and
3. all underground facilities are identified and that there locations are confirmed, and the bore path indicates clearances with all underground facilities.

Unless the Contract specifies otherwise, the Contractor shall within the first 50 feet of the launch location or pit and at additional locations determined by the Engineer, make a surface locate reading of the drill head location and depth, and shall then mark the surface directly over the indicated drill head location with the read location and read depth.

At locations of active interference and at locations of passive interference, the Contractor shall make surface readings of the drill head location and depth, and shall then mark the surface directly over the indicated drill head with the locator indicated location and depth.

At any time and at any location, the Engineer may require the Contractor to locate the drill head and read its depth, and mark the surface as described in the previous two paragraphs.

At any of these drill head reading locations and as the depth of the drill head may allow, the Engineer may require the Contractor to provide exploratory or other type excavation in advance of the drill head to enable visual verification of the drill head passing through the excavation including verifying drill head depth.

Should a discrepancy be identified including, but not limited to:

- 1) the indicated reading of the location or the depth of the drill head differing from the proposed bore path alignment or proposed profile.
- 2) the indicated reading of the drill head's location or depth differ from the actual visual verification of drill head location or depth,

then such a situation may be considered defective work or unauthorized work.

Directional drilling discrepancy that reasonably appears to potentially create an unacceptable condition, including, but not limited to:

- (1) an unsafe or potentially unsafe condition, or
- (2) that may result in damage or the potential for damage, or
- (3) that may be in violation of law, regulation, code, or other condition of the Contract,

may be cause for the Engineer to order the drilling operation be stopped in its entirety.

When such a condition occurs, the Contractor shall submit a remedy that addresses, as applicable:

- a. controls or adjustment of controls that indicate the drill head shall proceed with the attitude of staying on the proposed alignment and profile,
- b. correction of the current drill head attitude to return the drill head to the proposed alignment and profile,
- c. controls or adjustments to locating and tracking equipment ensuring locator indicated drill head location and depth actually match actual drill head location and depth,
- d. if the difference in actual location or depth of the drill head and the proposed alignment and depth of the drill head is significant, and underground facilities are indicated near or in the path of the advancing drill head, then the Contractor may be allowed to propose a corrected bore path alignment and profile from its existing location to return to the submitted bore path alignment and profile, and shall indicate both where that return location shall be and that the attitude of the drill head at the proposed return location is aligned with the proposed bore path alignment and profile. Such remedy may require additional applicable preparatory work as may be necessary in accordance with Section 7-22.3(3) ensuring clearance with all underground facilities.
- e. if the difference in actual location or depth of the drill head and the proposed alignment and depth of the drill head is significant, and underground facilities are indicated near or in the path of the advancing drill head, then the Contractor may be allowed to propose pullback and redrill. See Section 7-22.3(21).

The Contractor may resume drilling after the Engineer returns the proposed remedy without requiring resubmittal.

Should the Contractor not be able to restart drilling, this will be considered defective work.

All Contractor located drill head location and depth readings, and actual visually verified depth and location readings, shall be shown on the plan and profile Shop Drawing as it relates to the proposed bore path, and shall be recorded in the Daily Log.

As necessary and where necessary, the Contractor shall also “step outside the proposed bore path” to aid in making more accurate locate readings of actual depth and actual location of the drill head where interferences exist.

7-22.3(10) LOCATE TRACKING SYSTEM

The drill head locate system shall be of the strength and type for tracking with the greatest confidence, the drill head following the intended bore path alignment and profile including providing readings in areas of indicated active and passive interferences. The batteries in the transmitter and receiver shall be fresh, and shall be of the strength and type required for the conditions expected of the proposed bore path and Project Site conditions. The transmitter at the drill head shall be adequately calibrated with the receiver to overcome indicated interferences including obtaining readings that may be required on either side of the bore path where such information increases confidence of the readings.

At the beginning of each shift, and at the beginning of each day, the tracking and locating equipment shall be calibrated.

Locator readings, exploratory and other type excavation verification, and the status of batteries and locating equipment including any repair shall be recorded in the Daily Log and on the As-Built Drawings as applicable (see Section 7-22.3(20)).

7-22.3(11) LAUNCH AND RECEIVING LOCATIONS AND PITS

Unless the Contract specifies otherwise, the Contractor shall select the locations of the launch (entry) and the receiving (exit) locations best suited for all necessary for the directional drilling operation. Such entry and exit locations may be pits or excavations. As necessary and where necessary, such locations shall include adjacent area for safe working zone (Section 7-22.3(19)); support, staging, and related needs; bend radius considerations (Section 7-22.3(13)); bore path alignment and profile and clearances with existing underground infrastructure (Section 7-22.3(3)); depth of the launch pit and the receiving pit to allow for entry and exit angles; entry and exit pipe elevation; containment of drill waste (spoils), groundwater treatment and discharge, and as may be identified for safe and acceptable performance.

7-22.3(12) MATCH SITE CONDITIONS

The Contractor shall match the drill equipment and Supplies to the soils and Project Site conditions.

7-22.3(13) BEND RADIUS

The Contractor shall take into consideration the allowable bend radius capabilities of drill string, product pipe, casing pipe when applicable, and the drilling equipment. Bending at any joint of drill string or any pipe shall be within that product manufacturer's recommended tolerances.

These bend radius considerations shall be taken into consideration in proposing the bore path alignment and profile including expected directional adjustments along bore path. The allowable bend radius of product pipe, of casing pipe when applicable, of drill string, and of drill equipment shall be compatible and shall not present a condition for overstressing pipe, joint, casing when applicable, drill string, and equipment.

7-22.3(14) PREREAMING AND BACK REAMING

Prereaming may be necessary to incrementally enlarge a pilot bore to a size to accommodate acceptable product pipe installation. Backreaming enlargement of the bore hole shall allow for minimizing frictional resistance during installation of the product pipe, and for allowing removal of spoils while installing the product pipe. Pipe joint tensile and bend strengths shall not be exceeded during product pipe installation.

7-22.3(15) DRILLING MUD

For the drilling mud, the Contractor shall maintain and adjust “filter cake” and “gel strength” needs; shall have adequate monitoring equipment and Supplies in-place to clean mud for re-use; shall amend mud with additives as progress and conditions dictate; and shall maintain adequate quantity of mud as the bore progresses and as the mud quality indicates.

The Contractor shall continuously monitor mud quality and spoils content as they relate to “filter caking” and “gel strength”.

When excessive spoils content in the mud is indicated for a relatively short length of bore progress, the Contractor shall note such in the daily log including the location and depth of the drill head when such condition is noticed, any underground facilities that are near or over or under the drill head, the type spoils or description of spoils to indicate the material being “lost”, and the date and time of day this occurs. The Contractor shall also immediately notify the Engineer of this condition and shall be prepared to stop the drilling if a condition exists where an excessive loss of soil may have detrimental impacts to surface or other underground improvements. The Contractor shall confirm that excessive loss of soil is not occurring and is not adversely impacting any existing facility or improvement.

The Contractor shall identify locations of “frac outs” or “uncontrollable loss of mud” along the bore path as they are indicated. This information shall be entered into daily log and shall include location of drill head, depth of drill head; time of day; date; estimated amount of lost mud; and if a surface loss, how contained and cleaned up.

7-22.3(16) ENVIRONMENTAL CONTROL

The Contractor shall employ environmental controls in containing and handling spoils, mud, waste, additives, and other pollutants of any kind that are in compliance with law, code, regulation, and as may be required in the Contract.

The Contractor shall also have on-call and shall be able to respond within very short notice, a vector truck with a minimum two (2) cubic yard storage capacity and with adequate ability to extract, any drill waste or mud that may appear at any location at any time, such as a "frac out". Other Supplies that absorb and contain mud and as may be associated with the drilling shall be readily available. Also see Section 1 -07.5 for required environmental controls.

The Contract may specify additional constraints when proposed drilling is within environmentally critical areas, critical habitat areas, other sensitive areas, and as required by permit.

7-22.3(17) SLOPE DRILLING AND SUBMITTAL REQUIREMENTS

When drilling on slopes, and in particular on landslide prone slopes, the Contractor shall have controls in-place to control the flow and release of groundwater and any resulting buildup of hydraulic head, the flow and release of drilling mud and any resulting buildup of hydraulic head, and the influence and control of vibrations resulting from any part of the directional drilling operation and product pipe installation.

The Contractor shall promptly cease drilling and shall promptly alert the Engineer of any condition where excessive groundwater is indicated and where the stability of the slope or any part of the slope may become questionable.

Unless the Contract specifies otherwise, prior to the start of any directional drilling on any slope, the Contractor shall include in its submittal to the Engineer, a detailed drawing and a description of controls of how the Contractor proposes to drill on the slope. The following shall be addressed in this submittal as may apply:

- 1) Direction of drilling all pilot holes, any pre-reaming, and the backreaming – upslope, downslope, or crossing the slope;
- 2) The control of drilling mud and groundwater hydraulic head build-up including how prevent the potential for sudden loss of fluid on the slope;
- 3) The influence of vibrations generated by any part of the directional drilling operations on the stability of the slope or parts of the slope including minimizing adverse impacts of vibrations;
- 4) Installation of any temporary subsurface drain to assist in the relief of hydraulic build-up;
- 5) If drilling uphill, installation of any controlled outlet at the launch location or pit that captures and controls groundwater and drilling mud that may follow the drill string, any required treatment and how discharge;
- 6) If drilling uphill, how lubricate the drill head;
- 7) If drilling downhill, how the build-up of hydraulic head along the drill string and at the drill head due to drilling mud and any groundwater is kept under control;
- 8) If drilling downhill, how remove spoils;
- 9) How the drill head location and depth will be tracked and verified on the proposed bore path alignment and profile, and the proposed frequency of locator tracking of the drill head;
- 10) How the Contractor shall reduce hydraulic head in any and all boring holes where pullback of the drill head has occurred and redrilling a new bore path is initiated. Also address how the abandoned bore path(s) is(are) backfilled, how hydraulic head build-up is prevented, and how stability of the slope is not reduced. See Section 7-22.3(21).

7-22.3(18) PERSONAL PROTECTIVE EQUIPMENT (PPE)

The Contractor shall comply with all applicable safety rules and standards including those recommended by designated and recognized directional drilling and trenchless technology industry organizations. All equipment shall be grounded. The operator's station shall be electrically isolated and protected. Boots, gloves and other as necessary clothing shall provide protection from potential hazards associated with directional drilling including contact with underground facilities.

7-22.3(19) SAFE WORKING ZONE

The area surrounding the launch location or pit and the receiving location or pit shall be secured as a safe working area to protect the public from potential hazards associated with directional drilling.

7-22.3(20) DAILY LOG AND AS-BUILT DRAWING

7-22.3(20)A GENERAL

The Contractor shall keep daily written records (a "Daily Log") of all daily progress and events, and a copy of the proposed bore path updated to reflect the actual bore path (As-Built Drawing).

The Daily Log shall be coordinated with and shall reference the As-Built Drawings, and the As-Built Drawings shall reference entries in the Daily Log where appropriate.

The Daily Log and As-Built Drawings shall be kept at the Project Site and shall be made available to the Engineer upon request.

See Section 7-22.3(7)C for submittal requirements.

7-22.3(20)B DAILY LOG

Entries to appear in the Daily Log shall be recorded as they occur, or if unable, a brief entry shall be made in the diary stating that additional explanation shall be provided at end of Working Day. Typical entries to the Daily Log shall reference entries on the As-Built Drawings as applicable and shall include, but are not limited to, the following:

1. notifications made to utility owners including date notified and a summary of any requirement made by the utility owner beyond a simple notification.
2. utility owners on-site visits including name of individual(s), phone and e-mail 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. for locations shown on the As-Built Drawings of locator tracking of the drill head and the indicated depth of drill head at that location, and if exploratory or other type excavation was used to verify location and depth of drill head, state the results. See Sections 7-22.3(9) and 7-22.3(10).
If in an area of active or passive interference, so state which interference and describe additional measures used to verify locator indicated drill head location and depth. See Section 7-22.3(5).
5. for As-Built Drawings showing exploratory and other type excavation's location and depth not addressed in preceding item 4, include a description of the purpose of the excavation and state the findings. Reference the As-Built Drawings where exploratory or other type excavation was used or was required to verify drill head clearance with underground facility, and state results including identifying which underground facility.
6. describe mud status including changes in, adjustments made to mud content or quality, and reasons for adjustment. State the distance of the drill head from the launch location or pit where adjustment to mud content was required. Also state the location of the drill head when a significant loss of mud is indicated. See Section 7-22.3(15) for Daily Log entry requirements.
7. describe daily progress made. Start with time of day beginning drilling and list how far drill head advanced at each succeeding hour. Also list time of day of drill head reaching exit location, and state the time of day for items 1, 2, 3, 4, 5, and as applicable, 6, 9, and 10 of this Specification subsection.
8. describe how groundwater that flowed into any launch or receiving location or pit, and any dewatering that may have been done, was treated including how discharged or disposed of. See Section 7-22.3(11).
9. if pullback and redrill was performed, describe why such a condition occurred, the reasons for the revised bore path, and how the abandoned bore void was filled including description of void filling material.
10. describe pre-reaming and back-reaming as may be applicable, and the 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.
11. other information as may be required by the Engineer (Section 7-22.3(8)), by the Contract, or as may be necessary by the Contractor for documentation purposes.

7-22.3(20)C AS-BUILT DRAWINGS

The As-Built Drawing shall be the proposed plan and profile bore path alignment and profile and shall show existing underground facilities, including their dimension, depth, any appurtenance, and proposed and required clearances.

Unless the Contract specifies otherwise, As-Built Drawings shall be Shop Drawings on 24 inch by 36 inch 20 pound bond paper. Horizontal scale shall be 1" = 20' and vertical scale shall be 1" = 10'. The Contractor may provide a continuous sheet (any length greater than 36 inch) with a 24 inch minimum width and same horizontal and vertical scales.

As the bore progresses, the following shall be shown on the As-Built Drawing as applicable:

- 1) locations of entrance and exit locations, and details of pits if used. Identify safe working zone(s), locations of equipment and Supplies, and as may be used for the drilling. See Section 7-22.3(11).
- 2) locations of locator tracking of the drill head and the indicated depth of drill head at that location, and note that the surface was marked as specified in Section 7-22.3(9). If exploratory or other excavation was used to verify locator indicated reading, show the location of the exploratory or other type excavation performed in advance of the verification reading. Reference the Daily Log entry as to status of visual verification.
- 3) locations of active and passive interference, if applicable (Section 7-22.3(5)). Show locations and depth of exploratory or other type excavations verifying locator drill head readings (Sections 7-22.3(9) and 7-22.3(10)).
- 4) locations of underground infrastructure including depth to facility, dimension of facility, special bedding as may exist, and appurtenance associated with a facility. Clearly identify exploratory or other type excavation locations and depths as required by Section 7-22.3(3).
Clearly identify exploratory or other type excavation locations and depths that were performed during the drilling, and reference the entry in the Daily Log, including "pipeline" and "pipeline system".
- 5) clearly label proposed bore path alignment and profile (Section 7-22.3(6)C), and actual bore path alignment and profile if different. Show entry location and exit location angles for product pipe installation including size pipe and invert elevations at entrance and exit locations.

If the actual bore path alignment or profile or both differ from as shown in the Contract or as proposed (Section 7-22.3(6)C), the Contractor shall show both actual and proposed bore paths and shall clearly identify and label each.

7-22.3(21) PULLBACK AND REDRILL

Should a condition occur that requires pull back and redrilling, before attempting any pull back and redrill, the Contractor shall submit to the Engineer, the reasons for pulling back and redrilling; a procedure for the pull back describing in detail how the resulting void shall be filled with a suitable material; and shall indicate the new bore path alignment and profile.

Should the drilling be "frozen" or a condition arise where progress cannot be made, such a condition will be considered defective work or unauthorized work.

7-22.3(22) TESTING

The Contract may specify testing of the installed pipe or conduit, such as a test specified in Section 7-17.3(4).

7-22.4 MEASUREMENT

Measurements for “Casing Pipe, (Material), (Class), (Size), (Directional Drilling)”, and for “Pipe, (Material), (Class), (Size), (Directional Drilling)” will be by the linear foot of pipe and casing pipe actually installed and successfully tested. Measurement will be from end of pipe to end of pipe whether a pipe end is within a structure or not. No measurement will be made for pit whether an entry pit or an exit pit.

Measurement for “Preparation Required Before Directional Drilling” will be per lump sum.

Measurement for “Exploratory Or Other Type Excavation, (Directional Drilling)” will be per lump sum for all exploratory and other type excavation directly related to directional drilling.

7-22.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 6-02 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **“Preparation Required Before Directional Drilling”**, per lump sum.

The Bid item price for “Preparation Required Before Directional Drilling” shall include all costs for the work necessary to perform investigatory requirements including necessary exploratory and other type excavation, and to provide preparations required to complete the information in Section 7-22.3(6)C.

2. **“Casing Pipe, (Material), (Class), (Size), (Directional Drilling)”**, per linear foot.

The Bid item price for “Casing Pipe, (Material), (Class), (Size), (Directional Drilling)”, per linear foot, shall include all costs for the work required to furnish and install casing pipe. All cost for filling the annular space when required in the Contract shall be incidental to this Bid item and no separate or additional payment will be made therefore.

3. **“Pipe, (Material), (Class), (Size), (Directional Drilling)”**, per linear foot.

The Bid item price for “Pipe, (Material), (Class), (Size), (Directional Drilling)”, per linear foot, shall include all costs for the work required to directional drill all required by Section 7-22 except for other Bid items in this Section.

4. **“Exploratory or Other Type Excavation, (Directional Drilling)”**, per lump sum.

The Bid item price for “Exploratory Or Other Type Excavation, (Directional Drilling)” shall include all costs for the work required to perform exploratory or other type excavation to accommodate the requirements of Section 7-22.

Payment for exploratory and other type excavation related to preparation required before directional drilling shall be included in the Bid item “Preparation Required Before Directional Drilling” and no separate or additional payment will be made therefore.

5. **Other payment information.**

Payment for all cost for the Electrical Safety Observer shall be in accordance with 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 shall be incidental to the various Bid items and no additional or separate payment will be made therefore.

Payment for all costs for surface restorations associated with directional drilling shall be in accordance with the various Bid items in the Contract.

All costs for daily log shall be included in the various Bid items and no separate or additional payment will be made therefore.

All cost for submittals shall be as specified in Section 1-05.3.

DIVISION 8 MISCELLANEOUS CONSTRUCTION**SECTION 8-01 EROSION CONTROL****8-01.1 DESCRIPTION**

Section 8-01 describes work consisting of furnishing, installing, maintaining, removing, and disposing of temporary erosion and sediment controls to prevent erosion and scour, to treat sediment laden water for acceptable discharge, and to prevent the conveyance of sediment into surface waters, drainage systems, and environmentally critical areas.

8-01.2 MATERIALS

Materials shall meet the requirements of the following Sections:

RipRap and Quarry Spall	9-13
Erosion Control Materials	9-14
Geotextile	9-37

Unless the Contract specifies otherwise, erosion control geotextile shall be permanent erosion control, high survivability.

8-01.3 CONSTRUCTION REQUIREMENTS**8-01.3(1) GENERAL**

In general, Work involving erosion and sedimentation control within The City of Seattle limits shall comply with Section 1-07.15. Work involving erosion and sedimentation control within Seattle's Rights-of-Way not within The City of Seattle limits shall also comply with the requirements of the local jurisdiction.

In general, in doing the Work, the Contractor shall address measures that:

1. Prevent and control erosion and sedimentation processes,
2. Prevent and control scour and scour processes in water bearing channels,
3. Prevent transport of sediment,
4. Protect surface waters and drainage systems from entry of sediment and other construction byproduct,
5. Prevent erosion and sedimentation impacts to areas not designated for Work and
6. Coordinate erosion and sedimentation controls with scheduling of the Work.

Such measures may include, but not be limited to, one or more of the following:

- (1) Installing temporary ditches, berms, culverts, and other measures to control and redirect surface waters;
- (2) Installing temporary dams, settling basins, energy dissipaters, and other measures to detain water, prevent scour, and allow for sediment drop and controlled removal;
- (3) Installing measures controlling surfacing groundwater and dewatering discharges;
- (4) Installing temporary covers or otherwise protecting slopes, stockpiles, and exposed or disturbed soils from erosion and sediment producing processes;
- (5) Installing temporary work area perimeter and sediment transport prevention measures, such as silt fence, wattle, filter, and berm;
- (6) Treating sediment laden waters, and removing and disposing of sediment,
- (7) Installing sediment and debris removal controls for equipment entering and leaving designated Work areas, and
- (8) Installing temporary fencing, flagging, and other markings at boundaries of areas identified as not part of the Work.

8-01.3(2) TEMPORARY EROSION AND SEDIMENT CONTROL (TESC) SUBMITTAL

At the preconstruction conference, the Contractor shall be prepared to discuss temporary erosion and sedimentation controls. Following the outcome of these discussions, the Certified On-Site-Erosion Control Lead (ESC Lead) shall prepare and submit a TESC Plan as indicated in the table immediately following, unless the Contract specifies otherwise or unless agreed to otherwise at the preconstruction conference.

In the following Table, NTPD = Notice To Proceed Date.

Contract Time (Working days)	First TESC Plan Submittal	Final TESC Plan Submittal	Comment
≤ 30	See Final TESC Plan Submittal	TESC Plan for all Work is due on NTPD	Allow 5 Working Days for Engineer Review
30 < and ≤ 100	TESC Plan for first 15 Working Days is due within 5 Working Days of NTPD	TESC Plan for all Work is due within 10 Working Days of NTPD	Allow 10 Working Days for Engineer Review
100 <	TESC Plan for first 30 Working Days is due within 10 Working Days of NTPD	TESC Plan for all Work is due within 30 Calendar Days of NTPD	Allow 15 Working Days for Engineer Review

The TESC Plan shall show, as it relates to the Contractor's critical path schedule, the scheduling of installation, maintenance, phasing, and removal of erosion and sedimentation controls as it relates to the Work. Unless the Contract specifies otherwise, work areas to be addressed in this plan include as applicable:

1. The Project Site identifying staging, storage, stockpiling, non-Work boundaries, and other construction related areas;
2. Areas beyond the Project Site;
3. Transportation facilities including construction traffic routes and access/exit control areas on and off the Project Site;
4. Environmental Critical Areas, as defined in Ch 25.09 SMC, within or near the Project Site, such as geologic hazard areas, flood prone areas, riparian corridors, wetlands, fish and wildlife habitat conservation areas, and abandoned landfills;
5. Inlets, catch basins, ditches and channels whether dry or water filled, and other surface drainage facilities;
6. Surface waters such as streams, lakes, and other bodies of water; and
7. Identify areas of erodible soil not being worked that may be exposed that may exceed 4,000 square feet, or may be unprotected or uncovered for more than 2 calendar days.

The TESC Plan submittal shall include, but not be limited to, one or more of the following as the Contract may require, as the Work may require, and as the Work is scheduled:

- 1) Describe with Shop Drawings of sufficient scale and detail showing the Project Site, and the locations and types of temporary erosion and sediment controls. As necessary, show by a series of time sequence Shop Drawings, how TESC controls are to be installed, maintained, removed and coordinated with the Work and the progress schedule;
- 2) Describe how non-work areas will be identified and protected;
- 3) Describe the details and continuing maintenance of entrance and exit equipment wash areas;
- 4) Show locations with cross-sections as applicable and describe control details of existing and proposed ditch, berm, Culvert, pipe, sediment basin, basin outfall, scour control, inlet, catch basin, drain, bypass, subsurface drain and related feature;
- 5) Describe treatment processes for, controls of, and the disposal of waters resulting from dewatering, surfacing groundwater, and rainfall;
- 6) Describe protections and covering practices for stockpile, muck, and related deposits;
- 7) Describe the controls to prevent sediment, debris, and other pollutants from entering surface waters and drainage features;
- 8) 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 TESC applications;
- 9) The name of the Certified On-Site Erosion Control Lead (ESC Lead), qualifications, experience, and certifications directly related to temporary erosion and sediment control, and other information as the Contract and the Work may require, including how to timely contact. If the Work is of such a magnitude that 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 ESC Lead;
- 10) A schedule of typical inspections ensuring timely maintenance and repair;
- 11) Identify and provide timelines for submitting permit required or related documentation;
- 12) Provide details of seed mix, amendment, mulch, and protections for placing and establishing temporary seeded erosion control areas;
- 13) In areas where exposed erodible soil exceeds 4000 square feet or that may be unprotected for more than 2 calendar days, describe the controls and the proposed monitoring ensuring erosion and sedimentation shall not become non-compliant; and
- 14) Provide details of other TESC measures indicated in Section 8-01 as may be used in the Work.

The Contractor shall have at a designated location at the Project Site, and the ESC Lead shall have immediately available, copies of the current TESC Plan.

8-01.3(3) MAINTAINING TESC PLAN CURRENT

During the course of the Work, the Contractor and On-Site Erosion Control Lead shall be prepared to discuss with the Engineer the status of TESC controls in-progress and to come as they relate to the Work, to the progress schedule, to permits, to Change Order, and as may be required in the Contract.

When revisions to the current TESC Plan are required by the Engineer, the Contractor and ESC Lead shall be prepared to update the TESC Plan as discussed and shall submit the updated TESC Plan to the Engineer within 5 Working Days unless the Engineer agrees to other arrangements.

8-01.3(4) AUTHORITY OF CERTIFIED ON-SITE EROSION CONTROL LEAD (ESC LEAD)

See Section 1-05.13(3).

8-01.3(5) EROSION CONTROL SEEDING

8-01.3(5)A GENERAL

As may be required in the Contract, and as indicated in the TESC Plan, the application of seed, fertilizer, lime, mulch, tackifier, and other amendment shall be in accordance with Section 8-02.

Where the application of erosion control seeding is within, near, or may contribute to runoff entering into streams, surface waters, and environmental critical areas, both fertilizer and tackifier, whether or not part of a mulch, shall be of a slow release variety.

8-01.3(5)B CULTIVATION

Clearing, grubbing, grading, cut, fill, and removal of large rock, limb, and related material shall be completed as necessary prior to beginning cultivation. Native soils shall be cultivated with amendment to produce a 4-inch minimum depth homogeneous mixture suitable for seeding. Where amendment is required in the Contract, amendment shall consist of applying a layered application of either 1 inch thick decomposed organic mulch or 2 inch thick planting soil and then mixed into native soils to a depth twice or two times the thickness of the amendment. The Contract may require a specified rate of application of agricultural lime during the cultivation process to bring the native soil pH to a level conducive for the seed mix type. Cultivation of excessively wet soil will not be allowed.

Cultivating, whether or not amendment and/or lime is required, may be by rototilling, farm disc, harrow, or other suitable equipment. On slopes or grades, cultivating shall follow the contours or be done at right angles to the natural flow of water. Where the slope grade is relatively steep, the Contractor shall submit a cultivating plan to the Engineer for review at least 2 Working Days in advance. When near streams and other bodies of water, cultivating shall be done reasonably parallel to the water bodies' boundaries and shall gradually transition with distance from the water to slope or grade cultivating.

For trees identified in the Contract not for removal, and where grading and shaping of soils within the dripline of tree exposes tree roots, the exposed roots shall be cleanly cut at a location to allow a one inch cover of amended soil. Unless the Contract specifies otherwise, cultivation within the dripline of existing tree, shown as "Zone B" on Standard Plan no. 133, shall be by hand methods and hand held equipment.

8-01.3(5)C COMPACTION

After cultivation and before seeding, the area shall be compacted for a depth of 4 inches to not less than 80% and not more than 85% as determined by the method specified in Section 2-03.3(14)E. On slopes, and as the grade may permit, equipment shall 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 shall make its best effort to follow the contour.

Soil to be seeded that is adjacent to curb, sidewalk, driveway, walking path, pavement, and other improved surface for pedestrian or vehicular traffic, shall be at least one inch below the finished grade of the improved surface.

For trees identified in the Contract not for removal, compaction shall be by equipment and methods that shall not compact soil to more than 85%. Dripline is defined as Zone B as shown on Standard Plan no. 133.

8-01.3(5)D SEEDING

Areas shall be seeded immediately following cultivation and compaction.

Seeding shall not be done during windy weather, when the ground is frozen, or when the ground is excessively wet or dry as determined by the Engineer.

The application of seed, fertilizer, mulch, and other identified amendment in the TESC Plan shall be a single operation for all seed applications. Seed of the mix type specified shall be placed at the rate of application for the seed mix as specified in Section 9-14.2, unless the TESC Plan indicates otherwise.

Seeding shall be applied by the following methods, as applicable:

1. Large area applications: A hydro-seeder may be used that utilizes water as the carrying agent, and can acceptably handle the additional fertilizer, mulch, and other amendment as identified. The hydro-seeder shall have an operating and feed capacity sufficient to agitate, keep in suspension, and mix all ingredients into a homogeneous slurry, the required mixture of seed, water, and amendment as may be required. Distribution and discharge lines shall be sized to prevent blockage and binding, and shall allow for uniformity in required application rates. Spray nozzles shall be designed to provide a uniform and consistent slurry application.
2. Small area applications: Areas of a size not economical for hydro-seeding methods, shall be seeded by hand or by small scale equipment or both. The Contractor shall provide the Engineer at least 2 Working Days in advance, the proposed method for applying seed or seed mixture.

For hydro-seeding applications, seed, fertilizer, mulch, and other identified amendment shall be applied in one application provided that:

- 1) The fertilizer is placed in the hydro-seeder tank no more than 30 minutes prior to application;
- 2) The amount of fertilizer added to the seed mixture shall produce the specified coverages for all ingredients;
- 3) Unless the TESC Plan indicates otherwise, a wood cellulose fiber mulch shall be added to the seed mixture to act as a buffer. The mulch can substitute as a tracer; however, the rate of mulch application shall not exceed 250 pounds per acre; and
- 4) The seed mixture shall have a tracer added to aid in uniform application by visual means. If not wood cellulose fiber mulch, the tracer shall not be harmful to the environment.

8-01.3(5)E TIME FOR APPLICATION OF SEED, FERTILIZER, AND MULCH

Seeding, fertilizing, and mulching shall be performed at times when environmental conditions are conducive to satisfactory growth. The Contractor shall take into consideration, the application of pre-germinated seed.

8-01.3(5)F ESTABLISHMENT PERIOD AND MAINTENANCE

The seeding establishment period for temporary erosion control seeding shall begin on the Day the final seeding is applied and shall continue for the greater of 90 Days or as identified in the TESC Plan. The Contractor shall perform the following maintenance during this establishment period:

1. Protect seeded areas from vehicle and pedestrian traffic.

2. Employ other TESC measures to protect seeded areas.

Sixty (60) Days after seeding, seeded areas indicating no growth, or spotted growth defined as an area showing less than 90% growth, or damaged by traffic, or covered by sediment, or eroded, shall be repaired as needed that may include one or more of removal of sediment, regrading, reseeding, fertilizing, and mulching. Repaired areas shall be re-inspected 30 Days after repair is completed to ensure establishment.

8-01.3(6) EROSION CONTROL MULCHING

8-01.3(6)A GENERAL

When the TESC Plan indicates a separate mulch application for an area in addition to seeding, this mulching shall immediately follow the seeding.

Areas not accessible by mulching equipment shall be mulched by approved hand methods.

8-01.3(6)B STRAW MULCH

Straw mulch erosion control application shall be with a forced air mulch spreader. In spreading straw mulch, the spreader shall not cut or break the straw stalks into lengths less than 2 inches. Straw mulch coverage shall have a minimum thickness of 2 inches. Where a forced air equipment mulch application is indicated as providing unacceptable results, the Contractor shall employ manual or other application methods such as hand spreading and raking.

Should the straw mulch coverage expose at any time bare ground of more than 50% in any 100 square foot area, then the Contractor shall promptly remulch the exposed area to full coverage of the thickness required.

8-01.3(6)C WOOD CHIP MULCH

Wood chip mulch erosion control application shall be with a forced air mulch spreader and provide a 2 inch minimum thickness coverage. Where a forced air equipment mulch application is indicated as providing unacceptable results, the Contractor shall employ manual or other application methods such as hand spreading and raking.

Should the wood chip mulch coverage expose at any time bare ground of more than 50% in any 100 square foot area, then the Contractor shall promptly remulch the exposed area to full coverage of the thickness required.

8-01.3(6)D BARK MULCH

Bark mulch erosion control application shall be with a bark mulch spreader, or by a delivery method that does not disturb the surface to be protected, followed by hand raking to obtain a coverage with minimum thickness of 2 inches. Where a bark mulch spreader application is indicated as providing unacceptable results, the Contractor shall employ manual or other application methods such as hand spreading and raking.

Should the bark mulch coverage expose at any time bare ground of more than 50% in any 100 square foot area, then the Contractor shall promptly remulch the exposed area to full coverage of the thickness required.

8-01.3(6)E WOOD CELLULOSE FIBER MULCH

Wood cellulose fiber mulch erosion control application shall be applied using a hydroseeder. When used without seeding for the sole purpose of erosion control, the rates of application specified in Section 9-14.4(2) shall be 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 4H:1V.
2. 100 pounds per 1000 square feet, or 4000 pounds per acre, for areas having a slope ranging from greater than 4H:1V to as much as 2H:1V.
3. 120 pounds per 1000 square feet, or 5000 pounds per acre, for areas having a slope greater than 2H:1V.

Where a hydroseeder application is indicated as providing unacceptable results, the Contractor shall employ manual application or other methods such as hand spreading and raking.

Should the wood cellulose fiber mulch coverage expose at any time bare ground of more than 50% in any 100 square foot area, then the Contractor shall promptly remulch the exposed area to full coverage of the thickness required.

The application of wood cellulose fiber mulch shall have a tackifier incorporated into the mulch fiber during manufacture. The submittal shall indicate the manufacturer's recommended amount of soil binder and tacking agent in the mulch mixture.

8-01.3(6)F DECOMPOSED ORGANIC MULCH

Decomposed organic mulch erosion control application shall be with a forced air mulch spreader. Coverage applications shall have a minimum thickness of one and one half inches (1-1/2 inches). Where a forced air mulch spreader application is indicated as providing unacceptable results, the Contractor shall employ manual or other methods such as hand spreading and raking.

Should the decomposed organic mulch coverage expose bare ground of more than 50% in any 100 square foot area, then the Contractor shall promptly remulch the exposed area to full coverage of the 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.

Erosion control matting shall be installed and secured in accordance with the manufacturer's recommendations.

Unless the matting manufacturer recommends otherwise, seeding, with or without amendment or mulch, shall be applied before the placement of matting.

Staking shall be driven flush with grade and shall penetrate the earth by a minimum 12 inches.

The Contractor shall timely maintain the integrity of the matting by repairing or replacing as necessary all improperly anchored, torn, uplifted, and missing matting. Torn or missing matting shall be covered with additional matting overlapping the tear or the exposed area with a minimum 24-inch overlap of all surrounding matting. This patch shall be staked at each corner 3 inch from the edge of patch and along all edges with a spacing not exceeding 12 inch. Uplifted and improperly anchored matting shall be repaired by replacing failed anchors, or by increasing the density of anchors as applicable.

Temporary matting and stakes shall be completely removed at the time of permanent restoration.

8-01.3(7)B NON-DITCH AND NON-CHANNEL MATTING INSTALLATION

In general, the matting shall be placed flush with the soil surface with the first matting installed at the lowest elevation. Additional upper elevation matting shall be installed over lower elevation matting with a minimum 6 inch overlap. Matting shall be installed with the long axis of matting parallel to the contour. Overlap of matting ends installed along a contour shall be with the "upstream" matting being installed over the "downstream" matting with a minimum 6 inch overlap with the "upstream" direction indicated by the grade in the swale at the base of the slope.

Unless the matting manufacturer recommends otherwise, the higher elevation edge of matting shall be buried in an anchor trench 6-inches-deep by 12-inches wide with soil firmly tamped against the matting. Upper elevation matting shall be installed over lower elevation matting with an overlap the full width of anchor trench. Before backfilling the anchor trench, staking shall penetrate the matting in the center of the anchor trench. Spacing of staking within the trench shall not exceed three (3) feet except that at each end of the matting strip, a stake shall be placed through the mat fabric six (6) inches from edges at the corner including if overlapped by another mat. Backfill in the trench shall be tamped firm.

When placing matting within the dripline area of tree, anchor trench shall not be constructed. Rather, the upper elevation edge of the upmost matting shall be staked approximately 3 inches from the edge. Spacing of the stakes shall not exceed three (3) feet, except at ends where the stake shall be installed through the mat fabric 6 inches from all edges including when overlapped. Upper elevation fabric installed over lower elevation fabric shall 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 shall not be less than three feet and spacing between rows of stakes shall not be less than three (3) feet. Each long edge of matting fabric, whether overlapped or not, shall be staked three (3) inches from the long edge with stake spacing not exceeding three (3) feet. The fabric ends, the short edge, shall be staked three 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 shall have the long axis of the matting parallel to the direction of water flow. The first matting installation shall be at the invert of the ditch or channel. Additional matting installation shall be installed overlapping the upper edge of previously placed fabric by at least 12 inches. In the direction of flow, upstream matting shall overlap downstream matting by 12 inches. Matting shall 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 black plastic covering. Sandbag or similar ballast shall be placed on the cover in a grid with no less than 5 foot spacing in two right angle directions. At all ends without overlap, ballast shall be placed within 12 inches of the edge and spaced no more than 5 feet along the perimeter.

Clear plastic covering shall cover areas where the growth of vegetation is not to be inhibited.

With the exception of stockpiles, plastic covering sheets shall be installed with the long axis parallel with slope contours. The upper edge of the fabric shall be placed into a 12-inch wide by 6-inch deep anchor trench and backfilled with native soils tamped into place. Upper slope fabric shall overlap downslope fabric in the anchor trench a minimum of 12 inches. Along the same contour, the ends of new fabric shall overlap in-place fabric a minimum of 24 inches.

In general, ballast shall be placed on the cover using sandbags or similar ballast distributed over the cover in a manner to prevent uplift, slippage, and any other movement of the cover. Spacing of ballast shall be not more than a 10-foot grid in line with and against the long axis of the sheet. All overlaps, edges, and corners shall be ballasted.

On steep slopes and where slippage of ballast or ballasted fabric is indicated, the ballast shall be secured in-place by rope tied to upslope anchors firmly set in the earth.

Within the dripline of trees, excavation of anchor trenches will not be allowed. Rather, ballast shall be placed on the fabric and on the overlaps secured by rope tied to anchor stakes upslope of the dripline area.

Rips and tears shall be timely repaired by placing additional covering over the defect with a minimum 24 inch overlap in all directions from the defect. The repair shall be ballasted with a spacing in any direction of no more than 5 feet and along all edges and at all corners. Ballast shall be anchored to upslope stakes.

Uplifted areas shall receive additional ballast resulting in reduced ballast spacing.

Areas where covering has slipped and the underlying surface becomes exposed shall be timely repaired in the same manner as rips and tears.

Clear plastic covering intended to cover a vegetated surface without long term inhibiting effects shall require frequent monitoring ensuring permanent damage is not occurring. Should vegetative degradation be indicated, the Contractor shall 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 a work area within a Project Site, and beyond the Project Site, the Contractor shall have in place a stabilized construction wash area at a location or locations to remove sediment, mud, and other debris from tires and the entire piece of equipment and vehicle.

Stabilized construction wash areas shall be in place and ready for operation before the potential for transporting such material occurs.

The wash area shall consist of one or more of the following as the Work requires and as the Contract may require:

1. graded entrance and exit water trough all equipment and vehicles must go through. The Contractor may require a water trough for each direction. The depth of water in the trough shall be maintained at a level adequate for the size of equipment and vehicle expected. The length and width of the trough shall be sized to ensure all length and width equipment and vehicle can be acceptably cleaned.
2. hose, hose brush, long handled brush, and similar Supplies, and adequately labor to acceptably handle the size and volume of traffic.
3. adequate source of water and means to contain the water within the designated wash area.
4. regular removal and disposal of sediment and debris.
5. removal and disposal of non-debris and non-sediment pollutants and contaminants.
6. a drain as may be necessary with controls in place to discharge water complying with regulation, law, permit, and as the Contract may require.
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

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. The stabilization required shall be adequate for the equipment and vehicular traffic and for the Project Site local conditions, local climate, and weather typical for the Contract Time.

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 temporary road construction cannot be aligned to avoid areas within the dripline of trees not identified for removal, the Contractor shall comply with the requirements of Section 1-07.16(2).

Temporary road stabilization measures shall be maintained by repairing ruts, tracks, settling, and other failing areas. Such repairs may include placing and compacting additional aggregate. Settled, broken, rutted, and otherwise damaged timber, mulch, and other material within the driplines of trees shall be repaired by increasing the thickness of material.

Upon completion of the Work, or as may be required to accommodate the Work, temporary road stabilization measures shall be removed and disposed of. Within the dripline of tree, the removal shall be conducted to prevent damage to feeder and surface roots and minimize compaction of soils.

8-01.3(10) TEMPORARY SEDIMENT CONTROLS

8-01.3(10)A SILT FENCE (SEDIMENT FENCE OR FILTER FENCE)

Silt fences shall 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 shall be either in-place before the area is disturbed, or shall be coordinated with beginning soil disturbance activity.

Silt fence(s) shall be constructed at locations downstream or downslope of surface runoff areas, and upstream or upslope of surface bodies of waters. Silt fences shall be spaced to account for grade of slope, runoff flowrate and velocity, sheeting and rilling, type and relative density of soil(s), rate of sediment loading, expected maintenance type and frequency, and other factors as the site and Work require. Silt fences shall not be placed across or in streams, channels and ditches.

Silt fences shall 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 other than at the ends, gravel check dams shall be placed perpendicular to the uphill face of the fence to minimize concentrated flow and erosion along the fence. The gravel check dams shall be approximately 1 foot deep at the fence and shall continue perpendicular to the fence at the same elevation until the top of the check dam intercepts the ground surface. The gravel check dams shall consist of crushed surfacing base course gravel backfill for walls, or shoulder ballast. The gravel check dams shall 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 shall not be steeper than 3H:1V.

The height of the fence fabric, the geotextile, above ground surface shall be 30 inch minimum and 36 inch maximum.

Posts shall 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 shall be installed to a minimum 30 inch depth, except as specified below within the dripline of tree, and shall be spaced within a fence line of not greater than six (6) feet. Where required post depth penetration cannot be obtained, the posts shall be adequately

secured on the upslope side by bracing or guying to an adequately installed anchor to prevent overturning. Posts shall be either wood or steel. Wood posts shall have minimum dimensions of 1-1/4 inch by 1-1/4 inch and shall be white oak or other hardwood resistant to rot, and with no defects. Steel posts shall 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.

The fence fabric and support backing systems shall 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 shall 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 retained, shall be without damage to roots. Roots that are exposed shall not be damaged and shall be promptly covered with earth. Where the bottom of fabric and support backing cannot be installed to a 6 inch depth due to interference with roots, the fabric and backing shall be placed flat on the upside of fence for a minimum 12 inch width and then covered with a minimum 6 inch depth of large size aggregate ballast. In non-trench fabric bottom installations, post penetrations into the earth shall be increased and the height of fence above the top of ballast shall not exceed three (3) feet.

Fence support backing system, in the form of wire or plastic mesh with maximum mesh spacing of 2 inch by 4 inch and of adequate strength to withstand maximum loading, shall be attached to posts and fabric as recommended by the Supplier. Plastic mesh shall have the same or greater ultraviolet (UV) resistance as the geotextile fabric. All geotextile fabric shall have backing whether exposed or buried.

Fence fabric shall be continuous along any single length of filter fence. Continuous fence is defined as follows:

- a. 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 shall be located at a support post.
- b. Separate geotextile fabric may installed across posts with a minimum 10 foot overlap where the overlap is supported by no less than three (3) posts with spacing between any posts not greater than 4 feet. Overlapped fabric shall always be secured to support backing.
- c. 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 shall extend a minimum one (1) foot beyond the 2 posts before twisting.

Lapped or twisted fabric and backing that slip shall be considered defective and shall be replaced with sewn geotextile. For pre-staked silt fence, laps may be performed in accordance with the manufacturer's written recommendations.

8-01.3(10)B SEDIMENT REMOVAL

Sediment shall be removed and disposed of when the sediment build-up reaches a height of 10 inch to 12 inch, and in no case shall exceed one third (1/3) the height of fence.

8-01.3(10)C DAMAGED FENCE REPAIR

Damaged or improperly functioning silt fence shall be promptly repaired or replaced.

Rips, tears, holes, and other defects in the geotextile fabric or the backing or both shall be promptly repaired by placing new material(s) over the damaged materials the full width and height of fence including buried or covered fabric and backing, and shall overlap existing fence material(s) a minimum 5 feet each side of the defect. The repaired fence shall be supported by and securely tied to 5 evenly spaced posts.

Broken posts shall 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 shall be securely tied to each new post.

Posts that lean greater than 1H:4V shall be replumbed and shall be supported at the top with bracing or guying to an adequately installed upslope anchor.

Water or sediment escaping beneath the silt fence shall 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 shall be placed over the on-surface repair with a minimum 6 inch depth large aggregate ballast. A new post or posts shall be installed along the leak with spacing not exceeding 2 feet.

Any other conditions that reduce the effectiveness of the silt fence shall require immediate repair and/or replacement.

8-01.3(11) SHEAR BOARDS

Shear boards shall be spaced horizontally to allow not greater than a six (6) foot vertical change of grade between boards. Shear board shall be securely nailed to four (4) 2 inch x 4 inch stakes – 1 each stake at each end and the remaining stakes spaced evenly between. Stakes shall be driven a minimum 24 inches into the earth and shall extend full height of shear board.

The Contractor shall timely repair or replace shear boards and stakes exhibiting decay, structural failure, or leaning more than 1H:4V. Frequency of removal of sediment build-up against the board shall be such that build-up does not exceed 1/3 the height of the shear board.

8-01.3(12) DRAINAGE AND SEWER SYSTEM PROTECTION

The Contractor shall take measures to prevent the introduction of pollutants, contaminants, sediment, and other material from entering Storm Drain, combined Sewer, and other drainage system via any entrance vehicle. Sediment prevention for drainage Structures may require one or more of a sediment sump, a cover filter, or an outlet pipe cover filter.

Filters shall allow the passage of water into or from the drainage Structure without unreasonable backup or ponding, and shall prevent the passage of sediment and other debris.

Filters shall be secured to the opening being protected to withstand all loadings and to resist movement including sediment and debris build-up, flows typical for the drainage Structure and the local drainage conditions, and the potential for disturbance from construction and traffic activity.

Filters covering large areas not having adequate structural support shall be reinforced with and secured to a plastic or wire mesh support backing system.

Where filters are expected to be in place for a considerable period of exposure, UV resistance and other climate and environmental strengths shall be adequate.

Frequency of maintenance shall include removal of sediment and other debris when either the sump build-up reaches approximately 1/3 capacity, or when obstructed filtration or the allowance for the passage of water is causing water back up.

Sediment and debris removal shall require additional care to prevent the escape of these materials into the drainage system.

8-01.3(13) WATTLES

Wattles shall be installed within shallow trenches parallel with the contour and perpendicular to runoff or other flow. A sequence of wattles shall begin at the base of the slope and proceed uphill. Excavated material shall be spread evenly along the upslope side and shall be compacted using hand tamping or similar method. On gradually sloped or on clay and plastic silt type soils, trenches shall be 2 to 3 inches deep. On loose granular soils, in high rainfall areas, or on steep slopes, trenches shall be 3 to 5 inches deep or half the thickness of the wattle, whichever is greater.

Wattles shall be spaced horizontally to allow not greater than a six (6) foot vertical change of elevation between wattle rows.

The wattle shall be installed snugly into the trench, abutting adjacent wattles tightly end to end with minimal overlapping of ends. Wattles shall be staked at each end, and in between at 4-foot maximum centers. Where trench conditions require, pilot holes for the stakes shall be driven through the wattle and into the soil using a straight bar. Stakes shall 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 shall be maintained in contact with the soil in the trench, and shall be inspected immediately after a runoff producing rainfall verifying soil contact.

8-01.3(14) EROSION AND SEDIMENT CONTROL MAINTENANCE

Temporary erosion and sediment control measures shall be inspected at regular intervals and immediately following significant runoff producing rainfall events. The individual functions and the whole shall be verified performing acceptably and shall be maintained until they are no longer needed, or are to be converted as part of a permanent erosion and sediment control when specified in the Contract. The various devices shall be inspected for damage, bypass, undercutting, and non-performance, and shall be promptly repaired. Sediment buildup shall be removed as specified or more frequent intervals when performance becomes questionable. Debris and contaminated sediment shall be properly disposed of. Clean sediments may be stabilized on-site as the TESC Plan indicates.

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 shall remove the measure or measures.

Reuse of a control measure may be acceptable if:

1. The measure or device has been thoroughly cleaned of all debris;
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 requirements of Section 1-04.11, the Contractor shall ensure that soil, debris, or other material tracked and deposited are removed by sweeping or by washing and properly disposed of. In particular, when wet weather is forecast, the On-Site Erosion Control Lead shall verify that all measures are in-place and are functioning effectively and acceptably.

8-01.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Temporary erosion and sedimentation control (TESC) will be measured by lump sum.

8-01.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-01 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "Temporary Erosion and Sediment Control, Minimum Bid = (\$_____)", per lump sum.

The Bid item price for "Temporary Erosion and Sediment Control, Minimum Bid = (\$_____)" shall include all costs for the work required to prepare and update as necessary a temporary erosion and sediment control plan; to furnish, install,

maintain, remove, relocate, dispose of, and restore, temporary erosion and sedimentation control measures including conditions of permits and other Contract provisions as may be included in the Contract.

The Bid item price shall also include all costs for the On-Site Erosion Control Lead and any supporting staff as may be necessary.

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 in 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 temporary erosion and sediment control of less than the Bid item lump sum minimum price shown in the Bid Form will be revised to reflect the Bid item lump sum minimum price allowed including the extension and shall govern as becoming a part of the Bid.

Payments for progress estimates will be made in accordance with the lump sum breakdown specified in Section 1-09.3(2) including how this work relates to the Work and to the progress schedule.

SECTION 8-02 LANDSCAPE CONSTRUCTION

8-02.1 DESCRIPTION

Section 8-02 describes work consisting of furnishing, planting, and maintaining such trees, whips, shrubs, ground cover, seedlings, cuttings, and lawn.

This work also consists of furnishing and installing paver blocks, grid blocks, cedar edging, bollards, benches and tree grates.

Trees, whips, shrubs, ground covers, seedlings, cuttings, and sod will hereinafter be collectively referred to as, "plants" or "plant Material".

8-02.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Erosion Control and Landscape Materials	9-14
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Nomenclature for plants and varieties shall be in accordance with the current edition of "Standardized Plant Names" as prepared by the American Joint Committee on Horticulture Nomenclature.

Planting Soil shall be used unless otherwise specified in the Contract.

The type of seed mix shall be as specified in the Contract.

Mulch as amendment shall consist of decomposed organic mulch unless otherwise specified in the Contract.

Planting mulch for topdressing shall consist of bark mulch unless otherwise specified in The Contract.

The concrete mix for wood bollard footings shall be Class 5 (3/4) (See Section 5-05.3).

8-02.3 CONSTRUCTION REQUIREMENTS

8-02.3(1) RESPONSIBILITY DURING CONSTRUCTION

8-02.3(1)A GENERAL

The Contractor shall provide adequate and proper care of all plant Material and landscape Work done on the project from the time of installation to the end of the landscape establishment period (see Section 8-02.3(12)).

Adequate and proper care shall include, but is not limited to:

1. watering, cultivating, pruning, mulching, weeding, and pest control;
2. keeping all plant Material crowns, runners, trunks and branches free from mulch at all times;
3. keeping planted and landscaped areas free from insect infestation, weeds and grass, litter and other debris; maintaining finished grades in a neat, tidy, uniform condition;
4. resetting grade paver blocks that may have settled;
5. adjusting stakes and tree fasteners as needed to prevent strangulation or irregular growth of plant Material;
6. maintaining in pedestrian walking areas, a consistent 2 to 3 inch layer of mulch in all planting beds and tree pits; and
7. in non-pedestrian areas, a consistent 3 inch layer of mulch in all planting beds and tree pits.

The Contractor shall have sole responsibility for the survival of all plant Material, and operation of newly installed irrigation equipment when included in the Contract, from the time of installation to the end of the establishment period with the exception of third party damage or vandalism occurring after the start of the establishment period.

Dead, diseased, dying, damaged, and other unacceptable plant condition as determined by the Engineer shall be removed and replaced with healthy and vigorous plants of the same type and size.

8-02.3(1)B LANDSCAPE CONTRACTOR QUALIFICATIONS

All landscaping shall be performed by a licensed Landscape Contractor registered in the State of Washington and shall be qualified for landscaping work through certification by the Washington Association of Landscape Professionals (WALP).

8-02.3(2) TOPSOIL , PLANTING SOIL, AND PLAYFIELD SOIL**8-02.3(2)A GENERAL**

Topsoil, planting soil, playfield soil, decomposed organic mulch amendment or fertile mulch shall be evenly spread and incorporated into subsoil as required in 8-02.3(14) for seeded lawn installation and as identified in 8-02.3(4) for areas to be planted.

Topsoil, planting soil, playfield soil, decomposed organic mulch and/or fertile mulch shall 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

Topsoil Type A shall be obtained from a source provided by the Contractor meeting the requirements of Section 9-14.1(1). Should the Contractor propose a soil not meeting these requirements, the Contractor shall provide a Manufacturer's Certificate of Compliance stating the proposed substitute soil meets regulatory and legal requirements, and shall perform as least as acceptably as Topsoil Type A.

8-02.3(2)C TOPSOIL TYPE B

Topsoil Type B shall be native topsoil taken from within the Project Site complying with Section 9-14.1(2).

When topsoil Type B is specified in the Contract, it shall 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.

Upon completion of the Work, any topsoil Type B remaining and not required for use on the project shall be disposed of, unless the Engineer agrees otherwise.

Should a shortage of topsoil Type B occur and the Engineer has determined the Contractor has wasted topsoil Material, the Contractor shall furnish topsoil Type A at no expense to the Owner.

Topsoil Type B will not be considered as selected Material as defined in Section 2-03.3(10), and the conditions of Section 2-03.3(10) will not apply.

Material taken from the Project Site and used a Topsoil Type B will not be deducted from the Bid item quantities for the respective Bid items.

8-02.3(2)D PLAYFIELD SOIL

Playfield soil shall meet the requirements of Section 9-14.1(4)B, and shall be installed as indicated in the Contract.

8-02.3(2)E PLANTING SOIL

Unless the Contract specifies otherwise, Planting Soil meeting the requirements of Section 9-14.1(4)A shall be installed in accordance with Section 8-02.3(4).

8-02.3(3) PESTICIDES

All pesticide use within the City of Seattle shall be in accordance with the City of Seattle pesticide reduction strategy as documented under the keyword "pesticide reduction" on the City of Seattle website www.seattle.gov.

Pesticides proposed for use by the Contractor shall be submitted to the Engineer for review a minimum of 10 Working Days prior to scheduled use. The submittal shall include:

1. an MSDS;
2. a Manufacturer's Certificate of Compliance stating the pesticide is appropriate for intended application and the rate of application;
3. the pesticide complies with all law and regulation and is registered in the State of Washington;
4. the pesticide is not a soil residual pesticide and is not toxic to landscaping and lawn not to be controlled, unless the Contract specifies otherwise; and
5. the name of the pesticide applicator including a copy of current Washington State pesticide application license for the intended application.

Application of pesticides shall be in accordance with Ch 16-228 WAC and the manufacturer's recommendations and shall be carried out by an experienced applicator licensed by the State of Washington for the class of pesticide utilized.

The Contractor shall ensure pesticide application is confined to the areas designated.

Pesticide application will not be allowed during wet weather, unreasonable wind conditions, when wet conditions exist, or when wet weather is forecast within 24 hours of pesticide application, unless the pesticide manufacturer allows otherwise as provided in the submittal. The Contractor shall notify the Engineer at least 2 Working Days in advance, the location of the pesticide application.

All pesticide or pesticide components shall be delivered to the Project Site in unopened containers and shall comply with the spill prevention and control requirements of Section 1-07.5(5).

Pesticide application shall be restricted when near surface waters as specified in Section 1-07.5.

8-02.3(4) PLANTING AREA PREPARATION

Areas to receive plant Material shall be cleared, grubbed, cultivated and graded to accommodate the Work prior to planting and to provide the optimum conditions for plant and lawn, establishment and growth. Weed clearing shall 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). Planting areas shall be graded to finished subgrade and cleaned

of all debris including concrete, stumps, sticks, roots and rocks or lumps larger than 3 inches and inspected before planting soil or mulch is placed.

The Contract may require certain areas be built-up by embankment construction methodologies as specified in Section 2-03 prior to preparing for planting. Such areas will be identified in the Contract.

The Contractor shall 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 shall 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 shall be disposed of.

Planting area preparation shall take into account as applicable, work within the driplines of trees and other vegetation to be retained; the incorporation of topsoil, planting soil, playfield soil, decomposed organic amendment, fertile mulch, or other amendment; and the finish grade to accommodate the Work.

Incorporation of amendment, addition of soils, and as the Contract may require, shall result in a homogeneous blend to a minimum 6 inch depth. The Contractor shall 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 shall be the approximate centerpoint, or centerline(s), of the planting area. Soils and amendment shall 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 including any surface mulch top dressing shall 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 shall be placed at spacings and locations as indicated in the Contract. Location layout and staking shall be the responsibility of the Contractor, subject to the approval of the Engineer, before planting or construction of each item begins.

The Contractor shall sequence the plantings to minimize disturbance to new plantings and existing landscaping, and to comply with the TESC Plan (see Section 8-01).

All plants shall be furnished disease and pest free, in good health and condition, true to form, and shall be vigorous growers. All plant Material shall be inspected and determined by the Engineer to be acceptable for planting prior to planting.

8-02.3(6) PLANTING

8-02.3(6)A GENERAL

Plants brought to the planting site shall be bare root, balled and burlapped, or in containers, depending on how specified in the planting schedule in the Contract for the particular type of planting Material. Plants shall not be planted during freezing weather or when the ground is frozen. Plants shall not be planted during excessively wet conditions. Plants shall not be placed on any Day in which temperatures are forecast to exceed 80 degrees unless the Engineer approves otherwise. Plants shall not be placed in areas that are below finished grade.

Dates to plant Planting trees, shrubs, and groundcovers within the City of Seattle limits shall 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 shall promptly notify the Engineer.

Plants shall be removed from containers in a manner that prevents damage to the root system. Containers may require vertical cuts down the full depth of the container to accommodate removal. All circling roots shall be loosened to ensure natural directional growth after planting.

8-02.3(6)B TREES

In general, tree planting holes shall be excavated over a minimum surface area of 12" 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 shall allow a horizontal clearance of at least 3 inches from the curb or sidewalk without undermining foundation support of adjacent improvements. Unless the Contract specifies otherwise, two thirds (2/3) excavated native soil shall be mixed with one third (1/3) decomposed organic mulch to form a thoroughly mixed homogeneous blend for backfill. Backfill shall be placed and compacted without voids. For bare root trees, backfill shall be placed in a manner ensuring roots are properly spread to avoid circling, and tamped or compacted ensuring that no voids exist. For ball and burlap and container trees, roots showing at the edge of the root ball shall be loosened without tearing and shall be placed in a manner ensuring roots are properly spread for lateral directional growth.

The Contractor shall provide the Engineer a minimum 2 Working Days advance notice of the first tree(s) to be planted. The Engineer shall be present to approve the planting method of the first tree(s). The approved method shall be consistently applied for all remaining tree plantings.

Trees shall be placed with the root crown 2 inches above surrounding curb and sidewalk finished grade where applicable. Before planting, twine and burlap and wire basket shall be removed from the upper 2/3 of the root ball. However, the Contractor shall be prepared to remove all twine and burlap and wire basket before placing in planting holes at locations directed by the Engineer. All container shall be removed from container provided trees before planting. Containers may require vertical cuts down the full depth of the container to accommodate removal.

In their final position, trees shall have their root crowns positioned above the surrounding backfill as indicated on the Standard Plans. Backfill shall be carefully placed and compacted in loose lifts not exceeding 6 inches. Water settling of backfill will not be allowed. Where no sidewalk and curb is present, the finished grade of the backfill shall have a soil berm or soil saucer (watering ring) as shown on Standard Plan nos. 100a, 100b and 101. On Standard Plan no. 113, the mulch thickness to curb and sidewalk finished grade will be considered the watering ring. Water shall be applied after installation as set forth in Section 8-02.3(12) item 4. If settling occurs, the Contractor shall add enough soil to cover the roots but shall not rework the soil. Three inches of mulch shall then be added to topdress 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 shall be as shown in Standard Plan nos. 110 and 111. All plastic, burlap, ties, and other container material shall be removed from the plant prior to planting. Containers may require vertical cuts down the full depth of the container to accommodate removal. Backfill shall be firmly tamped or compacted without voids around the roots, then covered with mulch, and watered immediately after planting.

8-02.3(7) PRUNING AND STAKING

8-02.3(7)A PRUNING

Root pruning necessary for the Work shall be in accordance with Section 1-07.16(2).

All plants shall be pruned at the time of planting to remove any minor broken or damaged twigs and branches. Pruning shall be done in such a manner as to retain or to encourage the natural growth characteristics and proper form of the particular plant. Pruning shall be done with a sharp tool to produce a clean cut without bruising or tearing the bark. All completed pruning cuts shall be in the living wood where callous tissue can develop properly.

All tree trimming shall be done by a certified arborist, or a trained arboricultural technician working under the immediate supervision of a certified arborist and shall adhere to ANSI A300 standards.

Tree pruning shall 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 alter the natural form of the tree being pruned.
2. Major pruning Work is all other pruning Work. When major tree pruning Work is required, the Contractor shall notify the Engineer 3 Working Days prior to start of pruning and provide the name of the company or individual(s) proposed for doing the pruning. All major pruning work shall be done by an arborist with current certification by the Washington State Chapter of the International Society of Arboriculturists, and shall arrange in advance with the Engineer for observing and approving the pruning of the first tree(s). The first pruning shall be representative of all trees to be pruned and shall be adequate demonstration of the proper pruning method to apply to all trees.

8-02.3(7)B STAKING

Unless otherwise specified in the Contract, all deciduous trees shall be staked at the time of planting as indicated in Standard Plan nos. 100a, 100b and 113. Each tree shall be staked with two 2-inch diameter doweled treated wood stakes and "chainlock" tree tie (or approved equal) installed to allow for trunk growth. For deciduous tree installation, the stake shall penetrate a minimum of one foot into undisturbed subgrade. For coniferous tree, see Standard Plan no. 101.

Damaged stakes shall be promptly removed and replaced.

Trees and shrubs found out of plumb by wind or other cause shall be replumbed by loosening the soil around the root system and replumbing the tree or shrub, and rebackfilling and recompacting as necessary. Adjustment shall not be made 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 re-plumbing a tree or shrub, the tree or shrub shall be replaced by the Contractor.

Alternate methods of staking may be proposed by the Contractor and require approval of the Engineer.

Tree stakes shall be removed at the end of one year.

8-02.3(8) FERTILIZERS

Fertilizers for trees shall be a slow release form with a duration of availability greater than 6 months and shall be formulated as described in Section 9-14.3(1). Rate of application shall be per fertilizer manufacturer's recommendations and shall be applied both at the beginning and the end of the landscape establishment period for all area under the dripline or to a 4-foot diameter, whichever is greater and as adjacent improvement allows.

Fertilizer for shrub and ground cover shall be the same formulation as above applied at the rate appropriate for the plant as recommended by the fertilizer manufacturer and shall be applied at the beginning and at the end of the plant establishment period applied to all area up to 4 feet beyond all plants as adjacent improvement allows.

8-02.3(9) MULCH

Mulch used as a soil amendment shall be decomposed organic mulch applied and incorporated into native soils as specified in Section 8-02.3(4).

Mulch used as topdressing for tree pits and planting beds shall be bark mulch unless otherwise specified in the Contract. Wood chips, salvaged from clearing and grubbing operations, may be used as mulch for topdressing as approved by the Engineer.

Beginning 6 inches before a sidewalk or other pedestrian traffic surface improvement, mulch thickness shall be feathered to a 2 inch maximum thickness at the sidewalk.

8-02.3(10) SOIL AMENDMENTS

Soil amendments shall be applied during planting area preparation (see Section 8-02.3(4)). The soil amendments shall be thoroughly mixed with soils and other Material as specified in the Contract to produce a homogeneous blend. All amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's name and guaranteed components analysis. In lieu 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 shall be disposed of. Planting areas immediately adjacent to walks, curbs, pavements, driveways, and other improvement shall 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

1. **General:** Landscape establishment shall consist of the Contractor providing regularly scheduled adequate and proper care for all new planting for the landscape establishment period. The landscape establishment period shall begin on the date of written notice from the Engineer of the acceptance of plantings, including the acceptance of the automatic irrigation system (if included in the project), and shall end 365 calendar Days thereafter unless the Contract specifies otherwise.

2. **Submittal:** At least 5 Working Days before the beginning of the landscape establishment period, the Contractor shall submit a weed control plan for approval by the Engineer. The weed control plan shall identify the means, manner, 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.

The submittal shall also include a watering schedule indicating how and when each and every component of the landscaping receives water.

3. **Application of Pesticides:** See Section 8-02.3(3).

4. **Watering:** The Contractor shall water plants as needed to promote healthy and vigorous growth. For hand-watered trees, 15 gallons shall be applied per tree per watering on a 3 Day schedule. For automatic irrigation installations, the Contractor shall be responsible to conduct a water audit to set watering patterns and timing, including the setting of automatic sprinkler controls and shall submit water audit results by a certified water auditor to the Engineer for review and approval. Automatic irrigation systems shall be operated fully automatic during the plant establishment period, shall operate during the time period of 2:00 AM to 5:00 AM, and shall be coordinated with the work of Section 8-03. If water restrictions are established, the Contractor shall develop watering schedules in consultation with the Engineer. See Section 2-07.3(2) regarding hydrant use.

Change in the established watering schedule may be required to accommodate weather, seasonal factors, and as necessary; however, the Contractor shall provide at least 3 Working Days advance notice of such proposed change including the reasoning. All irrigation system components installed as part of the Work shall be maintained and operated by the Contractor as part of the Landscape Establishment Work. The contractor shall monitor watering to ensure compliance with the TESC Plan.

5. **Mulch:** Mulch topdressing shall be applied to the required thickness and shall be maintained by applying additional topdressing mulch when needed to maintain consistent depth. Final mulch application shall be made in conjunction with the final progress estimate payment period (see Section 8-02.5).

6. **Fastenings:** Tree fastenings shall be kept intact and effective in maintaining firm support for plant Material. Fastenings shall be adjusted as needed by the Contractor to prevent trunk strangulation and non-plumb growth. Fastenings and stakes shall be removed as indicated on Standard Plan no. 100a or at the completion of the first year establishment period, whichever is later. Reusable, doweled wood stakes shall remain the property of the Owner and arrangements shall be made by the Contractor to provide for their delivery to an Owner storage facility identified by the Engineer.

7. **General Cleanup:** A general cleanup shall be made after any landscape establishment work.

8. **Weed Control:** The Contractor shall maintain all areas, whether mulched or not, in a weed-free condition during the landscape establishment period. Removal shall be by mechanical control methods unless alternatives are approved by the Engineer in writing.

9. **Plant replacement:** Replacement plants required during establishment shall be planted within a time period set by the Engineer, which will depend on the season and availability of the replacement plants. Missing plants shall be replaced by the Contractor in kind. Scheduling of plant replacement shall be coordinated with the Engineer.

10. **Inspection:** 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 condition. The Contractor shall reply to the

Engineer within 7 Days of the date of written notice with proposed corrections. Such corrective measures shall occur within 14 Days after the date of written notice unless the Engineers agrees otherwise.

Approximately 15 Days before the end of the landscape establishment period, the Contractor shall request a final site inspection by the Engineer. Conditions found unacceptable by the Engineer shall be corrected by the Contractor within a 10-Day period immediately following the inspection. After correction, the Contractor shall notify the Engineer for a reinspection. Corrective Work shall 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 shall be arranged by the Engineer in accordance with the best planting time of the year.

8-02.3(13) PLANT REPLACEMENT

The Contractor shall be responsible for providing enough plants for replacement of unacceptable plant Material through the landscape establishment period.

All replacement plants shall be of the same species and size as the plants they replace, and shall be healthy and vigorous growers, unless the Engineer determines an equal value substitute plant be provided.

Relocated trees larger than 4-inch DBH that fail to survive shall 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 shall be assessed by the Engineer per Section 8-02.3(22).

8-02.3(14) LAWN INSTALLATION

8-02.3(14)A GENERAL

Lawn installation shall be by sodding unless "Seeded Lawn Installation" is specified in the Bid Form, and shall include Lawn Establishment as specified in Section 8-02.3(15) when specified in the Bid Form.

In areas with automatic irrigation, lawn installation shall not begin until the sprinkler system is operational. The Contractor may request the Engineer to approve the option of sodding in lieu of seeding for lawn installation; however, seeding in lieu of sodding will not be allowed.

Dates to seed: seeding, fertilizing, and mulching shall 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 should the Contractor schedule this portion of the Work outside the allowable time frames.

See Section 8-02.3(6)A for dates to plant groundcover, shrub, and tree.

8-02.3(14)B SEEDED LAWNS

Seeded lawn installation shall proceed through the following sequence of steps in its construction and shall be coordinated with irrigation system construction when applicable:

1. Areas to receive seed shall be cleared and grubbed, and the surface graded to a uniform surface including accommodating vertical clearances adjacent to improvements as specified in Section 8-02.3(4).
If the surface is determined suitable for seeding by the Engineer, no planting soil or decomposed organic mulch amendment will be required. Where fill is required, playfield soil shall be provided to bring the surface to finish grade.
If the existing soil is unacceptable for seeding, the Contractor shall remove enough Material to allow for the placement of a minimum of 2 inches of playfield soil, or placement of a minimum 1 inch of decomposed organic Mulch for seeding.
2. After the addition of any amendment and application of lime, the area shall be mechanically tilled to a depth of 4 inches to achieve a homogeneous blend. Soil shall 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.
3. The area shall then be rolled in 2 directions, the second rolling at right angles to the first. The roller shall be of a standard, waterfilled type to apply 150 to 300 pounds per square foot ground pressure.
4. The finished grade shall meet the vertical clearance requirements adjacent to improvements as specified in Section 8-02.3(4).
5. Fertilizer shall be applied as specified in Section 9-14.3(1). Coverage shall be fairly uniform and all areas shall be covered.
6. Apply the Contract-specified lawn seed mix by hydroseeding, mechanical, and hand application methods as the area may require.
7. Rake seed and fertilizer into the top 1/2 to 1 inch of soil to produce a uniform, dense lawn.
8. Roll the area in 1 direction.
9. Water the rolled area with a 1 inch average depth of water without causing erosion and sedimentation.
10. Temporary flagging and warning signs shall be installed preventing the public from disturbing and damaging newly installed lawn.
11. The lawn establishment period shall follow the Engineer's acceptance of the newly installed lawn.

NOTE: Items 5 to 9 may be accomplished by hydro-seeding as described in Section 8-01.3(5)D.

8-02.3(14)C SODDED LAWNS

A sod installation shall proceed through the following sequence of steps in its construction and shall be coordinated with irrigation system construction when applicable:

1. Areas to receive sod shall be cleared and grubbed and the surface graded to a uniform surface such that the root crown of sod will be at grade with adjacent curb, sidewalk, and other pedestrian improvement. If the existing soil is determined unsuitable by the Engineer for sodding, the Contractor shall remove enough soil to allow for either a placement of 2 inches of playfield soil, or placing a uniform 1 inch depth of decomposed organic mulch.
2. After any necessary preparation in item 1. above, lime shall be applied the specified rate, and then the area shall be mechanically tilled to a depth of 4 inches to produce a homogeneous blend.
3. The area shall then be raked by approved hand or mechanical methods in order to remove and dispose of all large clods, rocks, debris, and litter larger than 1 inch in any dimension.
4. Fertilizer shall be spread over the soil at a rate of 1 pound of Nitrogen per 1,000 square feet.
5. The area shall then be compacted by rolling in two directions. The second rolling shall be done at right angles to the first. The roller shall be of a standard, water-filled type applying 150-300 pounds per square foot ground pressure. The grade after compaction shall be sufficiently smooth to accommodate full contact with overlying sod.
6. The sod strips shall be placed within 48 hours after being cut. The soil subgrade shall be adequately pre-moistened by sprinkling water prior to the laying of the sod. Sod shall be placed such that it is in full contact with the soil without voids and with a snug fit with previously laid sod. Joints shall be staggered with adjacent sod strips and shall show no void. On sloped areas, sod shall be placed along the contour and where change in grade is variable, sod shall be cut to follow the contour as reasonably as can be done as determined by the Engineer. When installing sod to restore partially disturbed lawn areas, the Contractor shall 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 shall 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, shall constitute a smooth transition between new and existing stands of grass.
7. Following placement, the sod shall be rolled with a smooth, water-filled type roller. After rolling, the sod shall receive a minimum 1 inch depth of water. Lawn areas shall have smooth finished grading.
8. Visible joints between sod strips shall receive mixture of 50 percent sand and 50 percent decomposed organic mulch amendment.
9. Temporary flagging and warning signs shall be installed preventing the public from disturbing and damaging newly sodded area.
10. The lawn establishment period shall follow the Engineer's acceptance of the newly installed sod.

8-02.3(15) LAWN ESTABLISHMENT

Lawn establishment work shall be performed by personnel qualified in and experienced with, sustainable turf management practices.

Lawn establishment shall consist of providing adequate and proper care for all public and private lawn areas installed within the limits of the project. The lawn establishment period shall begin upon acceptance by the Engineer based upon both a uniform stand of grass and upon completion of a first mowing. Lawn Establishment shall extend for a minimum of 90 Days during the active growing season (defined as consecutive Days from April 30th to October 30th). During the lawn establishment period, the Contractor shall ensure the continuing healthy growth of the lawn.

Adequate and proper care shall include the labor, materials, and equipment necessary to keep installed lawn whether seeded or sodded, in a presentable condition including, but not limited to, watering, mowing, trimming, cutting disposal unless an acceptable mulch mower is used, 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 shall be in accordance with 8-02.3(3). As a part of lawn establishment, the Contractor shall:

1. **Submittal:** The Contractor shall submit at least 5 Working Days in advance, the proposed watering and mowing schedules to the Engineer. The submittal shall also identify the type of mower equipment to be used.
2. Mow and edge to limit the maximum height of lawn to 3 inches. The cutting height shall be 1½ inches with all cuttings removed, unless mulching mower equipment is used.
3. A turf fertilizer with a slow-release form of nitrogen shall be applied at the end of the lawn establishment period at the rate of application and formulation per Section 9-14.3(1). Following fertilizer application, the lawn shall be thoroughly watered with at least a 1 inch depth of water.
4. Watering shall be accomplished each week from March through September. When water application is by automatic irrigation system, then watering shall be done between the hours of 2:00 AM and 5:00 AM. At a minimum, a uniform application of 1 inch of water shall be required over all lawn areas each week. The Contractor shall be prepared to water more frequently should very dry conditions persist.
5. 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 shall make the necessary corrections within 5 Working Days of the date of the written notice and shall provide at least 2 Working Days

advance notice of doing such corrective work. Acceptance of lawn planting as specified herein shall 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 shall be remedied by regrading, removing and reseeding or resodding, refertilizing, removing, and rewatering, as appropriate.

6. Upon acceptance of lawn establishment by the Engineer, all temporary flagging and warning signs shall be removed.

Approximately 10 Days before the end of the lawn establishment period, the Contractor shall request a final inspection for acceptance of the established lawn. Conditions found unacceptable by the Engineer shall be corrected by the Contractor within 5 Working Days of such notice. When such correction is required, the lawn establishment period shall extend an additional 45 Days including performance of the requirements listed in items 1 through 4 above.

8-02.3(16) REMOVABLE PAVER BLOCKS IN TREE PITS

The Contractor shall install paver blocks of the size and type specified at the locations shown and as indicated in the Contract. Paver blocks shall 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. A bed of compacted sand shall be used as a setting bed for the pavers.

Voids or joints between pavers shall not be wider than ¼ inch and all voids between pavers and sidewalk and between pavers shall be filled with sand. The installation method shall provide a secure edge adjacent to sidewalk and curb and any slack shall be around the tree trunk for trunk growth. If for any reason paver installations in the tree pits become loosened or dislodged during Contract Time, the Contractor shall restore the paver installation to a condition acceptable to the Engineer. Excess sand and dirt shall be swept up and disposed of.

8-02.3(17) TURF REINFORCING GRID BLOCKS

The Contractor shall install grid blocks of the type specified at the locations and as indicated in the Contract. Areas receiving grid blocks shall 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% as determined by Section 2-03.3(14)E. After the subgrade has been approved by the Engineer, the Contractor shall install a sub-base of Mineral Aggregate Type 1 to a compacted depth of 6 inches where the relative density shall meet or exceed 95% as determined in Section 2-03.3(14)E.

Thereafter, a 2-inch sand setting bed shall be spread and tamped or rolled on top of the crushed rock base. The grid blocks shall then be placed on the sand bed and each block leveled with each adjacent block. The top of the blocks shall 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) shall be spread and worked into all voids. The area receiving grid blocks shall 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 shall install cedar edging as required and indicated in the Contract. Edgings shall 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 shall be secured with 2-inch by 2-inch by 12-inch cedar stakes in accordance with the detail shown 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 in the Contract, the Contractor shall prepare the soil subgrade, place and compact the base course (if required), and install the paver edge restraint system in accordance with the manufacturer's instructions. The edging shall be black or dark in color. For added support, selected Material or planting soil shall be placed against the restraint system before pavers are installed. The paver restraint system shall be inspected and approved by the Engineer before any backfilling occurs.

8-02.3(18)C EDGING, LANDSCAPE TIMBERS

The Contractor shall install 6-inch by 8-inch landscape timbers where required in the Contract. Timbers shall 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 indicated in the Contract. Timbers shall be secured with four No. 4 by 30-inch long reinforcing steel bars placed along the centerline axis and driven flush with the timber surface. Reinforcing steel shall be provided minimum 2 foot on center. Each timber shall have a minimum of 2 reinforcing steel bar. The Contractor shall 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 shall install bollards of the type specified in the Contract. Bollards shall be installed where indicated on the Drawings and in accordance with the requirements specified in the Contract.

Bollards shall be installed true to line and grade and set in a plumb position.

The Contractor shall furnish one padlock and 2 keys for each removable bollard. Padlock cores shall be provided as indicated in the Contract.

8-02.3(19)B WOOD BOLLARDS

The tops of concrete footings for wood bollards shall be formed and troweled level with surrounding surfaces.

8-02.3(19)C CONCRETE BOLLARDS

The Contractor shall construct reinforced concrete bollards where shown in the Contract. Bollards shall be of the size and shape indicated on the Drawings.

Bollards shall be set in excavated holes true to line and grade in a plumb position with backfill thoroughly tamped around them.

8-02.3(19)D STEEL BOLLARDS

The Contractor shall construct steel bollards where shown in the Contract. Bollards shall be of the size, Material, and shape indicated in the Contract.

Bollards shall be set in excavated holes true to line and grade in a plumb position with suitable backfill thoroughly compacted around them.

8-02.3(20) BENCHES

The Contractor shall install benches of the type indicated and as located in the Contract. The Contractor shall provide at least 1 Working Day advance notice prior to placement to the Engineer of proposed bench locations for verification.

8-02.3(21) TREE GRATES

The Contractor shall install tree grates at locations indicated in the Contract. Tree grates shall meet the requirements of Section 9-14.14.

The tree pit opening in concrete sidewalk shall be sized to accommodate the tree grate. The tree grate shall 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 shall be dimensioned for compatibility with the grate, and shall typically consist of legs which are 1-inch by 1-inch by 1/4-inch 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 shall be welded to the horizontal bottom leg of the angle iron frame at 18-inch centers, and embedded in the concrete sidewalk. The grates shall be sized to have a minimum of 1/2-inch bearing on each horizontal angle frame leg. Top of grates shall be flush with top of adjacent sidewalk. A continuous tooled scribe line shall 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 shall end at the curb.

Concrete sidewalk placed against the tree grate frame shall have a thickened edge surrounding the grate. The thickened edge shall 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 shall taper to sidewalk thickness in the remaining 4-inch width.

When concrete collar is detailed on the Drawing in lieu of thickened edge, such collar shall be no less than 8 inches deep by 8 inches wide, and shall be separated from the sidewalk pavement by a through joint. The angle iron frame details and anchorage will be indicated in the Contract.

8-02.3(22) RELOCATE TREE

The Contractor shall perform the Work in accordance with standard nursery practice. The tree shall be relocated while in a dormant state (see "dates to plant" in Section 8-02.3(6)A).

The tree to be relocated shall 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 prior to digging. The tree shall be dug by hand or approved equipment. The Contractor shall exercise extreme caution when working within the drip line of the tree to avoid damage to the trunk, branches or root structure. The Contractor shall prevent damage to adjacent plant material. Should adjacent plant material become damaged, the Contractor shall remove the damaged plant material and replace and establish new plant material in accordance with 8-02.3(12) at no separate or additional expense to the Owner.

The root ball shall be formed to encompass the entire fibrous root system within the minimum root ball diameters given for corresponding tree trunk diameters in the following table:

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 depth of the root ball shall be no less than 1/2 of the root ball diameter listed above. Exposed tree roots of 1-inch diameter and more shall be cut clean before wrapping the root ball. The root ball and moisture protecting medium shall be thoroughly wrapped with burlap, laced with 1/4-inch polypropylene rope, and shall be kept continuously moist until planted.

Tree removal work shall be performed with the Engineer present. The Contractor shall 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 shall 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 shall be kept moist.

The requirements of landscape establishment of Section 8-02.3(12) shall apply to relocated trees. If a relocated tree is damaged and does not reasonably and acceptably establish itself after relocation, then the Contractor shall replace the tree at the sole expense of the Contractor. Replacements for trees larger than 4 inch DBH, shall be provided in a minimum 3.5- to 4" inch caliper size and shall 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 shall reimburse the Engineer for the difference in value between the in accordance with the "Guide For Establishing Values of Trees and Other Plants" prepared by the Council of Tree and Landscape Appraisers", current edition. Removal and proper disposal of unacceptable trees shall be the responsibility of the Contractor.

8-02.3(23) TREE ROOT PRUNING PROCEDURE

See Section 1-07.16(2) and 8-02.3(7).

8-02.3(24) TUNNELING OR TRENCHING, AND TREE ROOTS

See Section 1-07.16(2).

8-02.3(25) MOWING

The Contractor shall mow all grass growing areas and slopes 2-1/2 horizontal to 1 vertical or flatter except for naturally wooded and undergrowth areas. Trimming around traffic facilities, Structures, curbs, tree pits, planting areas, or other features extending above ground shall 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 shall be incidental to mowing and shall be provided by the Contractor when directed by the Engineer to control encroachment of grass.

Each mowing shall be considered as one coverage of all grass areas to be mowed within a defined area. Prospective Bidders shall verify the estimated acreage for mowing as shown in the Contract, the topography, irregularity of the area, slopes involved, and access limitations to determine the appropriate equipment to use. Equipment and tools shall 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 shall 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 shall be in good repair at all times and maintained so that a clean, sharp cut of the grass results. The actual number of mowings will be based on the growth rate of the grass where mowing is required. Cutting shall occur at a height of grass of 3 to 4 inches, producing 1-1/2 to 2 inch blade height.

Grass cutting equipment shall 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. 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. The Contractor may request permission to mulch clippings in place based upon the Engineers pre-approval of equipment, mowing height and proposed mowing schedule. The Contractor shall collect and dispose of clippings from all pedestrian and vehicular traffic areas, and from any other improvement.

8-02.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

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", and for "Mulch, (Type)" will be per cubic yard.

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.

8-02.5 PAYMENT

Compensation for the cost necessary to complete the Work described in Section 8-02 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

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)" shall 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 (\$ _____)" shall include all costs for the work required to establish the landscape including all costs for the work required in Section 8-02.3(12) including all costs associated with Section 2-07. 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 in 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 in the Bid Form will be revised to reflect the Bid item lump sum minimum price allowed including the extension and shall govern as becoming a part of the Bid. Payment shall be made at the rate of 25 percent of the Bid item lump sum price for "Landscape Establishment, Min. Bid (\$ _____)" at the following periods: May 31, July 31, September 30 and the final 25% at the end of the landscape establishment period **and** after the necessary corrections and replacements have been made. The Contractor shall 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. **"Playfield Soil"**, per cubic yard.

The Bid item price for "Planting Soil", "Topsoil (Type)", and for "Playfield Soil" shall include all costs for the work required to furnish, mix, place and grade the specified type soil.

8. **"Mulch, (Type)"**, per cubic yard.

The Bid item price for "Mulch, (Type)" shall include all costs for the work required to furnish, install and rototill the specified type mulch.

9. **"Paver Block, (Size)"**, per each.

The Bid item price for "Paver Block, (Size)" shall 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" shall 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)" shall 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)" shall include all costs for the work required to furnish and install the specified type bollard and shall include the padlock for removable bollard.

13. **"Bench"**, per each.

The Bid item price for "Bench" shall 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" shall 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 indicated 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" shall 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" shall 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 shall 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, should the Contractor with approval of the Engineer substitute sodding in lieu 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 herein but not specifically mentioned, shall be incidental to, and all costs therefore shall 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 (\$ _____)" shall 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" shall 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 in 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 in the Bid Form will be revised to reflect the Bid item lump sum minimum price allowed including the extension and shall govern as becoming a part of the Bid.

Payment will be made in two payments at the rate of 50% 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 requirements.

21. "Relocate (Item)", per each.

The Bid item price for "Relocate (Item)" shall include all costs for the work required to remove and relocate the specified item.

22. 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 shall be included in the applicable Bid items and no separate or additional payment will be made therefore. If the Bid Form does not contain either a lawn establishment or a mowing Bid item, payment will be in accordance with Section 1-04.1(2).

Payment for clearing and grubbing will be in accordance with Section 2-01.5.

Payment for establishing the subgrade of planting areas prior to actual planting by excavation or embankment construction will be in accordance with Section 2-03.5.

Payment for fill Material of the type specified will be in accordance with 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 shall be included in the Bid item price of the applicable Bid item.

Any incidental work required to complete the roadside planting specified herein, but not specifically mentioned in these Specifications shall be incidental to the roadside planting, and all costs therefore shall be included in the Bid item prices of the Bid items.

SECTION 8-03 IRRIGATION SYSTEM

8-03.1 DESCRIPTION

Section 8-03 describes work consisting of furnishing and installing a complete and functional sprinkler irrigation system in accordance with the Contract.

The Contractor or Subcontractor shall be a Washington State licensed irrigation contractor. The irrigation system shall be installed by a journeyman irrigation mechanic or journeyman plumber and shall 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 shall provide notice to the Engineer for Seattle Public Utilities' Customer Service Division to inspect and approve the piping and back flow prevention devices.

Electrical Work shall be performed by a licensed electrical contractor. Required permits for electrical work other than irrigation, and other than street lighting and signals, shall be obtained in accordance with Section 1-07.6. The Contractor shall obtain a class 2 electrical permit from the Seattle Department of Planning and Development, when required in the Contract. The Contractor shall become thoroughly familiar with the electrical environment within the Project Site and with the relevant work.

Excavations over 4 feet deep are subject to the provisions of Section 7-17.3(1)A7a, Trench Safety Systems.

8-03.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Irrigation System Materials	9-15
Backflow Prevention Assemblies	9-30.16
Electrical Conduit	9-34.3
Geotextile	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 shall coordinate installation and operation of the irrigation system with landscaping construction.

The Contractor shall check and verify all pertinent dimensions at the Project Site before proceeding with the Work. Before installing the irrigation system, the Contractor shall carefully note all finish grades. Finish grades changed in the course of the Work shall be restored so that the terrain conforms to the finished grade.

The Contractor shall furnish the necessary equipment for proper execution and completion of all irrigation Work and shall make the connections to the water and electrical services. After payment for the new service has been received, Seattle Public Utilities' Water Operations will furnish and install the water service, water meter and meter box. The Contractor shall be responsible to request service coordination with the Engineer and shall allow 8 weeks for installation by Seattle Public Utilities' Water Operations.

After installation of the water service and meter, an acceptable backflow prevention assembly (BPA) between the water meter and the irrigation system shall be installed and tested. The Contractor shall 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 9-30.16 and 1-07.28 item 7D.

The Contractor shall 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 Seattle City Light.

Where indicated on the Drawings, piping and wiring shall be installed within plastic pipe sleeves of sufficient inside diameter to permit easy withdrawal and reinserting of the piping or wire. Pipe sleeves and piping shall have a minimum of 12 inches soil cover for water pipes, and electrical conduit including conduit sleeves shall have a depth of soil cover of 18 inches 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 shall be installed 6 inches above the piping or conduit, and 4 inches above the sleeve as indicated on Standard Plan no. 128.

8-03.3(2) LAYOUT OF IRRIGATION SYSTEM

Before construction begins, the Contractor shall 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 in order to conform to ground conditions and to obtain full and adequate coverage of sprinkler water. The Contractor shall be responsible for informing the Engineer of any anticipated coverage inadequacies. However, no changes in the system as planned shall be made without the prior authorization of the Engineer.

8-03.3(3) EXCAVATION

All pipe shall be laid in trenches shall be no wider than necessary to lay pipe and install equipment (see Standard Plan no. 128). The top 6 inches of topsoil, when such exists, shall be kept separate from other subsoil and shall be used as the topmost 6 inch layer when backfill is made. Trench bottoms shall be relatively smooth and be of suitable Material free from rocks, stones, or other deleterious material which might damage the pipe. All trenches shall 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 shall be on a straight line between sprinkler heads or other appurtenances and shall be without abrupt changes in grade.

Care shall 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 shall be hand-excavated and tunneled. When 2 inch or larger tree roots are exposed, they shall be wrapped with heavy burlap for protection and be kept moist to prevent drying. No cutting of tree roots larger than 2 inch will be allowed. Where excavating near trees exposes tree roots 2 inches or less in diameter, the Contractor shall clean cut the exposed roots at the trench wall to minimize further damage to the root. In no case shall tree roots be removed by pulling them from the soil. Trenches with exposed tree roots shall be backfilled within 24 hours. Trenches with burlapped roots shall have the burlap removed prior to backfilling.

8-03.3(4) PIPING

All lateral lines and power supply lines shall be a minimum of 18 inches below finished grade measured from the bottom of the pipe, and all mainlines and sleeved pipe shall be a minimum 24 inches below finished grade measured from the bottom of the conduit (see Standard Plan no. 128). All irrigation pipe placed under pavement, without exception, shall be placed in sleeves. Such sleeves shall extend a minimum of 1 foot beyond the limits of pavement. All jacking operations shall be performed in accordance with an approved jacking plan which shall be submitted to the Engineer at least 5 Working Days in advance for review. Where possible, mains and laterals or section piping shall be placed in the same trench and horizontally separated by 6 inches. Bedding Material shall 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 power conduit.

Mainlines and lateral lines shall be 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 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 shall 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 shall be plugged or capped to prevent entry of dirt, rocks, or other debris.

All galvanized steel pipe shall have sound, clean cut, well fitted standard pipe threads. All pipe shall be reamed to the full diameter and have all burrs removed before assembly. Threaded joints shall be constructed using either a nonhardening, nonseizing multipurpose sealant or teflon tape or paste as recommended by the pipe manufacturer. All

threaded joints shall be made tight with wrenches without the use of handle extensions. Joints that leak shall be cleaned and remade with new Material. Caulking or thread cement for making joints tight will not be permitted.

PVC pipe, couplings, and fittings shall be installed in accordance with the manufacturer's recommendation. The outside of the PVC pipe shall be chamfered to a minimum of 1/16 inch at approximately 22 degrees. Pipe and fittings shall be joined by solvent welding. Solvents used shall penetrate the surface of both pipe and fitting in order to produce complete fusion at the joint. Use solvent and cement only as recommended by the pipe manufacturer.

PVC pipe ends shall be cut at 90 degrees to their longitudinal axis and cleaned of all cutting burrs prior to cementing. Use approved reaming tool. Pipe ends shall be wiped clean with a rag and lightly wetted with PVC primer. A light coat of cement shall be applied on the inside of the fitting and a heavier coat on the outside of the pipe. The pipe shall be inserted into the fitting and given a quarter turn to seat the cement. Excess cement shall be wiped from the outside of the pipe. Pipe shall be tested as indicated elsewhere in these Standard Specifications. No backfilling will be permitted, other than 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 shall exercise care in their handling, loading, unloading and storing to avoid damage. The pipe and fittings shall be stored under cover. Pipe shall 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 shall be set aside until such damage has been cut out and the pipe sections rejoined with a coupling.

Solvent-welded joints shall be given at least 15 minutes set-up time before moving or handling. Pipe shall be partially center-loaded to prevent arching and slipping. No water shall be permitted in pipe until a period of at least 10 hours has elapsed for solvent weld setting and curing.

Backfilling shall 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 shall be given at least 24 hours curing time.

8-03.3(6) INSTALLATION

Final position of planting bed sprinkler heads shall be as shown in Standard Plan nos. 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 shall be flush with finish grade. All sprinklers adjacent to walks, curbs, and pavement shall be placed 6 inches clear of the edge unless otherwise indicated in Contract.

Shrub sprinkler heads shall be placed on permanent risers approximately 12 inches above finished grade, except pop-up risers shall be used when located adjacent to walks or driveways. All risers shall have approved flexible swing joints.

Final position of valve boxes, capped sleeves, and quick coupler valves in planting beds shall be between 1/2 and 1 inch above finished grade or mulch. Final position of valve boxes shall be flush with finish grade. The geotextile placed under the Mineral Aggregate Type 4 for the quick coupler valve as indicated on Standard Plan no. 121 shall be a nonwoven low survivability underground drainage geotextile as specified in Section 9-37.

Drip irrigation emitters shall be installed in accordance with 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 shall 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 shall be run from the automatic controller to each valve. A white colored wire shall be used for the neutral as specified in the National Electrical Code. Wires shall 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 shall be common to each valve in the system. A loop shall be provided at each valve in any wire that passes or terminates at that valve. Loop knot end of spare wire at valves where wire dead-ends.

Splice insulation shall 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 shall be left at each junction box and automatic control valve to facilitate splicing and inspection.

Electrical service shall be provided at controller enclosures as shown on the Drawings.

A diagram of the wiring schedule shall be pasted in the controller cabinet to facilitate the selection of valves to be operated.

The minimum size of wire shall be determined strictly by the following chart:

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 above table are AWG.

The control wires shall be color-coded as follows:

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 indicated in the Contract, all electric work shall be installed by an electrician licensed in the State of Washington.

Completion of irrigation work may require inspection and approval of the electrical system by DPD. 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 9-30.16 shall be furnished and installed in an approved vault as indicated on Standard Plan no. 125. The installation shall be verified acceptable by the Engineer. The Contractor shall 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 7D for notification requirements). All backflow prevention assemblies shall be provided acceptable drainage outlets and shall not be submerged in water. Any drainage problems encountered at the time of system layout or installation shall 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 shall be completed before backfilling irrigation system trenches.

The Contractor shall notify the Engineer at least 24 hours before conducting pressure tests.

All gauges used in the testing of water pressures shall 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 shall be tested for a consecutive two week period under normal operating conditions. Should adjustments be required, the Contractor shall carry them out according to the manufacturer's directions and continue tests until operation is acceptable.

Flushing shall be accomplished as follows:

Main Line Flushing: All main supply lines shall receive two 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 prior to testing.

Main Line Testing: All main supply lines shall 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 shall be done with one pressure gauge installed on the line at a location specified by the Engineer. The Contractor shall be prepared to install an additional pressure gauge when so directed by the Engineer. Lines which show loss of pressure exceeding 5 psi at the ends of test periods indicated in the Contract will be rejected.

The Contractor shall correct rejected installations and shall retest them for acceptance.

Lateral Line Flushing: All lateral lines shall receive one fully-open flushing prior to placement of sprinkler heads, emitters, and drain valves. The flushing shall be of sufficient duration to remove any dirt or debris that may have entered the lateral lines during construction.

Lateral Line Testing: All lateral lines shall be purged of air and tested under operating line pressure with risers capped and drain valves closed. The operating line pressure shall be maintained for 30 minutes through open valves and pressure regulating devices. Lines which show leaks at the end of the specified test periods shall 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, shall 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 shall correct and retest lateral line installations that have been determined unacceptable.

Throughout the life of the Contract, the Contractor shall 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 shall be brought up to operating pressure. The Contractor shall then conduct a thorough inspection of all sprinkler heads, emitters, etc., 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 shall adjust and balance all sprinklers to provide adequate and uniform coverage. Spray patterns shall 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 shall 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 shall be corrected by the Contractor to an acceptable condition at the Contractor's sole expense.

8-03.3(11) BACKFILL

The Contractor may begin 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 shall be sand or selected Material approved by the Engineer. Backfilling from the bottom of the trench to approximately 6 inches above the pipe shall be done by continuous compacting in a manner that does not damage pipe or wiring and shall proceed evenly on both sides of the pipe. The remainder of the backfill shall be thoroughly compacted, except that heavy equipment shall not be used within 18 inches of any pipe. The top 6 inches of backfill shall consist of either topsoil or the upper 6 inches of excavated Material if found suitable by the Engineer.

Detectable marking tape shall 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 shall be as recommended by the manufacture for the maximum burial depth to be encountered on the project.

The Contractor shall give 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 shall be re-excavated, the system uncovered and left exposed until it is approved for backfilling by the Engineer.

Restoration of ground surface shall include the resetting of removed sod. Sod survival shall be the responsibility of the Contractor.

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 shall 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 shall be reproducible and on sheets conforming in size to the provisions of Section 1-05.3(10).

Before system operation testing (Section 8-03.3(13)), the Contractor shall 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 shall provide the Engineer with an Operations and Maintenance Manual (O&M Manual) per Section 1-05.3(11). The Contractor shall provide written notice to the Engineer at least two weeks prior to the training and orientation session. The date and time of the training session shall be subject to approval of the Engineer.

The Operations and Maintenance Manual (O&M Manual) shall include the following:

1. Catalogues of Materials used;
2. Parts lists;
3. Summary of all operations (spring start-up and winterization techniques, controller programming, valve cleaning, sprinkler adjustment, backflow prevention, etc.); 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 shall be completely tested and fully operable in the automatic mode prior to planting in the sprinkled area except where otherwise specified in Contract. The Contractor shall, in the presence of the Engineer, do a water coverage test for each sprinkler zone in the system. The Contractor shall change nozzles and make all necessary adjustments to obtain full coverage with minimum overspray. All balancing and adjusting of the system shall have been completed before requesting system operation testing. The Contractor shall 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 ordered 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 shall include restoration of the ground surface to compensate for settling of trenches.

For the life of the Contract, the Contractor shall be 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 shall be shown on the final as-built record set of drawings and shall be submitted to the Engineer for approval no later than 5 Working Days after the date of system operation testing accepted by the Engineer.

8-03.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

8-03.5 PAYMENT

Compensation for the cost necessary to complete the Work described in Section 8-03 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **"Irrigation System, Automatic"**, per lump sum.

The Bid item price for "Irrigation System, Automatic" shall 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, valve 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 shall be 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" shall 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" shall 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)" shall 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" shall 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 shall 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 in accordance with Section 1-05.3.

SECTION 8-04 CEMENT CONCRETE CURB, CURB AND GUTTER**8-04.1 DESCRIPTION**

This Work shall consist of constructing Portland cement concrete curb, and curb and gutter.

8-04.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Portland Cement	9-01
Concrete Aggregate	9-03
Premolded Joint Filler	9-04.1
Reinforcing Steel	9-07
Curing Compounds	9-23

The Portland cement concrete shall meet the requirements of Section 5-05. Concrete mix for curb and gutter Type 410B shall be Class 5 (1-1/2), and for curb Type 410C shall be Class 5 (3/4). Slump of the concrete mix shall not exceed 3-1/2 inches.

Epoxy grout for curb dowel anchored in concrete shall be ASTM C 881, Type 1 epoxy grout.

Dowels and reinforcing steel shall 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 shall be accomplished by hand methods. Where curb or curb and gutter construction is in an area with exposed tree roots 2 inch or greater in diameter, the Contractor shall work with the Engineer as indicated in Section 1-07.16(2).

The subgrade shall be prepared in accordance with Section 2-06 and properly compacted to the specified grade and width. The compacted subgrade shall extend at least one 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 shall comply with the requirements of Section 8-14.

The opening of new pavement placed with new curb shall comply with the requirements of Section 5-05.3(17).

8-04.3(1)A ERECTING FORMS

Before erecting forms, the Contractor shall bring the subgrade to the required line, grade and compaction. Curbs shall not be set until the subgrade has been compacted to within one inch of established grade.

Forms, wood or steel, shall be staked securely in place, true to line and grade.

Sufficient support shall be given to the form to prevent movement. Forms shall be clean and well oiled prior to setting in place. When set, the top of the form shall not depart from grade more than 1/8 inch when checked with a 10-foot straightedge. The alignment shall not vary more than 1/8 inch in 10 feet. Immediately prior to placing the concrete, forms shall be carefully inspected for proper grading, alignment and rigid construction. Adjustments and repairs as needed shall be completed before placing concrete.

8-04.3(1)B PLACING CONCRETE

The subgrade shall be properly compacted and brought to specified grade before placing concrete. The subgrade shall be thoroughly dampened immediately prior to the placement of concrete. Concrete shall be placed and consolidated into the forms to provide a dense, compacted concrete free of rock pockets. The exposed surfaces shall be floated, finished, and brushed longitudinally with a fiber hair brush approved by the Engineer.

The rate of concrete placement shall not exceed the rate at which the various placing and finishing operations can be acceptably performed in accordance with these Specifications.

8-04.3(1)C DOWELS

Dowels shall be placed in the pavement slab as detailed on Standard Plan no. 411.

The dowel bars shall 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 shall be stripped early enough in the curing process to permit correction of all irregularities that may appear.

Forms may be removed on the Day following the pour if the concrete has set sufficiently to retain its true shape and removal causes no chipping or spalling. When forms are removed before the expiration of the curing period, the concrete shall be protected and cured. The exposed surface of the curb shall be brushed with a fiber hair brush.

8-04.3(1)E CURING

Transparent curing compound shall be applied to all exposed surfaces immediately after finishing. Transparent curing compounds shall contain a color dye of sufficient strength to render the film distinctly visible on the concrete for a minimum period of 4 hours after application.

If, at any time during the curing period any of the forms are removed, a coat of curing compound shall be applied immediately to the exposed surface. The curing compound shall be applied in sufficient quantity to obscure the natural color of the concrete. Additional coats shall be applied if the Engineer determines that the coverage is not adequate. The concrete shall be cured for the minimum period of time set forth for pavement in Section 5-05.3(13)A.

8-04.3(1)F EXPANSION AND DUMMY JOINTS

Joints shall be constructed in the manner shown on Standard Plan nos. 410 and 411 at locations to match joints in new concrete pavement, unless otherwise indicated in the Contract. In no case shall joint spacing exceed 15 feet center to center. All expansion and construction joints shall extend entirely through the curb section. Joint filler in the curb shall be normal to the pavement and in full butt contact with the pavement joint. Joints shall match existing transverse joints or cracks in existing pavement.

Locations of joints associated with depressed curbs for curb ramps shall comply with Section 8-14.3(7).

8-04.3(1)G FINISHED WORK

When checked with a 10-foot straightedge, grade shall not deviate more than 1/8-inch, and alignment shall 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 shall 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 shall be constructed monolithic with curb as shown on Standard Plan nos. 422a and 422b.

New curb installation with no sidewalk shall 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) RESERVED**8-04.3(4) TYPE 410B CURB AND GUTTER**

Curb and gutter shall be constructed as shown on Standard Plan no. 410 on a compacted subgrade prepared in accordance with 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 in accordance with Section 8-06, or the curb may be extruded upon the gutter section in which case steel dowels shall be provided as specified in Section 8-04.3(1)C.

Premolded joint filler shall be as shown on Standard Plan no. 411.

8-04.3(5) TYPE 410C CURB**8-04.3(5)A CEMENT CONCRETE CURB ON EXISTING PAVEMENT**

Cement concrete curb constructed on an existing pavement shall be doweled into the existing pavement as shown on Standard Plan nos. 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 shall comply with the requirements of Section 6-02.3(30). 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 6-02.3(31). Holes shall be spaced as indicated on the Standard Plans. The distance from the top of the finished curb to the top of the dowel shall be one inch. The epoxy resin system used shall be Type I meeting the requirements of Section 9-26.

Premolded joint filler shall be as shown on Standard Plan no. 411.

8-04.3(5)B CEMENT CONCRETE CURB ON NEW PAVEMENT

Doweled curb on new pavement shall be constructed as shown on Standard Plan nos. 410 and 411.

The pavement width shall extend to the back of the curb. The pavement where the curb is to be placed shall be roughened or otherwise treated so that a permanent bond can be secured between the curb and the pavement. Curing compound shall not be used on the pavement where curb is to be constructed.

Dowels, as detailed in Standard Plan nos. 410 and 411 shall be placed at 28 inches on center in the fresh concrete pavement.

Premolded joint filler shall be as shown on Standard Plan no. 411.

8-04.3(6) MOUNTABLE CURB

Mountable curb for traffic circles shall be constructed with the alignment and configuration as shown on Standard Plan no. 415.

The extended depth Portland cement mountable curb to be installed adjacent to asphalt pavement shall have the same dimensions as other mountable curb detailed on Standard Plan no. 415 except the depth of curb shall be extended an additional 7 inches, or more to match the greater depth of adjacent asphalt pavement.

8-04.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

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, including that portion installed through driveways and curb ramps.

No measurement will be made for curb where new curb ramps or new driveways are "cut in" to areas of existing improvements where adjacent curb is to remain as this curb is monolithic with the curb ramp, driveway, or alley access (see Section 8-14.4 and Standard Plan nos. 422a, 422b, and 430).

8-04.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-04 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "Curb, Cement Concrete", per linear foot.
2. "Curb, Cement Concrete, Mountable", per linear foot.
3. "Curb and Gutter, Cement Concrete", per linear foot.

The Bid item price for "Curb, Cement Concrete", for "Curb, Cement Concrete, Mountable", and for "Curb and Gutter, Cement Concrete" shall 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 upon which it is placed. That portion of the pavement slab underneath Type 410C curb that is new will be paid for as concrete pavement in accordance with Section 5-05.5.

SECTION 8-05 RESERVED

SECTION 8-06 EXTRUDED CURB

8-06.1 DESCRIPTION

This Work shall consist of constructing extruded asphalt concrete and cement concrete curb in accordance with these Specifications at locations shown on the Drawings and to the dimensions shown on Standard Plan no. 412. Except as noted otherwise in Section 8-06, all requirements for cement concrete curb as specified in Section 8-04 shall apply to extruded cement concrete curb.

8-06.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Portland Cement	9-01
Asphalt	9-02.1
Aggregates	9-03
Reinforcing Steel, Tie Bars	9-07
Curing Compounds	9-23

Extruded asphalt concrete curb shall consist of a hot mix asphalt concrete meeting the requirements of Section 5-04 and shall be of the HMA Class specified in the Contract.

The concrete mix design for extruded cement concrete curb shall be the following (quantities for 1 cubic yard of mix):

Cement (Type II)	658 pounds
Fine Aggregate	1,800 pounds
Coarse Aggregate	1,260 pounds
Water	245 pounds
Air	5% ±1-1/2%

Aggregate for cement concrete shall meet the requirements of Grading for Fine Aggregate as specified in Section 9-03.1(2). The curing compound shall be Type1D, Class B as specified in Section 9-23.2. Air-entrained concrete shall be used as specified in Section 9-23.6 except that air content shall range from 3 % minimum through 6 % maximum by volume.

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 shall be dry and cleansed of loose or deleterious material. Immediately after cleaning the pavement surface, a tack coat shall 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 shall be dry and cleansed of loose or deleterious Materials prior to curb placement. At the Contractor's option, concrete curbs shall be anchored to the existing pavement either by placing steel dowel bars one foot on each side of every joint or by using an adhesive. Dowel bars shall meet the dimensions shown on Standard Plan nos. 411 and 412. The adhesive shall meet the requirements of Section 9-26 for Type II epoxy resin.

8-06.3(2) RESERVED

8-06.3(3) EQUIPMENT FOR LAYING CURB

8-06.3(3)A EXTRUDED ASPHALT CONCRETE CURB

The machine for laying the curb shall 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 in accordance with Standard Plan no. 412. Curbs shall be placed in an even homogenous manner, free of honeycombs.

8-06.3(3)B EXTRUDED CEMENT CONCRETE CURB

Extruded cement concrete curb shall be placed, shaped and compacted true to line and grade with an approved extrusion machine. The extrusion machine shall be capable of shaping and thoroughly compacting the concrete to the required cross section.

8-06.3(4) MIXING AND PLACING**8-06.3(4)A EXTRUDED ASPHALT CONCRETE CURB**

The HMA asphalt concrete mixture shall be homogeneously mixed to conform with Section 5-04.3(7) and shall 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 shall be run through the curb laying machine, properly adjusted to form a well compacted asphalt concrete curb.

8-06.3(4)B EXTRUDED CEMENT CONCRETE CURB

The cement concrete mixture shall be homogeneously mixed to conform with Section 5-05.3(5) when delivered to the hopper of the curb machine. Each hopper load of cement concrete shall be run through the curb laying machine, adjusted properly to form and compact the cement mix for the concrete curb.

8-06.3(5) JOINTS**8-06.3(5)A EXTRUDED ASPHALT CONCRETE CURB**

Asphalt concrete curb construction at the specified temperature shall be a continuous operation in one direction so as to eliminate curb joints. However, where conditions are such that this is not possible, the joints between successive Days work shall 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 shall be painted with a thin, uniform coat of tack coat or cutback emulsion immediately prior to placing the fresh asphalt concrete curb against it.

8-06.3(5)B EXTRUDED CEMENT CONCRETE CURB

Joints in the extruded cement concrete curb shall be spaced at 15-foot intervals or shall match existing transverse joints or cracks in existing pavement. Joints shall be cut vertically. Joints shall not be placed at location of curb dowels.

8-06.3(6) CURING EXTRUDED CEMENT CONCRETE CURB

Type 1D, Class B liquid curing compound shall be used. Sufficient pigment shall be present so that the sprayed compound is easily discernible.

8-06.3(7) PROTECTION FROM TRAFFIC

The newly laid extruded asphalt concrete curb shall 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 shall 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 1-10.

8-06.3(8) SUBSTITUTIONS

The Contractor may substitute extruded cement concrete curb for extruded asphalt concrete curb upon submitting to and receiving approval from the Engineer (see Section 1-05.3(5)). Asphalt curb shall not be substituted for Portland cement concrete curb.

8-06.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Extruded concrete curb will be measured by the linear foot along the front face of the curb and returns.

8-06.5 PAYMENT

Compensation for the cost necessary to complete the Work described in Section 8-06 will be made at the Bid item price Bid only for the Bid item listed or referenced as follows:

1. "Extruded Curb, (Material)", per linear foot.

The Bid item price for "Extruded Curb, (Material)" shall include all costs for the work required to furnish and install the Material type extruded curb.

2. Other information.

Extruded cement concrete curb substituted for extruded asphalt curb as specified in Section 8-06.3(8) shall 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 shall consist of furnishing and installing precast Portland cement concrete traffic curb and block traffic curb of the design and type, and at the locations, specified in the Contract, conforming to these Specifications and to Standard Plan nos. 413a, 413b and 414. See Section 8-04.3(6) for traffic circle curb.

8-07.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Portland Cement	9-01
Concrete Sand	9-03.1(2)
Grout	9-04.3(2)B
Precast & Block Traffic Curb, Water Repellent Compound, Sodium Metasilicate	9-18
Paint	9-29

Glass traffic beads shall comply with the requirements of 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 shall be secured to underlying pavement as indicated on Standard Plan no. 413a. 413C curb shall 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 shall be completely filled with grout. The remaining hole above the rebar shall be a minimum 1 inch and shall be filled with grout. All traffic curb in contact with pavement shall 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 shall also be completely filled with the grout.

Before the grout bed is laid, the pavement surface shall 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 shall 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 shall be cleaned as follows:

1. The pavement shall be flushed with water.
2. While the pavement is still wet, sodium metasilicate shall 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 shall remain on the pavement for at least 15 minutes. Areas where patches of oil, tar, or grease occur shall be scrubbed with a stiff brush or broom.
4. The pavement surface shall then be thoroughly rinsed.
5. Steps 2 through 4 shall 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 indicated in the Standard Plans and in the Contract, shall be filled with grout. The Contractor shall provide the Engineer at least one Working Day advance notice of this grouting.

Joints between adjacent units of block traffic curb shall not be filled with mortar.

The alignment and the top surface of adjoining sections of curb shall be true and even with a maximum tolerance of 1/16 inch.

For traffic circles and median islands, all precast curb shall have 1 inch diameter holes for anchoring the curb to the pavement with rebar as shown on Standard Plan no. 413a.

Nosing pieces, connecting dividers, and radial sections as detailed on the Drawings shall be required at the ends of the curb lines for all types traffic curbs at transitions from Type 413C traffic curb to Type 413A traffic curb, and at Type 413A traffic curb installation with radii less than 10 feet.

8-07.3(2) PAINTING OF CURBS

Concrete traffic curbs shall be painted with 2 full coats of approved traffic paint as specified on the Drawings. The second coat shall 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 shall be applied as specified in Section 8-22.3(4)A.

8-07.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for precast traffic curb and block traffic curb 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 one face or more than one face.

8-07.5 PAYMENT

Compensation for the cost necessary to complete the Work described in Section 8-07 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "Curb, Traffic, Precast", per linear foot.
2. "Curb, Traffic, Block", per linear foot.

The Bid item prices for "Curb, Traffic, Precast" and for "Curb, Traffic, Block" shall include all costs for the work required to furnish and install the specified type traffic curb.

3. **Other payment information.**

Payment for painting precast curb will be in accordance with Section 8-22.5.

SECTION 8-08 PLASTIC LANE MARKERS AND TRAFFIC BUTTONS**8-08.1 DESCRIPTION**

This Work shall consist of furnishing and installing plastic lane markers and traffic buttons with an epoxy adhesive in accordance with these Specifications and Standard Plan nos. 700 and 710.

Color of Type 1, Type 2A, and Type 2B lane markers and traffic buttons shall match the color of the pavement markings on which they are installed. The color of applicable pavement markings are set forth in Section 8-22.

8-08.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Lane Markers Type 1 & Type 2, and Plastic Traffic Buttons	9-21
Adhesive	9-26.2

8-08.3 CONSTRUCTION REQUIREMENTS**8-08.3(1) GENERAL**

Location and spacing shall be as indicated on the Drawings or designated by the Engineer. The Engineer will provide necessary control points. The Contractor shall be responsible for preliminary spotting of plastic buttons and lane markers from the control points prior to installation. Approval by the Engineer of the layout shall be obtained before traffic button or markers are installed.

8-08.3(2) SURFACE PREPARATION

Traffic buttons and lane markers shall be bonded to clean and dry pavement with an adhesive as specified herein.

All sand, dirt and loose extraneous Material shall 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 shall not proceed until the cleaned surface has been approved by the Engineer.

8-08.3(3) ADHESIVE PREPARATION

At the time of use, the contents of Packages A and B specified in Section 9-26 shall be thoroughly blended by mixing to produce a uniformly distributed mixture. One volume or weight of Package A shall 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 revised, if approved by the Engineer.

Catalyst shall be added to the base just before use. Unused mixed adhesive shall 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 shall be maintained at a temperature between 60 °F and 85 °F before use and during application.

8-08.3(4) APPLICATION PROCEDURE

Applications of traffic buttons and lane markers to pavement shall not be done if the ambient air temperature is below 40°F or if the pavement is moist.

The mixed adhesive shall 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 shall be spaced and aligned as indicated on Standard Plan no. 710 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 established guide line will be permitted. Improperly placed buttons shall be removed and replaced at the Contractor's expense.

Bonding shall be 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 shall 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 shall install the lane markers prior to the application of the paint striping.

At the option of the Contractor, a hot melt bitumen adhesive may be used to cement markers to the pavement in lieu of epoxy adhesive. The bitumen adhesive shall conform to the requirements of Section 9-02.1(8).

Markers shall not be placed using bitumen adhesive when the pavement or air temperature is 50 °F or cooler.

Bitumen adhesive shall be indirectly heated in an applicator with continuous agitation. The adhesive shall be applied at a temperature between 400 °F and 425 °F. Markers shall be placed immediately after application of the adhesive.

Lane markers shall not be placed over any pavement joint.

8-08.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

8-08.5 PAYMENT

Compensation for the cost necessary to complete the Work described in Section 8-08 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows.

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)" shall 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 shall consist of furnishing and placing flexible delineator posts of the type specified on the Drawings in accordance with these Specifications and at the locations indicated on the Drawings or where designated by the Engineer.

8-10.2 MATERIALS

Flexible delineator posts and reflective sheeting shall be made of approved Materials and shall be purchased from manufacturers listed in the Contract.

All posts shall be a minimum length of 72 inches. Posts shall be painted white or brown as called for on the Drawings.

All flexible delineator posts shall have a permanent mark identifying the manufacturer's recommended burial depth.

8-10.3 CONSTRUCTION REQUIREMENTS

Flexible delineator posts shall be installed plumb and in accordance with the manufacturer's recommendations. The Contractor shall submit to the Engineer, the manufacturer's recommended installation procedure at least 5 working Days prior to installation. Only one type of flexible delineator post shall be used on each project.

If the ground adjacent to the posts is disturbed in any manner, it shall be backfilled to the level of the pre-existing surface and thoroughly compacted. When applicable, the new surfacing on the ground adjacent to the post shall be restored with in kind Material matching the pre-existing material.

8-10.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Flexible delineator posts will be measured by each post furnished and installed.

8-10.5 PAYMENT

Compensation for the cost necessary to complete the Work described in Section 8-10 will be made at the Bid item price Bid only for the Bid item listed or referenced as follows:

1. "Flexible Delineator Post", per each.

The Bid item price for "Flexible Delineator Post" shall include all costs for the work required to furnish and install the delineator post of the type specified, including reflectorizing and any excavating and backfilling that may be required.

SECTION 8-11 GUARDRAIL

8-11.1 DESCRIPTION

Section 8-11 describes the work consisting of constructing, modifying, 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 indicated on the Drawings.

8-11.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Guardrail Elements, Posts, Blocks, Hardware, and Anchors	9-16.3 and 9-16.8
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8-11.3 CONSTRUCTION REQUIREMENTS**8-11.3(1) BEAM GUARDRAIL****8-11.3(1)A ERECTION OF POSTS**

The posts shall 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 shall be set to accommodate the curve. End treatment shall be in accordance with the appropriate WSDOT Standard Plans unless the Contract indicates otherwise.

The dimensions of posts to be installed shall be as shown in 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 shall be as specified 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 prior to final shoulder or median compaction, surfacing, and paving.

The posts shall 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 RESERVED**8-11.3(1)C ERECTION OF RAIL**

All metal work shall be fabricated in the shop. No punching, cutting, or welding shall 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 shall be erected so that the bolts at expansion joints are located at the centers of the slotted holes.

Rail plates shall be assembled with the splice joints lapping in the direction of the traffic.

Galvanized rail plates shall be fastened to the posts with galvanized bolts, washers, and nuts of the size and kind shown on the Drawings. Weathering steel rail plates shall be fastened to the posts with weathering steel bolts, washers, and nuts of the size and kind showing on the Drawings and shall not be galvanized.

All bolts, except where otherwise required at expansion joints, shall be drawn tight. Bolts through expansion joints shall be drawn up as tight as possible without being tight enough to prevent the rail elements from sliding past one another longitudinally. Bolts shall be sufficiently long to extend at least 1/4-inch beyond the nuts. Except where required for adjustments, bolts shall not extend more than 1/2-inch beyond the nuts.

After completing the installation of weathering steel beam guardrail, the Contractor shall wash the rail with clean water under high pressure. If the rail is contaminated by oil or grease, sandblasting shall be used as necessary to clean the rail.

8-11.3(1)D ANCHOR INSTALLATION

All excavation and backfilling required for installation of anchors shall be performed in accordance with Section 2-09.

Bolts shall be tightened to the tension specified. The anchor cable shall 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.

8-11.3(1)E GUARDRAIL SHOP DRAWINGS

At least 5 Working Days in advance, the Contractor shall 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 shall be put back in place within 5 calendar Days of the date the guardrail was removed.

The Contractor's operations shall be conducted in such a manner that fixed objects including beam guardrail posts shall 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 shall have a Type G terminal end section bolted securely in place.

8-11.3(3) ACCESS CONTROL GATES

Access control gates shall be placed to line and grade as shown on the Drawings or as staked by the Engineer. After the posts have been set, the holes shall be backfilled with suitable Material and the Material thoroughly tamped.

8-11.3(4) RAISING GUARDRAIL

Guardrail shall 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 shall be tamped to prevent settlement of the raised rail.

8-11.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

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

Compensation for the cost necessary to complete the Work described in Section 8-11 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows :

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)" shall 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)" shall 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 shall be included in the Bid item price of the anchor. 10-inch x 10-inch treated timber posts (or steel alternate) will be paid separately as outlined herein.

5. **"Beam Guardrail Transition Section, (Type)"**, per each.

The Bid item price per each for "Beam Guardrail Transition Section, (Type)" shall 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" shall 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" shall 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" shall include all costs for the work required to remove and reset or raise the guardrail and for backfilling and compacting holes.

SECTION 8-12 CHAIN LINK FENCE AND WIRE FENCE

8-12.1 DESCRIPTION

This Work shall consist of furnishing and constructing chain link fence and wire fence of the types specified in accordance with the Drawings, these Specifications and Standard Plan nos. 450a, 450b, and 450c and WSDOT Standard Plan no. L-1, at the locations shown on the Drawings and in conformity with the lines as staked by the Engineer.

8-12.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Concrete Class 5	5-05
Chain Link Fence, Wire Fence, and Gates	9-16

Chain link fence shall be of diamond woven wire mesh mounted on steel posts. All fence and gate without barbed wire shall 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 shall 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 shall 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 shall be selected for use in any Contract.

Gates shall 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 shall be in accordance with Section 2-01.3(1).

For chain link type fences, the clearing width shall be approximately 10 feet. For wire type fences, the clearing width shall be approximately 3 feet. Grubbing will not be required except where short and abrupt changes in the ground contour necessitate cuts or fills in order to properly grade the fence line. All stumps within the clearing limits shall 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 shall be 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 shall be constructed close to and inside the Right of Way line unless otherwise shown in 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 shall be placed in a vertical position and, except where otherwise shown in Contract, shall be spaced at 10-foot centers. Spacing shall be measured parallel to the slope of the ground.

All posts, except line posts for Type 3 fence, shall be set in concrete to the dimensions shown in Standard Plan nos. 450a and 450c. All concrete footings shall be crowned so as to shed water. Line posts on Type 3 fence shall be set in undisturbed earth either by driving or drilling, except as specified. Driving shall be accomplished in such a manner as not to damage the post. Voids around the post shall be backfilled with suitable Material and thoroughly tamped.

Concrete footings shall 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 shall 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 shall have a minimum width 1 inch greater than the largest dimension of the post section to be set. The posts shall be cut before installation to lengths which give 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 shall be filled with grout consisting of one part Portland cement and three parts clean, well graded sand. The grout shall be thoroughly worked into the hole so as to leave no voids. The grout shall be crowned to carry water from the post.

Where solid rock is covered by an overburden of soil or loose rock, the posts shall be set to the full depth shown in the Standard Plans unless penetration into solid rock reaches the minimum depths specified above, in which case the depth of penetration may be terminated. Concrete footings shall 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.

Pull posts, as shown in Standard Plan nos. 450a and 450c, shall 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 shall be braced to the adjacent brace post(s) in the manner shown in Standard Plan nos. 450a and 450c. Changes in line amounting to 2 foot tangent offset or more between posts shall be considered as corners for all types of fence.

Steep slopes or abrupt topography may require changes in various elements of the fence. It shall be the responsibility of the Contractor to provide 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 shall 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 shall have approved tops fastened securely to the posts. The base of the top fitting for round posts shall carry an apron around the outside of the posts.

8-12.3(2)B TOP RAIL

Top rails shall 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 shall be joined by sleeve couplings. Top rails shall be securely fastened to terminal posts by pressed steel fittings or other appropriate means.

8-12.3(2)C TENSION WIRE

One continuous length of tension wire shall be used between pull posts. Sufficient tension shall be applied to avoid excess sag between the posts. Tension wires shall be tied or otherwise fastened to end, gate, corner, or pull posts by methods approved by the Engineer.

8-12.3(2)D CHAIN LINK FABRIC

Chain link fabric on Type 1, 3, 4, and 6 fence shall be placed on the face of the post as indicated on the Drawings.

Chain link fabric on Type 1, 3, 4, and 6 fences shall 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 shall be stretched taut and securely fastened to the posts. Fastening to end, gate, corner, and pull posts shall 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 shall be with tie wire, metal bands, or other approved method attached at 14 inch intervals. The top and bottom edge of the fabric shall 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 shall 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 shall 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 shall be thoroughly cleaned by wire brushing and all traces of the welding flux and loose or cracked spelter removed. The clean areas shall then be painted with two coats of galvanizing repair paint, Formula A-9-73.

The drop bar locking device for the wire gates shall be provided with a 12 inch round by 18 inch deep footing of Class 5 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 shall be as specified by the manufacturer of the locking device. A lock approved by the Engineer shall be installed on all locking gates. Four keys shall be supplied with each lock.

8-12.3(3) WIRE FENCE AND GATES**8-12.3(3)A POSTS**

Line posts shall be spaced at intervals not to exceed 14 feet. All intervals shall 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 shall be placed in a vertical position except where otherwise indicated 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 shall be set in Class 5 concrete footings to the dimensions shown in WSDOT Standard Plan no. L-1 and crowned at the top to shed water.

Class 5 concrete footings shall be constructed to embed the lower part of steel line posts, and wood anchors shall 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 shall 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 shall 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 shall have a minimum dimension 1 inch greater than the largest dimension of the post section to be set. The posts shall be cut before installation to lengths which give 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 shall be filled with grout consisting of one part Portland cement and three parts clean, well graded sand. The grout shall be thoroughly worked into the hole so as to leave no voids. The grout shall 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 shall 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 terminated. When the depth of the overburden is greater than 12 inches, anchor plates will be required on the steel line posts, and concrete footings shall 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 shall be anchored to soil or loose rock with a Class 5 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 shall be set on the diagonal as shown on Standard Plan nos. 450a and 450c and connected to the post with an approved connection.

Wood braces shall be dapped 1/4-inch into the posts and shall be fastened to each post with three 20d galvanized nails.

Wire braces shall consist of a 9 gage wire passed around the wood posts to form a double wire. The wire shall be fastened to each post with two staples and fastened together to form a continuous wire. The wires shall then be twisted together until the wire is in tension.

Where the new fence joins an existing fence, the two shall be attached in an acceptable manner, end or corner posts being set as necessary.

Pull posts shall be spaced not more than 1000 feet apart, but spacing shall 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 shall be considered as corners, and corner posts shall be installed. Where it is deemed by the Engineer that a change in alignment of less than 30 degrees materially lessens the strength of the fence, the line post at the angle shall 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 shall be pulled taut to a no slack condition, and each longitudinal wire shall be cut and securely fastened to the pull post with devices customarily used for the purpose. Wire or mesh shall not be carried past a pull post, but shall be cut and fastened to the pull post independently for the adjacent spans.

After the tensioning of the wire or mesh between two pull posts, all longitudinal wires shall be properly fastened at proper height to each intervening line post.

Wire mesh and barbed wire shall be placed on the face of the post which is away from the highway, except that on horizontal curves, the mesh and wires shall be fastened to the face on the outside of the curve.

Where unusual ground depressions occur between posts, the fence shall be guyed to the ground by means of a 9 gage galvanized wire attached to a deadperson of approximately 100 pounds buried 2 feet in the ground. The guy wire shall be securely attached to each strand of barbed wire and to the top and bottom wires of the wire mesh fabric in a manner to maintain the entire fence in its normal shape. If necessary to guy the fence in solid rock, the guy wire shall be anchored in a grouted hole 2 inches in a diameter and 10 inches deep. The operation of guying shall leave the fence snug with the ground.

8-12.3(3)C VERTICAL CINCH STAYS

Vertical cinch stays shall be installed midway between posts on both types of fence. The wire shall be twisted in such a manner as to permit weaving into the horizontal fence wires to provide rigid spacing. All barbed wires and the top, middle, and bottom wire of the wire mesh shall be woven into the stay.

8-12.3(3)D WIRE GATES

The wire mesh fabric shall be taut and securely tied to the frame and stays in accordance with recognized standard practice for wire gate construction.

Welded connections on gate frames shall be treated as specified for chain link fence gates.

The drop bar locking device for double wire gates shall be provided with a footing of Class 5 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 shall be as specified by the manufacturer of the locking device.

8-12.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Chain link fence, and wire fence, will be measured by the linear foot of completed fence, along the ground line, exclusive of openings.

8-12.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-12 will be made only at the Bid item prices Bid for the Bid items listed or referenced as follows:

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)" shall 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 shall 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 shall be included in the applicable fence and gate Bid item price.

SECTION 8-13 MONUMENT CASES**8-13.1 DESCRIPTION**

This Work consists of furnishing and setting 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 shall meet the requirements of the following Section:

Monument Frame and Covers	9-22
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The Engineer may specify in the Contract, a gray iron casting monument case and cover complying with WSDOT Standard Plan H-7 conforming to the requirements of AASHTO M 105, Class 30B. The cover and seat shall 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 will not be permitted.

8-13.3 CONSTRUCTION REQUIREMENTS**8-13.3(1) REFERENCE POINTS – GENERAL**

The Engineer will reference all monuments in advance of construction, and will tie out and reset the points and grades in coordination with Contractor activities.

It shall be the responsibility of the Contractor to furnish and install required castings and Materials in accordance with the Contract.

The Contractor shall carefully protect all reference points and witness monuments, to the monuments and shall give the Engineer a minimum 4 Working Days advance notice of the schedule for monument work removal, and a minimum 4 Working Days advance notice of monument casting installation in order to avoid destruction of the survey points. See Section 1-07.28 item 17A for notification information.

The survey monument will be furnished and set by the Engineer (see notification in Section 1-07.28 item 17B).

8-13.3(2) FURNISH AND PLACE MONUMENT CASTINGS

Where indicated on the Drawings, the Contractor shall furnish and install Type 020, or WSDOT Standard Plan H-7 when specified in the Contract, monument frames and covers to the lines and grades established by the Engineer. See Standard Plan no. 020. Monument castings installed in concrete pavement or in rigid concrete pavement base shall comply with the requirements of Section 7-05.3(1)R.

8-13.3(3) ADJUST EXISTING MONUMENT CASTINGS TO GRADE

Existing monument castings shall be adjusted to grades in accordance with Section 7-20.3(3). Monument castings installed in concrete pavement or in rigid concrete pavement base shall comply with the requirements of Section 7-05.3(1)R.

8-13.3(4) RESET OR RELOCATE MONUMENT CASTINGS

See Section 8-13.3(1).

The Contractor shall carefully remove monument castings as required during construction and shall store the castings in a secure place.

Monument castings designated for removal and not reused on the project, shall be carefully removed and salvaged in accordance with Section 2-02.3(7)A.

The monument castings shall 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 shall comply with the requirements of Section 7-05.3(1)R.

The Contractor shall replace lost or damaged castings with new castings.

8-13.3(5) MISSING AND BROKEN CASTINGS, AND EXTRA WORK

Missing or damaged monument castings resulting from Contractor operations shall be replaced and installed at no cost to the Owner in accordance with Section 8-13.3(2).

Monument castings not identified on the Drawings but found during construction to be missing, damaged, or substandard shall at the Engineer's discretion be replaced in accordance with Section 8-13.3(2). Payment will be made in accordance with "Monument Frame and Cover".

Monument castings not identified on the Drawings for relocate or reset which are adversely impacted by extra Work or by specified Work shall at the Engineer's discretion be reset or relocated in accordance with Section 8-13.3(4). Payment will be either for "Reset Monument Frame and Cover" or for "Relocate Monument Frame and Cover".

Monument castings installed in concrete pavement or in rigid concrete pavement base shall comply with the requirements of Section 7-05.3(1)R.

8-13.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

8-13.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-13 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **"Monument Frame and Cover"**, per each.

The Bid item price for "Monument Frame and Cover" shall 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" shall 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" shall 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"** shall include all costs for the work required to survey in the new Owner furnished 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 shall 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. **Other payment information.**

Lost or damaged castings, and castings damaged during installation resulting from the Contractor's operations shall be replaced, or replaced and reinstalled, respectively, by the Contractor with a new Type 020 casting at no cost to the Owner.

SECTION 8-14 CEMENT CONCRETE SIDEWALK**8-14.1 DESCRIPTION**

Section 8-14 describes work consisting of cement concrete sidewalks, thickened edge for sidewalk, monolithic curb and sidewalk, curb ramps and detectable warnings, and bus shelter pads, including excavation and subgrade preparation.

8-14.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Cement Concrete Class 5 (3/4) ¹	5-05.3
Portland Cement	9-01
Aggregates	9-03
Premolded Joint Filler	9-04.1
Interlocking Concrete Paver Materials	9-14.9
Concrete Curing Materials and Admixtures	9-23
Detectable Warning	9-36

Note ¹Concrete sidewalk monolithic with handrail shall be Class 6 (3/4) (see Section 8-18.2 and Standard Plan nos. 442, 443a and 443b).

All new concrete sidewalk and curb ramp shall be with concrete Class 5 (3/4), and the slump of the concrete mix shall not exceed 3-1/2 inches.

Lamp black coloring agent for matching the color of newly constructed cement concrete sidewalk and curb ramp to the color of adjacent existing cement concrete sidewalk shall be added to the concrete during mixing in an amount not to exceed 1-1/2 pounds per cubic yard of concrete.

8-14.3 CONSTRUCTION REQUIREMENTS**8-14.3(1) GENERAL**

The curb and gutter section shall be placed prior to the placement of the sidewalk section. Where sidewalk construction is in an area with exposed tree roots 2 inch or greater in diameter, the Contractor shall comply with the requirements of Section 1-07.16(2).

Tree grates for tree pits installed in the sidewalk shall have a concrete collar as specified in Section 8-02.3(21).

8-14.3(2) EXCAVATION AND SUBGRADE

Excavation for sidewalks shall be as described in Section 2-03. Unsuitable material in the subgrade shall be removed to a depth determined by the Engineer and then backfilled with suitable Material.

Embankments shall be compacted by Method B as specified in Section 2-03.3(14)D.

Before the forms are set, the subgrade shall be graded to within 1 inch of established grade and the area between the sidewalk and the adjacent private property line shall be shaped to line, grade, and section shown on the Drawings.

Compaction of the subgrade shall be to 95% as determined by Section 2-03.3(14)E.

If the Drawings call for sidewalk drains or the Engineer directs sidewalk drains to be installed, they shall be installed before forms are placed. Sidewalk drains shall be installed according to Section 7-01 and Standard Plan no. 241b.

8-14.3(3) FORMS AND FINE GRADING

Forms shall conform to requirements specified in Section 5-05.3. Wood forms shall be 2" x 4" (nominal) in lengths of not less than 10 feet. Steel forms may be used upon approval of the Engineer. Forms shall be staked to a true line and grade. A subgrade template shall then be set upon the forms and the fine grading completed so that the compacted subgrade shall be a minimum of 3-1/2 inches below the top of the forms. The subgrade shall be thoroughly dampened prior to the time the concrete is placed.

Forms shall be provided around all street name sign posts and traffic sign posts that are placed in concrete areas. Forms used for this purpose shall 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 shall 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 shall be spread uniformly between the forms and thoroughly consolidated to a minimum thickness of 3-1/2 inches. Through joints and dummy joints shall be located and constructed in accordance with Section 8-14.3(6). In construction of through joints, the premolded joint filler shall 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 shall be installed at the casting location to control cracking of the sidewalk. Concrete sidewalk placed around fire hydrant shall include reinforcing steel and a joint with 1/4 inch premolded through joint filler as detailed on Standard Plan nos. 310a or 311a. Concrete sidewalk placed to accommodate a tree pit with a tree grate shall 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 joint Material would be unsuitable, the Contractor shall install rebar to strengthen the sidewalk section as required by Section 5-05.3(9) for castings in the pavement area.

Dummy joints shall 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 dummy joints shall 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 shall be constructed with a thickened edge as shown on Standard Plan no. 420.

After the concrete has been thoroughly compacted and leveled, it shall be floated with wood floats and finished at the proper time with a metal float. Joints shall be edged with a 1/4 inch radius edger and the sidewalk edges shall be tooled with a 1/2 inch radius edger.

Additional requirements for placing concrete in cold weather shall be as specified in Section 5-05.3(14).

Placing concrete for the curb section of the monolithic curb and sidewalk shall be as specified in Section 8-04.3(1)B.

8-14.3(4)B FINISHING CONCRETE

The surface shall be brushed with a fiber hair brush of an approved type in a transverse direction except that at driveway and alley crossings it shall be brushed in a longitudinal direction. The placing and finishing of all sidewalk shall be performed in a manner acceptable to the Engineer, and the tools used shall be acceptable to the Engineer. After brush finish, the edges of the sidewalk and all joints shall be lightly edged again with an edging tool to give it a finished appearance.

Sidewalk 120 feet in length or less, shall be scored to match the pattern of existing sidewalk to which new sidewalk joins unless otherwise specified in Contract. All other sidewalk shall be divided into panels by scoring 1/4 inch deep "V grooves" in the manner indicated on Standard Plan no. 420.

Additional requirements for finishing concrete in cold weather shall be as specified in Section 5-05.3(14).

8-14.3(5) CURING AND PROTECTION

The curing Materials and procedures specified in Section 5-05.3(13) shall prevail, except that white pigmented curing compounds shall not be used on sidewalks. The curing agent shall be applied immediately after brushing and shall be maintained for a period of 5 Days.

The Contractor shall 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 shall be protected against damage or defacement of any kind until it has been accepted by the Owner.

Additional requirements for curing in hot weather shall be as specified in Section 5-05.3(13)C. Additional requirements for curing in cold weather shall be as specified in Section 5-05.3(14).

Curing for the curb section of the monolithic curb and sidewalk shall 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.
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 (dummy joints) shall be constructed with premolded joint filler 1/4-inch thick by 2 inches wide, 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 shall be as indicated in Contract. At no time shall joint spacing exceed 15 feet.

Transverse and longitudinal through joints as shown on Standard Plan no. 420 shall be 1/2-inch thick premolded non-extruding joint Material. The joint Material width shall be cut to a width equal to the full depth of the concrete sidewalk plus 1/2-inch. When installed, the joint Material shall 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 shall be in straight alignment, except where placed in curved locations as required by the Drawings.

Construction joints for sidewalks shall conform to the applicable requirements for through joints for pavement except for thickness of joint Material being 3/8 inch and width of 2 inches. The top edge shall be 1/8-inch below the finished surface of the sidewalk. At no time shall joint spacing exceed 15 feet.

8-14.3(7) CURB RAMP

8-14.3(7)A GENERAL

All curb ramps constructed under this Contract shall have cast in place detectable warning plates.

Curb Ramps shown on the Drawing per Standard Plan 422a with a ramp length greater than eight (8) feet will be constructed in accordance with the Standard Plan and considered to be a Non-Standard Curb Ramp.

Any curb ramp that is labeled on the Drawings as Non-Standard will be referred to as "Non-Standard Curb Ramp".

Curb ramp alignment shall be as indicated on the Drawings, or as directed by the Engineer in the field. Curb passing through the curb ramp shall be monolithic with the curb ramp. Curb ramps shall be constructed separately from the sidewalk to produce a definite break line between the ramp and the sidewalk. A 3/8 inch through joint premolded filler shall be installed between the curb ramp and the sidewalk with 1/4 inch concrete edging as specified in Section 8 14.3(4)A.

The Contractor shall notify the Engineer 1 Working Day in advance of placing concrete for each curb ramp to allow the Engineer the opportunity to inspect the curb ramp layout. The Contractor shall not place concrete for a curb ramp until the Engineer has either inspected and accepted the layout or waived the layout inspection. The Contractor shall be responsible for the curb ramp installation regardless of the Engineer's inspection of the curb ramp layout or not, see Section 1-05.7.

Concrete for curb ramps shall not be overlaid or topped. Triangular shaped siding areas shall be brush finished with brushing parallel to the curb face. The adjacent sidewalk "V" groove scoring pattern shall not extend into the curb ramp siding areas. The inclined plane of the ramp indicated shall have a coarse textured surface similar to the impression that is obtained through the use of a 3/4 inch x # 9 flattened expanded metal mesh screen pressed into the fresh concrete.

The subgrade for curb ramps shall 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.

Where existing sidewalk or existing curb ramp are to be replaced with new curb ramp and a detectable warning plate, the Contractor shall have Supplies and Materials in place to complete these constructions within 3 Days of beginning this work. In no case shall this work extend into or through a Non-Working day. The only exception to the 3 Day requirement is when the manufacturer of detectable warning plate provides written instruction requiring a length of time longer than 3 Days for acceptable performance of the plate and is approved by the Engineer.

All curb ramp and curb ramp retrofit shall have a detectable warning plate or detectable warning retrofit plate installed in accordance with the manufacturer's written instructions. The Contractor shall 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 shall be oriented as shown on Standard Plan nos. 422a and 422b.

8-14.3(7)B SUBMITTAL

For Standard Plan nos. 422a and 422b curb ramps, for curb ramp type 1 and curb ramp type 2, and for curb ramp retrofit, the Contractor shall submit to the Engineer for approval at least 5 Working Days in advance of this work, the following detectable warning plate information:

- 1) A description of the detectable warning plate proposed including the manufacturer's name, address, phone number, and e-mail and web-site addresses as available. (Note – approved Materials are specified in Sections 9-36.2 and 9-36.3);
- 2) For "or equal" products other than approved Materials specified in Sections 9-36.2 and 9-36.3, see Section 9-36.4 for additional submittal 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 three (3)

- Days to complete, provide written instruction from the manufacturer stating in detail the reason(s) for more than 3 Days;
- 4) Manufacturer's Certificate of Compliance indicating the plate meets all requirements of these Specifications including material test reports from a testing laboratory accredited by a recognized designated standards organization such as ASTM; and
 - 5) Manufacturer's 1 year warranty against breakage, fading, and deformation.

8-14.3(7)C STANDARD CURB RAMP

Standard Curb Ramps, No 422a and 422b shall be installed at locations indicated on the Drawings.

The coarse textured surface similar to the impression that is obtained through the use of a 3/4 inch x # 9 flattened expanded metal mesh screen shall have the long axis of the diamond shaped impression perpendicular to the curb line for Standard Plan no. 422a ramps, and shall be parallel to the curb line for Standard Plan no. 422b ramps.

Curb ramps shall be considered as beginning at a point flush with the pavement and terminating at a point flush with the sidewalk or sidewalk landing. For Curb Ramp No. 422a, the ramp area, the detectable warning plate area, and sloping triangular shaped wings indicated on Standard Plan no. 422a will be considered as part of the curb ramp. For Curb Ramp No. 422b, the landing area, ramp areas, and detectable warning plate area, indicated on Standard Plan no. 422b, will be considered part of the curb ramp.

8-14.3(7)D NON STANDARD CURB RAMP

Construction and alignment of a "Non-Standard Curb Ramp" shall be as indicated on the Drawings or as directed by the Engineer in the field and shall meet the conditions outlined in Sections 8-14.3(7)A and 8-14.3(7)B.

Non-standard curb ramps shall be constructed with monolithic depressed curb and shall be constructed separately from the sidewalk, with 3/8 through joint premolded filler and 1/4 inch concrete edging as specified in Section 8-14.3(4)A, to produce a definite break line between the ramp and the sidewalk.

8-14.3(7)E CURB RAMP RETROFIT

Where indicated in the Contract, existing curb ramp without a detectable warning plate shall be retrofitted with a detectable warning retrofit plate located as shown on Standard Plan nos. 422a and 422b, and as described in Section 9-36.3.

The Contractor shall submit to the Engineer for approval at least 5 Working Days in advance, information on the detectable warning retrofit plate as follows:

1. a 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. a 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. a Manufacturer's Certificate of Compliance indicating Material testing and performance satisfying the requirements of 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;
4. a manufacturer's one year warranty against breakage, fading, deformation, and loss of bonding strength.

When a detectable warning plate is to be applied to an asphalt surface it shall be Top Mark as manufactured by Flint Trading, Inc: (336) 475-6600 (www.flintrading.com), or approved equal.

8-14.3(8) RESERVED

8-14.3(9) BUS SHELTER FOOTING

The Contractor shall construct a bus shelter footing according to the details shown on Standard Plan no. 423 unless indicated otherwise on the Drawings. Prior to construction, the Contractor shall notify METRO at least 10 Working Days in advance so that coordinating the installation of the bus shelter by METRO forces is accommodated (see Section 1-07.28 item 2 for contact information).

8-14.3(10) INTERLOCKING CONCRETE PAVERS

8-14.3(10)A GENERAL

Cement concrete sidewalk and curbs shall be placed and cured prior to placing concrete pavers shown on Drawings.

8-14.3(10)B PRESSURE MOLDED INTERLOCKING CONCRETE PAVER

8-14.3(10)C BASE COURSE

In areas where crushed rock base is to be placed between the existing subgrade and the sand bedding layer, the base course shall be spread in layers not exceeding 4 inches after compaction. Compaction shall be at 95% maximum density while at optimum moisture in accordance with Section 2-03.3(14)C.

8-14.3(10)D BEDDING SAND

After crushed rock base course installation has been approved by the Engineer, the bedding sand shall be spread uniformly over the working area and screeded accurately to the limit indicated on the Drawings. The screeded and leveled

surface shall be loose and shall not be disturbed or compacted in any manner. Any area of bedding sand, which becomes compacted by any means (including foot prints), shall be removed immediately, and the bedding sand shall be replaced and re-screeded to a loose compacted condition.

Sand shall not be placed more than 6 feet ahead of pavers. Sand shall not be allowed to sit overnight. Filter fabric shall be placed between the sand bed and the leveling course.

8-14.3(10)E PAVER BLOCK PLACEMENT

Pavers shall be placed on the screeded sand from the low side to the high side, in a herringbone pattern. Joints between pavers shall be 1/8 inch.

The pavers shall not be placed so that they are touching. Development of interlock depends on the use of narrow joints filled with compacted sand.

Full pavers shall be laid first with the gaps at the edges filled with standard edge pieces or with pieces cut to fit. The pieces shall not be less than 25% of a full paver. Pavers shall be cut to a straight even surface without cracks or chips. Cutting shall be done with a masonry saw or a guillotine cutter. The cut surface shall be at 90 degrees to the top/bottom of the paver. Any cut paver failing to meet this requirement shall be discarded.

Except where it is necessary to correct minor variations in the laying pattern, pavers should not be hammered into positions. The face shall be laid in such a manner that the paver is forced into a space.

It is required that pavers be laid from at least three bundles to minimize the effect of color variation. Pre-manufactured edging material shall be installed directly adjacent to concrete curb or sidewalk.

8-14.3(10)F COMPACTION

After placing the pavers, the Contractor shall use a vibrating plate compactor to consolidate the pavers and sand to the finished grade. Compaction shall be continued until the level of the pavers has stabilized.

The plate compactor shall be a high frequency, low amplitude vibrator of sufficient size to compact the sand layer and have a plate surface of at least 2-1/2 square feet.

Compaction shall be done as close as possible to within three (3) feet from the overlaid paver laying faces. At no time shall the length of uncompacted pavers exceed six (6) feet.

Initial compaction shall be completed before any joint filling.

The pavers shall be compacted at the completion of each day's laying.

Any pavers that are cracked or structurally damaged during compaction shall be removed and replaced at no expense to the Owner.

8-14.3(10)G FILLING JOINTS

As soon as practicable after compaction, joint filling sand shall be swept into joints. Excess sand shall be swept from the top surface of the pavers before vibrating. A vibrating plate compactor shall be run over the pavers to work the sand into the joints. This procedure shall be done until the joints do not need to receive any more sand.

The Contractor shall return one week after this last placement of sand to sweep and vibrate additional sand into the paver joints. This process shall be repeated on a weekly basis until the joints are filled and do not accept no more sand.

8-14.3(10)H FINISHED SURFACE

After final compaction, the finished surface shall be true to grade and not vary by more than 1/8 inch when tested with a 10 foot straight edge. Any pavers or paver areas which do not meet these tolerances shall be removed and reset.

8-14.3(10)I MAINTENANCE

The pavement shall be maintained from installation through the maintenance period. Maintenance period shall be for two years from the date of acceptance.

Maintenance shall include, but not be limited to, the following:

1. Resetting settled pavers to finished grade, which have settled or rutted greater than 3/8 inch in 10 feet in any direction.
2. Periodic joint filling of sand shall be reviewed, and performed as necessary, on the following schedule: 1st week, 2nd week, 4th week, 3rd month, 6th month, 9th month, 12th month, 15th month, 18th month, 21st month, and 24th month.

8-14.3(11) STRIPPING FORMS AND FINISHING – MONOLITHIC CURB AND SIDEWALK

Stripping forms and finishing for the curb section of the monolithic curb and sidewalk shall be as specified in Section 8-04.3(1)D.

The concrete shall be cured for at least 72 hours by one of the methods specified in Section 5-05.3(13)B.

8-14.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Sidewalk, Cement Concrete" will be by the square yard for the surface of concrete walk 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 in accordance with Section 4-01.4.

Measurement for monolithic curb and sidewalk will be considered as three 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 "Interlocking Concrete Pavers" will be by the square yard of total concrete paver surface area installed.

Measurement for "Interlocking Paver Maintenance, Min. Bid = ____" will be by lump sum.

Measurement for "Curb Ramp, (No)" will be per each and shall not include the curb.

Measurement for precast detectable warning plate will be by the square foot area of detectable warning plate installed in non-standard curb ramps. No measurement will be made for detectable warning plate installation in standard curb ramps.

Measurement for "Curb Ramp, Non-Standard" will be per square yard and shall not include the curb.

Measurement for "Curb Ramp Retrofit" will be by the square foot area of detectable warning plate installed in existing curb ramps.

In areas of existing improvement where a "cut-in" is required for new curb ramp, new driveway, or new alley access driveway, the monolithic curb will be considered incidental to the new curb ramp, new driveway, or new alley access driveway and no measurement for curb will be made (see Section 8-04.4).

8-14.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-14 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **"Sidewalk, Cement Concrete"**, per square yard.

The Bid item price for "Sidewalk, Cement Concrete" shall 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 in accordance with Section 2-03.5 "Common Excavation" as defined in Section 2-03.1(2).

All costs for reinforcing bars constructed around castings shall be included in the Bid item price for "Sidewalk, Cement Concrete".

2. **"Sidewalk, Thickened Edge"**, per linear foot.

The Bid item price for "Sidewalk, Thickened Edge" shall include all costs for the work required to construct the thickened edge where required.

3. **"Curb Ramp, (No.)"**, per each.

The Bid item price for "Curb Ramp, (No.)" shall include all costs for the work required to construct the curb ramp and wing(s) complete and in place, including detectable warning plate, sawcut, common excavation, sidewalk thickened edge and brushed or coursed textural surface finish as detailed on Standard Plan nos. 422a and 422b.

Payment for the removal of existing concrete walk, curb, or curb and gutter shall be made separately in accordance with Section 2-02. Payment for new curb or new curb and gutter shall be made separately in accordance with Section 8-04.

Curb ramp landing for curb ramp 422a shall be paid as "Sidewalk, Cement Concrete" per this Section. No separate payment shall be made for curb ramp landing for curb ramp 422b.

4. **"Curb Ramp Retrofit"**, per square foot.

The Bid item price for "Curb Ramp Retrofit" shall include all costs for the work required to prepare the existing curb ramp surface, and to furnish and install the detectable warning retrofit plate.

5. **"Bus Shelter Pad"**, per square yard.

The Bid item price for "Bus Shelter Pad" shall include all costs for the work required to construct the bus shelter pad.

6. **"Interlocking Concrete Pavers"**, per square yard.

The Bid item price for "Interlocking Concrete Pavers" shall include all costs for the work required to furnish and install the interlocking concrete pavers.

7. **"Interlocking Paver Maintenance, Min. Bid = ____"**, per lump sum.

The Bid item price for "Interlocking Paver Maintenance, Min. Bid = _____" shall include all costs for the work required to maintain the interlocking paver area.

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 in 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 interlocking paver maintenance of less than the Bid item lump sum minimum price shown in the Bid Form will be revised to reflect the Bid item lump sum minimum price allowed including the extension and shall govern as becoming a part of the Bid.

Payment shall be made at the rate of 25 percent of the Bid item lump sum price for "Interlocking Paver Maintenance, Min. Bid = _____" on the following payment dates: 25% on the last Day of the sixth month, 25% on the last Day of the twelfth month, 25% on the last Day of the eighteenth month, and the final 25% on the last Day of the twenty fourth month unless corrections or replacements are necessary and the Engineer has provided written notice of such. Should correction or replacement be required and the Contractor has made such correction or replacement, the Contractor shall at least 5 Working Days after all necessary corrections and replacements have been made, provide written notice of request for payment to the Engineer.

8. **"Curb Ramp, Non-Standard"** per square yard.

The Bid item price for "Curb Ramp, Non-Standard" shall include all costs for the work required to construct the curb ramp and wing(s) complete and in place including sawcut, common excavation, sidewalk thickened edge and brushed or coursed textural surface finish.

Payment for the removal of existing concrete walk, curb, or curb and gutter shall be made separately in accordance with Section 2-02. Payment for new curb or new curb and gutter shall be made separately in accordance with Section 8-04.

Payment for detectable warning plate shall be made separately in accordance with this Section.

9. **"Detectable Warning Plate"** per square foot.

The Bid item price for "Detectable Warning Plate" shall include all costs for the work required to furnish and install precast detectable warning plate. This bid item shall only be used in construction of non-standard curb ramps.

10. **Other payment information.**

Payment for imported Mineral Aggregate of the Type specified for sidewalk fill will be made in accordance with Section 4-01.5.

Payment for sidewalk drains will be made in accordance with 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 in accordance with Section 8-21.5.

Costs for finishes, edging, joints, joint Materials, and other minor work incidental to Section 8-14 constructions shall be included in the applicable Bid item prices.

Payment for furnishing and installing the concrete collar for tree grate will be paid as "Sidewalk, Thickened Edge".

SECTION 8-15 RIPRAP

8-15.1 DESCRIPTION

This Work shall 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 shall meet the requirements of the following Sections:

Mineral Aggregates	9-03
Riprap and Quarry Spall	9-13
Geotextile	9-37

Filter Material shall meet the gradation requirements for Mineral Aggregate Type 13, shoulder ballast.

The geotextile shall 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 shall be Class 5 (3/4) (see Standard Plan no. 313).

8-15.3 CONSTRUCTION REQUIREMENTS

8-15.3(1) GENERAL

The foundation for riprap shall be excavated below probable scour or to the elevation shown on the Drawings. No stones shall be laid or concrete placed 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, shall be classified as ditch excavation as defined in Section 2-10. Before placing riprap, the slopes shall be dressed to the lines and grades as staked by the Engineer.

Where specified in Contract, the slope or the area to be protected shall first be covered with a geotextile. A filter blanket shall be 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 upon which the riprap is placed.

8-15.3(2) LOOSE RIPRAP

Loose riprap shall be placed in such a manner that all relatively large stones shall be essentially in contact with each other, and all voids filled with the finer Materials to provide a well graded compact mass. The stone shall be dumped on the slope in a manner that ensures the riprap attains its specified thickness in one operation. When dumping or placing, care shall be used to avoid disturbing the underlying Material. Placing in layers parallel to the slope will not be permitted. A 12-inch tolerance for loose riprap will be allowed from slope plane and grade line in the finished surface.

8-15.3(3) HAND-PLACED RIPRAP

The stones shall be laid by hand on prepared slopes to such thickness as may be ordered by the Engineer. The riprap shall be started at the toe of the embankment by digging a trench and placing a course of the largest stones therein. Each stone shall be placed so that it shall rest on the slope of the embankment and not wholly on the stone below, and it shall be thoroughly tamped or driven into place. The exposed face of all hand-placed riprap shall be made as smooth as the shape and size of the stones permit and shall not vary more than 3 inches from a plane surface on the required slope.

8-15.3(4) SACK RIPRAP

Sack riprap conforming to the requirements of Section 9-13.4 shall be deposited in the trench and on the slope of the embankment to be protected in accordance with the Drawings.

The concrete shall be placed in the sacks to a uniform volume leaving sufficient room for effectively tying the sacks. The sacks shall 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 shall 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 shall be turned under and the sack firmly pressed into place against the header or screed. Each sack shall rest equally on two sacks below it such that vertical joints shall be staggered in succeeding horizontal rows. Sack riprap shall not be placed in freezing weather, and work damaged by frost shall be removed and replaced by the Contractor at no additional cost to the Owner.

8-15.3(5) CONCRETE SLAB RIPRAP

Concrete slab riprap for other than Standard Plan no. 313 applications shall consist of concrete placed in slabs 4 inches thick unless otherwise indicated in the Contract.

A trench of the dimensions shown on the Drawings or as staked by the Engineer shall be dug at the toe of the slope. The forms shall be of the depth of the concrete to be placed.

The panel length shall be 10 feet unless otherwise shown on the Drawings, and the concrete panels shall be placed in layers. The joints between panels in one layer shall alternate with the joints in progressive layers to present a staggered and regular joint pattern among all layers. Care shall 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 shall be placed and rodded true to the plane of the embankment and shall be finished smooth by troweling or other methods approved by the Engineer. The edges shall be tooled to a 1/2 inch radius.

The riprap shall be protected from flood waters and tides during the hardening of the concrete.

Weep holes shall be constructed every 10 feet. All Material placed in back of the riprap and within 18 inches of weep holes shall be gravel backfill for drains.

8-15.3(5)A CONCRETE SLAB FOR HYDRANT WALL REQUIREMENTS

Concrete slab for use on fire hydrant wall requirements as shown on Standard Plan no. 313 shall be no less than 3'-0" in length and no less than 1'-6" in width. The depth of concrete slab shall be no less than 3 1/2 inch. The side of each concrete slab to be visible on the face of the hydrant wall shall be straight. Broken concrete sidewalk meeting the dimension requirements of this Specification Section are acceptable. All concrete slab shall be intact with no visible cracking. The minimum depth of filter layer behind the concrete slab wall shall be no less than a 6 inch thickness of Mineral Aggregate Type 2. The concrete slabs need not be cemented together. If the concrete slabs are required to be cemented together, 3 inch diameter weep holes are required with a spacing along the wall face not exceeding 5 feet with each weep hole located within 1 foot above finished grade on the outside face of the wall.

The concrete slab wall shall be constructed in horizontal layers with vertical joint spacing offset between adjacent layers. Each horizontal layer shall have uniform thickness and each individual concrete slab shall be set stable with no rocking.

8-15.3(6) QUARRY SPALLS

Quarry spalls shall be placed in ditches and channels, and on slopes to be protected in accordance with the Contract. After placement, the quarry spalls shall be compacted by tracked equipment making a minimum of three passes. On steep slopes, the Contractor shall compact the quarry spall in a manner approved by the Engineer.

8-15.3(7) FILTER BLANKET

When required, a filter blanket shall 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

shall be even and free from mounds or windrows. Additional layers of filter Material, when required, shall be placed using methods which do not cause mixing of the Materials in the different layers.

8-15.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

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 shall 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 2-12.4.

8-15.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-15 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

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" shall 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" shall 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 in accordance with Section 2-10.5.

Payment for "Geotextile" will be made in accordance with Section 2-12.5.

Payment for Mineral Aggregate will be in accordance with Section 4-01.5.

All cost for weep holes shall be included in the appropriate Bid item prices

SECTION 8-16 CONCRETE SLOPE PROTECTION

8-16.1 DESCRIPTION

Section 8-16 describes the work of constructing concrete slope protection as shown on the Drawings, and at the locations and in conformity with the lines, grades, and dimensions as staked by the Engineer.

8-16.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Concrete Class 3000	6-02
Wire Mesh	9-07.7
Concrete Slope Protection	9-13

8-16.3 CONSTRUCTION REQUIREMENTS

8-16.3(1) FOOTING AND PREPARATION OF SLOPE

The footing for the slope protection shall be constructed in accordance with Sections 2-09 and 6-02.

The surface on which application is to be made shall 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 shall 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 shall be placed in horizontal parallel courses, and successive courses shall break joints with the preceding course to form a running bond.

8-16.3(3) CAST IN PLACE CEMENT CONCRETE

The wire mesh shall lap a minimum of one mesh spacing, and laps shall be securely fastened at the ends. During the placement of the concrete, the reinforcement shall 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 upon the slope, the method of depositing and compacting shall result in a compact, dense, and impervious concrete which shows a uniformly plane surface.

The newly constructed concrete shall be finished by means of a wood float and shall be striated with a rustication joint as shown on the Drawings.

Curing shall be performed in accordance with Section 5-05.3(13).

8-16.3(4) PNEUMATICALLY PLACED CONCRETE

Workers: Only workers experienced in pneumatically placed concrete shall be employed; and acceptable evidence of such experience shall be submitted when requested by the Engineer.

Equipment: The Contractor shall submit to the Engineer two 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 shall be approved by the Engineer.

Proportions of Materials: The sand/cement ratio shall be 4-1/2 parts sand to 1 part cement based on loose dry volume.

Water shall be maintained at a constant pressure which shall be at least 15 psi above atmospheric pressure at the nozzle. For lengths of hose up to 100 feet, pneumatic pressure at the gun shall be 45 psi or greater. Pressure shall be increased 5 psi for each additional 5 foot increment over 100 feet of hose required. A steady pressure shall be maintained.

Method of Application: Portland cement and sand shall 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 are to be wetted, but application shall not be made on any surface on which free water exists.

Reinforcement: The wire mesh shall lap a minimum of one mesh spacing, and laps shall be securely fastened at the ends. During the placement of the concrete, the reinforcement shall be held so as to provide a minimum of 1-3/4 inches of cover at the recess.

Finishing: The newly constructed concrete shall be finished by means of a wood float and shall be striated with a rustication joint as shown on the Drawings.

Curing: Curing shall be in accordance with Section 5-05.3(13).

Protection of Facilities: During the construction, the Contractor shall protect all retaining walls, columns and Structures from concrete splash or overspray. Suitable covering shall be provided if such protection is deemed necessary by the Engineer.

Test Cylinders: Two test cylinders shall be made for each full Day's operation. The Contractor shall furnish the cylinders 6 inches in diameter and 12 inches high made of 3/4-inch mesh hardware cloth. The test cylinder shall be filled with concrete by utilizing the same pneumatic application described above. Contact the SPU Materials Laboratory at 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 (see Section 6-02.3) at the age of 28 Days, unless another Class of concrete is specified in the Contract.

8-16.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for concrete slope protection will be by the square yard and will include the actual area of the slope protection face covered excluding the footings. Footings will be measured by the cubic yard within neatlines indicated on the Drawings (see Section 2-09.4).

8-16.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-16 will be made at the Bid item price Bid only for the Bid item listed or referenced as follows:

1. "Concrete Slope Protection", per square yard.

The Bid item price for "Concrete Slope Protection" shall include all costs for the work required to construct the slope protection including the Work required to construct the footing.

SECTION 8-17 RESERVED

SECTION 8-18 CEMENT CONCRETE STAIRWAYS, LANDINGS, AND STEPS

8-18.1 DESCRIPTION

This Work shall consist 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, in accordance with these Specifications and in conformity with the lines, grades, and cross sections indicated on the Drawings. See Standard Plan nos. 440a, 440b, 441, 442, 443a, and 443b.

8-18.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Cement Concrete	5-05
Portland Cement	9-01
Aggregates	9-03
Joint & Crack Sealing Materials, and Non-Shrink Grout	9-04
Concrete Curing Materials and Admixtures	9-23

The concrete mix shall be Class 6 (3/4) for steps and stairways. Landings shall be Class 5 (3/4). Sidewalk monolithic with handrail shall be Class 6 (3/4).

Galvanized steel pipe railing shall be fabricated from standard weight steel pipe meeting the requirements of ASTM A 53. After fabrication, the railings shall be hot-dipped galvanized per ASTM A 123. Gripping handrail shall be standard steel pipe meeting the requirements of ASTM A 53 and shall be 1 inch nominal diameter (1.315 inch outside diameter) as specified in the American Institute of Steel Construction Manual.

Aluminum paint for handrails shall be Formula D-1-57 aluminum paint meeting the requirements of Section 9-08.2.

Wood for railings shall be as indicated on the Drawings.

Reinforcing Steel shall 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 shall be cleared, grubbed, excavated, graded, and prepared in accordance with Sections 2-01 and 2-03 to the limits indicated on the Drawings or staked by the Engineer. Where stairways, landings, or step construction is in an area with exposed tree roots 2 inch or greater in diameter, the Contractor shall comply with the requirements of Section 1-07.16(2).

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 shall meet the requirements for pavement subgrade preparation set forth in Section 2-06.

Forms shall meet the requirements of Section 5-05.3(21) except that wood side forms shall be not less than 2 inches nominal in thickness and shall be straight and true.

8-18.3(3) REINFORCING STEEL

Reinforcing steel for cement concrete stairways shall be placed as shown on Standard Plan nos. 440a through 443b. The reinforcing steel shall 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.

8-18.3(4) HANDRAIL

Handrails shall be of welded steel pipe construction, fabricated and installed as indicated on Standard Plan nos. 440a, 440b, 442, 443a, and 443b unless the Contract specifies otherwise. Welds shall be made by certified welders and each weld shall be ground and buffed to a smooth surface. Rails shall be hot dip galvanized according to ASTM A 123 after fabrication. If field welds are required, they shall be coated with a zinc alloy solder to a minimum thickness of 2.0 mils per ASTM A 780.

Either the railing shall be placed completely assembled at the time when stairway concrete is placed, or recesses shall be provided in the concrete for grouting the railing posts after the concrete has been placed, finished, and cured. The installed railing shall 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 shall conform to the applicable requirements in Section 5-05.3.

Front and side edging of concrete stair treads shall be to a radius of 1/2 inch.

Landings for stairways shall be scored as specified for concrete sidewalks in Section 8-14 except that transverse and longitudinal scoring shall 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 shall 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 shall be constructed in accordance with the detail on Standard Plan no. 440b. The gutter shall be constructed along and outside the stairway, adjacent to the concrete walk or landing that joins flights of stairs connecting the stairway gutters, and shall be sloped for continuous flow.

8-18.3(7) STEPS

Steps shall be constructed in accordance with Standard Plan no. 441.

Treads shall range from a maximum 12 inch to a minimum 11 inch. Risers shall range from a maximum 7 inch to a minimum 5 inch. 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, shall not exceed 3/8 inch respectively.

8-18.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Excavation for stairways, landings, and gutters will be measured by the cubic yard of common excavation in accordance with Section 2-03.

Measurement of "Steps, Cement Concrete" and "Stairway, Cement Concrete, Special" will be by the square foot of tread surface installed.

"Stairway, Cement Concrete, Type 440" will be measured by the linear foot for the horizontal distance from a point 2 feet 2 inches from the back of the top tread to a point 2 feet 2 inches from the face of the bottom riser for the width indicated in the Contract.

Handrail of the type specified will be 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 in accordance with Section 8-14.4. Asphalt walks will be measured in accordance with 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.

8-18.5 PAYMENT

Compensation for the costs necessary to complete the work described in Section 8-18 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **"Stairway, Cement Concrete, Type 440"**, per linear foot.

The Bid item price for "Stairway, Cement Concrete, Type 440" shall include all costs for the work required to construct the concrete stairway to the width indicated in the Standard Plans.

2. **"Stairway, Cement Concrete, Special"**, per square foot.

The Bid item price for "Stairway, Cement Concrete, Special" shall include all costs for the work required to construct a stairway in accordance with Standard Plans for Type 440 Stairway for a width other than indicated in the Standard Plans.

3. **"Handrail, (Type)"**, per linear foot.

The Bid item price for "Handrail, (Type)" of the type specified shall 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.

The Bid item price for "Steps, Cement Concrete" shall include all costs for the work required to construct concrete steps.

5. **"Gutter, Cement Concrete, Type 440"**, per linear foot.

The Bid item price for "Gutter, Cement Concrete, Type 440" shall include all costs for the work required to construct a gutter section along the edge of stairways and landings.

6. **Other payment information.**

Payment for excavation required for stairways, landings, and gutter sections will be paid as "Common Excavation" in accordance with Section 2-03.

Payment for concrete landings and walkways will be made as "Sidewalk, Cement Concrete" in accordance with Section 8-14.

Reinforcing steel shall be considered as incidental to the Bid item price for the appropriate Bid item .

SECTION 8-19 CEMENT CONCRETE DRIVEWAY

8-19.1 DESCRIPTION

This Work shall consist of cement concrete driveway and alley constructed at the locations shown on the Drawings and shall be in accordance with Section 8-19 and Standard Plan nos. 430 and 431.

Driveways for alleys and commercial access shall be 8 inch minimum depth.

8-19.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Cement Concrete	5-05
Portland Cement	9-01
Fine and Coarse Aggregates	9-03.1
Joint and Crack Sealing Materials	9-04
Reinforcing Steel	9-07
Curing Materials and Admixtures	9-23
Water	9-25.1

The cement concrete mix shall be as specified for Class 6 (1-1/2) or Class 6 (3/4).

8-19.3 CONSTRUCTION REQUIREMENTS

8-19.3(1) EXCAVATION AND SUBGRADE

Subgrade preparation for driveways and the required compaction shall conform to the applicable requirements in Section 2-06 to provide a firm, unyielding subgrade, acceptable to the Engineer. Where driveway construction is in an area with exposed tree roots 2 inch or greater in diameter, the Contractor shall comply with the requirements of Section 1-07.16(2). Driveways for accessing alleys and for commercial traffic shall be excavated to accommodate an 8 inch minimum thickness concrete driveway. Driveways for residential access shall be excavated to accommodate a 6 inch minimum thickness concrete driveway.

Subgrades shall be compacted to 95% relative density per Section 2-03.3(14)E for a 12 inch minimum depth.

8-19.3(2) FORMS AND FINE GRADING

Forms shall have a height of not less than the specified depth of concrete to be placed and shall be of ample strength to resist deformation. All forms shall be securely staked and braced plumb and true to line and grade.

A template shall be set upon the forms, and the subgrade shall be fine graded and compacted to conform to the required section. Prior to the placement of concrete, the subgrade shall be thoroughly dampened.

8-19.3(3) PLACING AND FINISHING CEMENT CONCRETE DRIVEWAY

The concrete shall be spread uniformly and consolidated between the forms (See Section 6-02.3(8)). Through joints and contraction joints shall be located in accordance with Standard Plan nos. 430 and 431. The concrete driveway shall be brush finished with the sidewalk portion scored as specified in Section 8-14.3(4)B. In the construction of through joints, the premolded joint filler shall be adequately supported until the concrete is placed on both sides of the joint.

Contraction joints (dummy joints) shall be formed with a tee bar by first cutting a groove in the concrete 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 joints and dummy joints shall 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 shall be floated with wood floats and finished at the proper time with a metal float. Joints shall be edged with 1/4 inch radius edger and the driveway or alley return edges shall be tooled with 1/2 inch radius edger. Curbs shall be tooled with a 1 inch radius edger.

The surface shall 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.

Driveways and alley crossings shall not be constructed at the same time the pavement is placed.

8-19.3(4) CURING AND PROTECTION

Curing Materials and procedures shall be as specified in Sections 9-23 and 5-05.3(13).

Before placing any concrete, the Contractor shall have enough protective plastic sheet or other suitable protection at the Project Site to protect the newly placed concrete of an entire Day in the event of rain or other unsuitable weather conditions.

8-19.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for cement concrete driveway and alley return will be by the square yard for the class and thickness of driveway actually placed, measured from the back of the curb to the back of the sidewalk.

8-19.5 PAYMENT

Compensation for the cost necessary to complete the Work described in Section 8-19 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "Driveway, Cement Concrete, (Thickness)", per square yard.
2. "Driveway, Cement Concrete, HES, (Thickness)", per square yard.

The Bid item prices for "Driveway, Cement Concrete, (Thickness)" and for "Driveway, Cement Concrete, HES, (Thickness)" shall include all costs for the work required to construct the driveway including excavation and subgrade preparation.

3. **Other payment information.**

Payment for alley return will be made as "Driveway, Cement Concrete, (Thickness)".

Payment for excavation below the prepared subgrade and additional selected Materials will be made as "Common Excavation" per Section 2-03.5 and as "Mineral Aggregate, (Type)" per Section 4-01.5.

No separate or additional payment will be made for driveway thickness, or for common excavation, greater than the thickness specified in the Contract.

SECTION 8-20 RESERVED

SECTION 8-21 PERMANENT SIGNING AND POSTS

8-21.1 DESCRIPTION

Section 8-21 describes work consisting of furnishing and installing new traffic signs, street designation signs, Owner furnished street name signs, bus zone signs, posts, and parking meter posts with or without signs; relocating existing traffic signs, and posts in accordance with the Drawings, these Specifications, and with Standard Plan nos. 601b through 630.

8-21.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Non-Shrink Cement Sand Grout	9-04.3(2)
Signing & Post Materials, and Jet Set Cement	9-28

Traffic sign post Material shall be Qwik Punch Telespar as shown on Standard Plan no. 625.

8-21.3 CONSTRUCTION REQUIREMENTS

8-21.3(1) SIGN INSTALLATION

8-21.3(1)A TRAFFIC SIGN

8-21.3(1)A1 GENERAL

The removal of signs shall be as specified in Sections 2-02.3(3)F and 2-02.3(3)K.

Unless the Contract specifies otherwise, installation of signs associated with parking pay stations, bus stop signs, and street name signs, will be by SDOT, and installation of street designation signs shall be by the Contractor.

All traffic signs, except as specified in Section 8-21, will be provided by SDOT. To order signs, and to coordinate SDOT's installation of signs, the Contractor shall arrange with the Engineer (notify (206) 233-7102) at least 10 Working Days in advance, and shall specify the number(s) and type(s) of signs needed. SDOT will notify the Contractor of when the signs are ready for pickup. The Contractor shall pickup the signs at the SDOT sign shop at 4200 Airport Way South on weekdays between the hours of 8:00 AM to 3:00 PM.

The signs shall be mounted level and face in the direction indicated on the Drawings or designated by the Engineer.

Unless the Contract specifies otherwise, the Contractor shall install and relocate all traffic signs and posts as specified in the Contract.

Unless the Contract specifies otherwise, the Contractor shall provide all hardware required to mount signs in accordance with the Drawings, these Specifications, Section 9-28.1(8), and with Standard Plan nos. 601a through 630.

Unless the Contract specifies otherwise, the Contractor shall not drill, tap, weld, screw, or nail into poles. See Standard Plans nos. 601c to 620 for details on mounting to poles.

8-21.3(1)A2 MOUNTED TO WOOD POST

When mounting a sign on an existing wood post or an existing wood pole, 5/16-inch x 3-1/4-inch galvanized or cadmium plated lagscrews shall be used, with 1/8-inch thick x 1-inch O.D. nylon washers.

8-21.3(1)A3 MOUNTED TO STEEL POLE

Sign mounted to steel poles shall be with steel bands as shown on Standard plan no. 615. Field repair of galvanized surfaces of drill holes shall be done with galvanized repair paint meeting the requirements of Federal Specification MIL-P-21035 (Ships) paint, high zinc dust content, galvanizing repair.

8-21.3(1)A4 MOUNTED TO PARKING METER POST

When mounting a 9-inch x 12-inch or larger sign on a parking meter post, the Contractor shall use 1/4-inch x 3-1/2-inch galvanized bolts, galvanized nuts, and 1-inch O.D. nylon washers. Signs smaller than 9-inch x 12-inch on a parking meter post shall be mounted with 1/4-inch x 3/4-inch galvanized self-tapping screws with 1-inch O.D. nylon washers. For details, see Standard Plan no. 628.

8-21.3(1)A5 MOUNTED TO SPAN WIRE OR MAST ARMS

Signs mounted on span wire or mast arms shall be mounted as indicated on the Drawings and in traffic signing details shown in Standard Plan nos. 601b and 612. Sag in the span shall be maintained between 5 percent and 7 percent of the span length. Clearance between the bottom of the sign and the roadway centerline shall be maintained between a minimum 17 feet and a maximum 19 feet. Use standard signal mounting hardware & span wire assemblies in accordance with Section 8-31. For mast arm mounting use aluminum C3X2.1 by "Drill & Tap" method.

8-21.3(1)A6 MOUNTED TO QWIK PUNCH TELES PAR METAL POST

Signs mounted to Qwik Punch Telespar posts shall be attached by punching out the appropriate holes on the Telespar post, then fastening the sign to the post using a 3/8" drive rivet as indicated on Standard Plan no. 621a.

8-21.3(1)B STREET NAME, STREET DESIGNATION, AND BUS ZONE SIGNS**8-21.3(1)B1 OBTAINING STREET DESIGNATION SIGNAGE**

To order signs, the Contractor shall provide 10 Working Days advance notification to the Engineer and shall specify the name(s) of the street designation sign(s) needed including Contractor contact information. The Engineer will notify the Contractor of when the signs are ready for pickup. The Contractor shall pickup the signs at the SDOT sign shop at 4200 Airport Way South on weekdays between the hours of 8:00 AM to 3:00 PM.

8-21.3(1)B2 INSTALLATION REQUIREMENTS

Unless the Contract specifies otherwise, all street name and bus zone signage will be installed by SDOT.

The Contractor shall mount all street designation signs as indicated on Standard Plan nos. 601b, 610, 612, 615, 622, and 623 for the type installation required.

8-21.3(1)C SIGNS AND "NUMBERED" BASE PLATES ASSOCIATED WITH PARKING PAY STATIONS

D-22 signs (includes "Pay L", "Pay R", "Pay H", and "Pay LR" signs) and "numbered" base plates located on new and existing sidewalk, will be installed by SDOT.

8-21.3(2) POST INSTALLATION**8-21.3(2)A SIGN POST INSTALLATION****8-21.3(2)A1 STEEL PIPE, AND METRO SIGN POST INSTALLATION**

Excavations for Quik punch telespar, METRO, and steel pipe sign post installation shall be of sufficient size to allow placement and compaction of backfill Material completely around the posts. Selected backfill Material shall be placed and compacted to meet the requirements of Section 2-03. The area disturbed during sign post installation shall be surfaced to match the surrounding surfaces. Where a sign post is to be installed in an existing paved concrete area, a neat 12-inch x 12-inch cut-out shall be provided by saw cutting, or an 8-inch diameter hole shall be provided by core drilling.

Where the Drawings or the Engineer require a traffic sign post to be located within the area of new sidewalk paving, the Contractor shall 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 shall 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 shall be placed in the joint. See Standard Plan no. 624 for details.

When required in the Contract, street name sign and bus zone sign posts shall be installed in an 8-inch diameter post hole, and shall be backfilled with Class 5 drypack concrete as indicated in Standard Plan nos. 622 and 630.

8-21.3(2)A2 TELESPAR POST INSTALLATION

Quik punch telespar posts shall be mounted and fastened to anchor posts as indicated on Standard Plan no. 621b. All posts shall be plumb.

In general, light duty anchors shall be used for earth installations, heavy duty anchors shall be used for new sidewalk and other new concrete surface improvement, and surface mounts shall be used on existing concrete surfaces.

8-21.3(2)B PARKING METER POST INSTALLATION

Parking meters shall be mounted either on direct burial meter posts or on surface-mounted meter posts.

Direct burial parking meter posts shall be installed plumb as indicated on Standard Plan no. 629. Backfill shall be Material specified in Section 9-28.2(2)B and shall be mounded for drainage.

Surface-mounted meter posts shall be installed with accessories, as applicable and as indicated on Standard Plan nos. 627 and 628, and shall have a 5/16-inch thick base plate welded to the bottom with 1/4-inch fillet weld all around. The base plate and anchors shall be covered with a metal canopy made of spun aluminum as specified in Section 9-28.2(2)C and filled with a non-shrink cement sand grout meeting the requirements of Section 9-04.3(2).

Direct burial and surface mounted parking meter posts not also used for signs shall have a steel sleeve fitted loosely over the full length of exposed parking meter post (Standard Plan no. 629 shows the sleeve on a direct burial post). The sleeve shall be cut and reamed free of burrs to a length extending from contact with the ground or canopy, to where the base of the parking meter.

Where a meter post is used as a sign post with no parking meter, a galvanized metal cap shall be placed over the galvanized post. The cap shall receive one undercoat and 2 finish coats of black exterior enamel. For cap installation details, see Standard Plan nos. 627 and 628.

8-21.3(2)C PARKING PAY STATION

Installation and removal of parking pay station will be by SDOT. For required notification, see Section 1-07.28 item 3.

8-21.3(3) SIGN COVERING

As indicated in the Contract, the Contractor shall be prepared to provide a temporary covering to hide or expose select signs for public convenience. The covering shall consist of 4 mil minimum thickness black polyethylene sheeting of sufficient size to cover the entire face or both faces of the sign if not blank, shall extend over the edges of the sign, and shall

be securely fastened to the sign and post. The Contractor shall not use any type of Material which may permanently adhere to the face of the sign or damage the face of the sign and post. The covering, and method of fastening the covering to the sign, is subject to the approval of the Engineer.

8-21.3(4) SIGN RELOCATION

Existing traffic and street designation signs and their posts, and signs on parking meters shall be relocated to new locations called out on the Drawings or designated by the Engineer. Temporarily stockpiled signs and posts shall be protected against loss or damage. Removal of signs and posts required for "sign relocation" shall conform to Section 2-02.3(3)K .

Reinstalling posts shall comply with Section 8-21.3(2).

8-21.3(5) SIGN CLEANING

Signs shall be thoroughly cleaned after relocation or installation. The Contractor shall not use cleaning solvents that harm the sign finish.

8-21.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Install Sign, (Type), Owner Furnished"; "Sign, (Type)"; "Post, (Type)"; and "Relocate Sign (Type)", will be per each.

8-21.5 PAYMENT

Compensation for the cost necessary to complete the Work described in Section 8-21 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "Install Sign, (Type), Owner Furnished", per each.

The Bid item price for "Install Sign, (Type), Owner Furnished", shall include all costs for the Work required to pickup the sign, furnish and install the mounting hardware, and install the sign.

2. "Sign, (Type)", per each.

The Bid item price for "Sign, (Type)", shall include all costs for the Work required to furnish the sign, mount the hardware, and install the sign.

3. "Post, (Type)", per each.

The Bid item price for "Post (Type)" shall include all costs for the Work required to furnish and install the specified post including foundation, selected backfill and surface restoration.

4. "Relocate Sign, (Type)", per each

The Bid item price for "Relocate Sign, (Type)" shall 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.

Payment for the removal and replacement of surrounding improvements shall be in accordance with the Bid items in the Bid Form. If this Work is not specified in the Bid Form, replacement of improvements shall be considered incidental to the Work and no separate payment shall be made.

5. Other payment information

Payment for signing Work related to the maintenance and protection of traffic control shall be as specified in Section 1-10.5.

Sign Covering shall be considered incidental to the other Bid items of this Section.

SECTION 8-22 PAVEMENT MARKING

8-22.1 DESCRIPTION

8-22.1(1) GENERAL

This Work shall consist of furnishing and installing pavement markings upon the roadway surface at locations shown on the Drawings, or where designated by the Engineer, in accordance with these Specifications and Standard Plan nos. 700 through 724. Pavement markings shall be for channelization, warnings, instructions, or curb usages.

8-22.1(2) PAVEMENT MARKING DESIGNATIONS

Pavement markings are defined as follows:

I. Paint		
Item Designation	Description	Usage
L-1	Two parallel solid 4-inch yellow stripes with 4-inch space between stripes	Double center line (Major Arterials)
L-2	Solid 4-inch yellow stripe	Median line

L-3	Dashed 4-inch yellow stripe (10 feet paint with 20 feet skip)	Centerline (Minor Arterials)
L-4	Solid 4-inch yellow stripe with parallel dashed 4-inch yellow strips (10 feet paint with 20 feet skip) with 4-inch space between the two paint stripes	One side of two-way left turn lane
L-5A	Dashed 4-inch white stripe (10 feet paint with 20 feet skip)	Lane line
L-5B	Dashed 6-inch white stripe (2 feet paint with 4 feet skip)	Bus/HOV lane line
L-5C	Dashed 4-inch white stripe (2 feet paint with 4 feet skip)	Intersection guideline.
L-6A	4-inch solid white stripe	Approach line, edge line, guide line
L-6B	6-inch solid white stripe	Bus/HOV lane line
L-7	4-inch solid white stripe	Parking stall line
L-8	8-inch solid white stripe	Barrier line, crosswalk and crosshatch
L-8A	16-inch white stripe	Stop bar
L-8B	24-inch white stripe	Stop bar
L-9	Triangles in a single line (H = 1.5B) with blank space between triangles	Yield line
L-10	6-inch white curb stripe	Various zones
L-11	6-inch red curb stripe	Tow-away zone
L-12	6-inch yellow curb stripe	Various zones
L-13	6-inch combination curb stripe (3 feet red - 4 feet yellow - 3 feet red)	Bus zone
L-17	Left and right arrow combination	
L-18	Oblique left arrow	
L-19	Oblique right arrow	
L-20	Left arrow	
L-21	Right arrow	
L-22	Through arrow	
L-23	Left and through arrow combination	
L-24	Right and through arrow combination	
L-25	"ONLY" legend	
L-26	"OK" legend	
L-27	Not applicable	
L-28	Not applicable	
L-29	Disabled person symbol	
L-30	"Bus" legend	
L-31	"Lane" legend	
L-32	"Carpool" legend	
L-33	Diamond symbol	
L-35	"School" legend	

II. Thermoplastic (Denoted by "T" Suffix)		
Item Designation	Description	Usage
L-8T	8-inch solid white stripe	Crosswalk
L-8AT	16-inch solid white stripe	Stop bar
L-8BT	24-inch solid white stripe	Stop bar
L-9T	Triangles in a single line (H = 1.5B) with blank space between triangles	Yield line
L-17T	Left and right arrow combination	
L-18T	Oblique left arrow	
L-19T	Oblique right arrow	
L-20T	Left arrow	
L-21T	Right arrow	

L-22T	Through arrow	
L-23T	Left and through arrow combination	
L-24T	Right and through arrow combination	
L-25T	"ONLY" legend	
L-26T	"OK" legend	
L-27T	Pedestrian symbol	
L-28T	Bicyclist symbol	In striped bike lane
L-28AT	Bicyclist symbol with arrow	In striped bike lane
L-28BT	Sharrow	In shared travel lane
L-29T	Disabled person symbol	
L-30T	"Bus" legend	
L-31T	"Lane" legend	
L-32T	"Carpool" legend	
L-33T	Diamond symbol	
L-35T	"School" legend	

III. Pressure Sensitive Tape (Denoted by "S" Suffix)		
Item Designation	Description	Usage
L-10S	4-inch white curb tape	Various zones
L-11S	4-inch red curb tape	Tow-away zone
L-12S	4-inch yellow curb tape	Various zones
L-13S	4-inch combination curb tape (3 feet red – 4 feet yellow - 3 feet red)	Bus zone
L-14S	4-inch white tape	Parking meter stall, motor cycle stall, barrier area

8-22.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Pavement Marking Materials	9-29
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Glass beads shall comply with the specifications for adherence coated glass spheres as approved by WSDOT Headquarters Materials Laboratory, 1655 South Second, Tumwater, Washington 98502.

Paint, and sprayed or extruded plastic Material, shall be applied with a top dressing of glass beads. Material for pavement marking shall be paint and/or thermoplastic as specified in the Contract.

8-22.3 CONSTRUCTION REQUIREMENTS

8-22.3(1) PRELIMINARY SPOTTING

The Engineer will provide the preliminary layout as indicated on the Drawings for permanent pavement marking alignment following paving operations by the Contractor. Preliminary layout will consist of providing the Contractor with necessary control points at intervals agreed upon with the Contractor to enable the Contractor to complete the preliminary spotting of the pavement marking alignment before marking begins. Control points for crosswalks will be marked near or adjacent to the curb. Control points for stop lines will be marked near or adjacent to the curb and at the center line. Control points for legend and symbols shall be the responsibility of the Contractor. Legend and symbols shall be placed in accordance with the 700 series Standard Plans at locations indicated on the Drawings. At least 2 Working Days before applying permanent pavement marking, the Contractor shall arrange with the Engineer for a review of proposed marking locations. Approval by the Engineer shall be obtained before applying permanent marking. Preliminary spotting to guide the striping machine is required for all longitudinal lines except where a clearly visible separation is present.

Permanent pavement markings such as crosswalks, stop lines, center lines, legends and lane stripes shall be installed by the Contractor within 5 Working days, weather permitting, after preliminary layout of the control points has been completed by the Engineer. Temporary pavement marking, for centerline and lane lines and other pavement markings, shall be installed in accordance with Sections 1-07.23(1) and 1-10.3(4)C. Temporary pavement marking tape shall 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 shall 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 shall be trimmed to the back edge of the curb and the curbs cleaned of foreign Material before painting.

Existing pavement markings shall be completely removed. Cleaning and removal methods used shall 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 shall be approved by the Engineer before application of the markings.

8-22.3(3) PAINTED PAVEMENT MARKING

8-22.3(3)A GENERAL

Equipment used for application of pavement markings shall be designed and operated to produce painted pavement markings of uniform quality to meet all specified requirements.

Traffic paint shall be applied at a rate of not more than 100 square feet per gallon (approximately 15 mils wet thickness). This rate is effectively 16 gallons of paint per mile of solid 4-inch wide line, which will be the basis for the measurement of yield. A tolerance not to exceed minus 10 percent will be allowed for film thickness or yield in paint application.

On "ladder type" crosswalks, pedestrian and bicyclist symbols (including arrows), white sharp sand shall be spread over fresh paint at a rate of approximately 1 pound per 20 square feet.

8-22.3(3)B TOLERANCES FOR STRIPES

The allowable tolerances for line striping are as follows:

1. **Length of Stripe:** The longitudinal accumulative error within a 30-foot length of lane line shall not exceed plus or minus 1 inch.
2. **Width of Stripe:** The width of stripe shall not vary more than plus or minus 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, shall not vary from the widths shown on the Drawings by more than plus or minus 4 inches.

8-22.3(4) THERMOPLASTIC PAVEMENT MARKING

8-22.3(4)A TYPE "A" INSTALLATION

The thermoplastic pavement marking shall be applied to an initially dry pavement surface after sufficient time has elapsed to insure that the primer, if required, has adequately dried and further curing of the primer does not adversely affect the thermoplastic Material.

Type "A" thermoplastic Material shall be applied in accordance with the manufacturer's recommended temperature ranges for ambient air temperature, pavement temperature, and temperature of the molten Material.

Hot-laid thermoplastic Material shall be applied to the pavement by a gravity or an extrusion method, or a combination of both. If the stripe width is obtained by two or more side-by-side applications, the adjacent applications shall be fused together with no apparent overlap or gap.

Glass beads, Type II, shall be applied separately to the thermoplastic Material as it is being placed. The glass beads shall be uniformly distributed over the entire width of thermoplastic Material so that no objectionable irregularities in the Material's reflectorization occur. The beads shall be applied separately and uniformly at the rate of 1 pound for every 50 square feet of pavement marking. The dispenser shall be located behind and controlled simultaneously with the pavement marking extrusion die such that the beads are imbedded in the pavement marking to a depth of at least 1/2 the bead diameter.

8-22.3(4)B TYPE "B" INSTALLATION

Type "B" prefabricated thermoplastic Material shall be applied to the pavement in a manner which provides a uniform surface over the various widths required. At application, the ambient air temperature shall be within the range recommended by the manufacturer.

Type "B" thermoplastic Material may be supplied complete with a pre-coated, factory applied adhesive, or may be furnished with separate adhesive, as recommended by the manufacturer. Whether pre-coated or supplied separately, the adhesive shall 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.

When completed, the pavement markings shall not be less than 0.06 inches (1.5 millimeters) in thickness, exclusive of any pre-coated adhesive Material, and shall have a uniform cross-sectional configuration.

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 shall be removed prior to continuation of the operation.

When thermoplastic sharrows are required to be installed, the Owner will furnish the Materials for the installation. The Contractor shall contact SDOT's Signs and Markings Traffic Shop at (206) 233-7101, 24 hours in advance to arrange for pick up. The sharrows shall be picked up at 4200 Airport Way South, Seattle.

8-22.3(5) PRESSURE SENSITIVE TAPE PAVEMENT MARKING

Application procedures for pressure sensitive tape shall be as recommended by the tape manufacturer. The Contractor shall 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 shall be in accordance with Section 2-02.3(3)J.

8-22.3(7) TEMPORARY PAVEMENT MARKING

See Sections 1-07.23(1) and 1-10.3(4)C.

8-22.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1 Measurement of Quantities unless otherwise provided for by individual measurement paragraphs herein this Section.

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.

The legends "ONLY" and "OK" will be measured as 1 unit each.

The symbol "Bicyclist" with "Arrows" 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 "Sharrow, install Owner furnished" will be per each.

8-22.5 PAYMENT

Compensation for the cost necessary to complete the Work described in Section 8-22 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

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, Pressure Sensitive Tape", per linear foot.

The Bid item prices for the above listed Bid items shall include all costs for the work required to furnish and install the specified types of pavement marking.

6. "Sharrow, install Owner furnished", per each.

The Bid item price for "Sharrow, install Owner furnished" shall include all costs for the Work required to schedule the sharrow pick up, pick up the sharrow and install the sharrow at the location specified in the Contract, or as directed by the Engineer.

SECTION 8-23 RESERVED**SECTION 8-24 RESERVED****SECTION 8-25 GLARE SCREEN****8-25.1 DESCRIPTION**

This Work shall consist of furnishing and constructing glare screen of the types specified, in accordance with the Drawings, these Specifications, and WSDOT Standard Plan nos. L-5 and L-5a.

Glare screen consists of diamond-woven wire mesh fence of aluminum, galvanized iron or aluminum-coated steel wire fabricated and placed to reduce glare from headlights of opposing traffic or other adjacent light sources.

8-25.2 MATERIALS

Materials shall meet the requirements of Section 9-16.6.

8-25.3 CONSTRUCTION REQUIREMENTS**8-25.3(1) GLARE SCREEN FABRIC**

Glare screen fabric shall be placed on the face of the posts designated by the Engineer. On curves the fabric shall be placed on the face of the post which is on the outside of the curve.

The fabric shall be stretched taut and securely fastened to the posts. Fastening to end, brace, and pull posts shall be with stretcher bars and fabric bands spaced at 1-foot intervals. The fabric shall be cut and each span attached independently

at all pull and corner posts. Fabric shall be securely fastened to line posts with tie wires, metal bands, or other approved methods at 14 inch intervals. The top and bottom of the fabric shall be fastened to the tension cable and tension wire with hog rings spaced at 24-inch intervals.

Rolls of wire fabric shall be joined by weaving a single strand into the end of the rolls to form a continuous mesh.

8-25.3(2) SLATS

The slats shall be fastened into the weave by using staples, screws, or other methods as approved by the Engineer. Allowing the tension of the mesh to hold the slats in place will not be permitted.

Slats broken or split during construction shall be removed and replaced by the Contractor at no expense to the Owner.

8-25.3(3) POSTS

Posts, other than for Type 1 Design A, shall be constructed in accordance with the WSDOT Standard Plans and applicable provisions of Section 8-12.3(2)A.

Posts for Type 1 Design A shall be bolted to the beam guardrail posts as detailed in WSDOT Standard Plan no. L-5. Drilling of the guardrail posts shall be done in such a manner to ensure that the glare screen posts are set plumb and centered over the guardrail posts.

All round posts for Type 1 Design B, and Type 2 glare screen shall be fitted with a watertight top securely fastened to the post. Line posts shall have tops designed to carry the top cable.

8-25.3(4) TENSION WIRE

Tension wires shall be attached to the posts as detailed in the WSDOT Standard Plans.

8-25.3(5) TENSION CABLES

The tension cable shall pass through the top of the line post. One continuous length of cable shall be used between pull posts. Sufficient tension shall be applied to the cable to allow a maximum sag of 1/4-inch between posts after the chain link mesh has been attached to the cable. The Contractor shall provide temporary bracing on pull posts when applying tension to one length of cable at a time to prevent undue stresses on the pull post.

The cable shall be fastened to the top of the pull post with an eye bolt through the post and a turnbuckle connecting the eye bolt to the cable. Pull posts shall be braced to the bottom of the end or anchor posts with a short length of cable or tension wire as shown in the WSDOT Standard Plans. All turnbuckles shall have a minimum of 1-inch takeup clearance after tensioning.

The ends of all cables shall be seized with annealed iron wire for a distance of at least 1 inch.

8-25.3(6) FITTINGS, ATTACHMENTS, AND HARDWARE

A lead washer shall be placed against the shoulder of the eye nut, eye bolt, or backup nut, and a lead washer backed by the steel washer shall be placed between the pipe and lock washer, and the nut tightened sufficiently to seal the hole in the pipe.

A galvanized iron strap 1/4 inch in thickness by 12 inches in width, formed as shown in the WSDOT Standard Plans, shall be provided for the attachment of eye bolts to the base of the H column post in order to take the strain of the cable tension off the web of the H column.

8-25.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement of glare screen will be by the linear foot of completed glare screen for the particular type and design specified.

8-25.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-25 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "Glare Screen Type 1 Design _____", per linear foot.
2. "Glare Screen Type 2", per linear foot.

The Bid item price for glare screen of the type and design specified shall include all costs for the work required to furnish and assemble in place the completed installation including excavation, backfilling, tamping, concrete footings, miscellaneous hardware, smoothing the irregularities of the ground at the site, clearing the line for the glare screen, and disposing of all debris.

SECTION 8-26 RESERVED

SECTION 8-27 PROJECT IDENTIFICATION SIGN

8-27.1 DESCRIPTION

Section 8-27 describes work consisting of either furnishing and installing project identification signs at the Project Site in accordance with these Specifications and with the Contract, or installing Owner furnished project identification signs.

The quality of Contractor provided signs and supports shall 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 shall be constructed with Medium Density Overlay plywood, or shall be Owner provided. Descriptions of Owner furnished signs will be provided in the Contract.

8-27.2(2) PLYWOOD

Plywood signs shall 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 shall be free of contaminants which would adversely affect the application and life of the paint. Face veneers shall be Grade B or better.

Core and crossband veneers shall be solid. Core veneers shall be jointed. Core gaps shall not exceed 1/8 inch in width. The entire area of each contacting veneer surface shall be bonded with a waterproof adhesive that meets the requirements of the U.S. Department of Commerce for exterior type plywood.

The overlay shall be high density type. It shall have a minimum weight of 60 pounds per thousand square feet and shall be at least 0.012 inches thick before pressing. The overlay shall 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 shall be as shown on the Drawings. The thickness of the single panel plywood sign shall be 1/2-inch.

8-27.2(3) SIGN BORDERS

Every project identification sign shall have a border frame of 2 X 4's as shown in the Contract.

8-27.2(4) LETTERING AND SPACING FORMULA

Letters and symbols shall be of the type, size, and color specified in the Contract.

Letters and symbols shall be of Material compatible with the sign surface Material recommended by the sign surface manufacturer.

The Contractor shall submit one sample of a finished project identification sign for the Engineer's approval prior to fabricating the remaining signs required under this Contract.

8-27.2(5) SIGN SUPPORTS

Posts and wood supports shall be 4-inch x 4-inch meeting the requirements of Section 9-09.2 Preservative treatment for posts and wood supports shall be as required in Section 9-09.3. Project identification signs shall be securely mounted either to the posts, or to the wood supports and supporting framework. Posts shall be of a length capable of installing in the ground to a minimum depth of 3 feet below grade. The signs shall be mounted to be level and in a vertical plane. Backfill around the posts shall be reasonably compacted to provide adequate lateral support to prevent movement caused by moderate wind conditions. The wood supports and framework shall be sturdy and shall be installed to provide the needed stability to prevent movement caused by moderate wind conditions.

8-27.3 CONSTRUCTION REQUIREMENTS

8-27.3(1) LOCATION OF SIGNS

The Contractor shall install project identification signs at locations indicated on the Drawings. Signs facing in each direction of traffic shall be placed at all Project Sites prior to construction. Signs shall 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 shall be as required in Section 8-27.2(5).

8-27.3(2) SIGN REMOVAL

The Contractor shall 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 shall be done in such a manner as to prevent disturbance or damage to the sign, wood support and supporting frame. Should the sign, post(s), or wood support(s) be disturbed or damaged, the Contractor shall 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 site terrain where signs are to be relocated.

All removed Materials become the property of the Contractor and shall be removed from the Project Site.

The area(s) shall be restored to pre-existing or better condition immediately after removal.

8-27.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

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

Compensation for the cost necessary to complete the work described in Section 8-27 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **"Sign, Project Identification"**, per each.

The Bid item price for "Sign, Project Identification" shall include all costs for the work required to fabricate, paint, install, remove and dispose of signs, and restore all area(s) after project completion.

2. **"Sign, Project Identification, Owner Furnished"**, per each.

The Bid item price for "Sign, Project Identification, Owner Furnished" shall include all costs for the work required to pickup and deliver, install, remove and dispose of signs, and restore the area(s) after project completion.

3. **"Posts, Project Sign"**, per each sign.

The Bid item price for "Posts, Project Sign" shall 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" shall 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 post(s) or wood support(s) and support frame(s) if disturbed or damaged by Contractor operations.

Relocation of a project sign to a different site where a significant change in the original post(s), or wood support(s) 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 the work consisting of constructing wire mesh slope protection in accordance with these Specifications and the details shown in WSDOT Standard Plan nos. D-7 and D-7a and in conformity with the lines and dimensions shown on the Drawings.

8-29.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Wire Mesh Slope Protection	9-16.4
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8-29.3 CONSTRUCTION REQUIREMENTS

8-29.3(1) ANCHORS

The Contractor shall install anchors of the type shown in 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 shall be thoroughly compacted.

8-29.3(2) CABLE ASSEMBLY

The cable assembly shall be in place before the wire mesh is attached. The bottom cable shall not be tensioned. No cable splicing will be allowed.

8-29.3(3) WIRE MESH

The wire mesh shall be fastened to the completed cable assembly as shown in the WSDOT Standard Plan nos. D-7 and D-7a. Hog rings on the vertical lap splices shall be placed in a single row centered on the splice. Horizontal splices joining two rolls of mesh shall 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 shall 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 shall 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 shall be secured to the mesh with a minimum of 1-1/2 turns.

The wire mesh shall not be tensioned in any direction but is to remain loose so as to increase its dampening effect on rolling rocks. The Contractor shall use care in the handling and installing of the wire mesh and cable. Any mesh or cable damaged due to the Contractor's operations shall be replaced by the Contractor at no additional cost to the Owner.

8-29.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

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

Compensation for the cost necessary to complete the Work described in Section 8-29 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **"Wire Mesh Slope Protection Anchor"**, per each.

The Bid item price for "Wire Mesh Slope Protection Anchor" shall 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" shall 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 the work consisting of furnishing and installing a complete and functional illumination and electrical system as specified in the Contract and in accordance with these Standard Specifications and the Standard Plans.

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 shall provide the Engineer at least 10 Working Days advance notice unless otherwise arranged with the Engineer.

Required permits for electrical Work other than street lighting and signals, and other than irrigation (see Sections 8-03.1 and 8-03.3(1)), shall be obtained in accordance with Section 1-07.6.

The Contractor shall become thoroughly familiar with the electrical environment within the Project Site and with the relevant Work.

8-30.1(2) APPLICABLE ELECTRICAL CODES

In addition to the safety rules and standards specified in Section 1-07.1(2), electrical Work shall be performed in accordance with the current applicable provisions of the following codes:

1. SCL Material Standards, SCL Construction Guidelines, and Requirements for Electrical Service Connection.
2. State of Washington Electrical Workers Safety Rules, Chapter 296-45 WAC.
3. National Electrical Code.
4. City of Seattle Electrical Code Supplement.
5. Edison Electric Institute (EEI).
6. National Electric Safety Codes.

8-30.1(3) ELECTRICAL SHOP DRAWINGS

The Contractor shall submit Shop Drawings to the Engineer of the following items in accordance with Section 1-05.3:

1. Luminaires (include photometrics and socket position):
 - a. Lamps
 - b. Wire
 - c. Ground Rods
 - d. Fuse Kits
 - e. Photoelectric Cells
 - f. Wire Connectors
 - g. Ground Clamps
 - h. Splice Kits

8-30.1(4) ELECTRICAL AND ELECTRONIC WORDS AND PHRASES

See Section 1-01.3.

8-30.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Illumination and Electrical Materials, Luminaires , Ground Rods & Clamps	9-31
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All welds on tubular steel shall comply with the requirements of 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 shall remain in service until cut-over to new luminaires can be accomplished. Roadways shall not be opened to traffic before all of the required lighting system is operating properly.

8-30.3(2) LUMINAIRES

The luminaire glassware, reflector and lamp shall be thoroughly cleaned before installation on the tenon on the bracket arm. The luminaire shall be secured and adjusted according to the manufacturer's recommendations. The luminaire refractor shall 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.

Date of installation shall be marked on the bottom of the photoelectric cell with an indelible ink. The luminaire shall have the installation date marked in the metal base adjacent to the photo cell.

The photoelectric cell receptacle shall be adjusted such that the photoelectric cell faces north.

8-30.3(3) RESERVED**8-30.3(4) RELOCATING EQUIPMENT**

When equipment and associated Material is to be relocated, the Contractor shall furnish and install all the equipment and material, including additional new material as necessary, required to complete the installation. All material and equipment shall meet the requirements of these Specifications.

8-30.3(5) WIRING, FUSING, AND SPLICING

Individual luminaire fuses shall be rated at 10 amps except for 400 watt luminaires at 120 volts which shall be rated at 15 amps.

Festoon outlets shall be fused at 15 amps.

The Contractor shall provide wiring from luminaire terminal boards to in-line fuseholders and to the source of secondary service.

The Contractor shall coil a minimum 8 feet of wire at the source of secondary service to allow for connections by Seattle City Light. The Contractor shall coil 3 feet of excess conductor in each type handhole.

Each "hot" conductor shall have an in-line fuseholder and fuse located as indicated on the Drawings. Poles fed underground shall be fused in the pole base and shall have at least 3 feet of wire above the pole base to provide sufficient slack wire so the fuseholders can be withdrawn through the pole handhole for servicing.

Wire attached to the face of a wood pole, not enclosed in conduit, shall be covered with plastic molding meeting SCL Material Standards.

Caution shall be exercised in working near and within Seattle City Light Vaults and the electrical distribution system. Voltages present can be 26,000 volts or higher. Vault wiring will not be de-energized while the qualified Contractor is working. The Contractor shall 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 in accordance with Sections 1-05.2(2).

When cables or single conductors are being installed, care shall be exercised not to exceed tension limitations recommended by the manufacturer. Conductors may be pulled directly by hand; however, conductors pulled by mechanical means require a dynamometer with drop-needle hand shall be used on every pull. On mechanical pulls, either the insulation shall be stripped off each conductor, and conductors formed into a pulling eye and firmly taped before pulling, or a cable grip shall be used. The pulling force shall be applied directly to the conductor.

Secondary insulator racks required for new construction shall be in accordance with SCL Material Standards and installed in accordance with SCL Construction Guidelines.

Where new cable is to be installed in existing conduits which are occupied, the Contractor shall protect existing wiring from damage. Cable pulling compound shall be used to minimize cable pulling tensions and adverse effects on existing wire insulation, jacket and shield. Care shall be exercised in pulling cable into poles and pedestals since sharp metal edges may be present.

Aluminum wire and connectors shall be prepared and coated with an oxide-inhibiting compound.

Where triplex wire is installed overhead to feed only one street light, the two hot conductors shall be tied together (brothered) at each pole.

Wire insulation shall be removed by a method that does not "ring" or nick the wire. "Ringing" will be cause for rejection of the splice.

Wire splices shall be made mechanically and electrically secure. Each individual splice or termination of extra leads shall be insulated and made waterproof.

All cables shall be marked with a permanent waterproof tag in handholes or access points with feed point circuit number.

For above ground splices, the connector shall be torqued to the manufacturer's recommended level. The splice and termination of extra leads shall be covered with rubber base insulating and waterproofing tape as specified in SCL Material Standards. This tape shall be worked around the wire insulation to insure a water tight assembly. The splice assembly shall be protected with two layers of electrician tape.

For below ground splices, connectors shall be tightened or crimped in accordance with the manufacturer's specifications. Only manufacturer's approved crimping tools shall be used to compress crimp splices. The metal splice shall be centered in the enclosure. The encapsulant shall be mixed and installed in accordance with manufacturer's recommendation. The encapsulant shall completely fill the enclosure and be free of voids and impurities.

Where festoon outlets are installed on poles a separate circuit shall be provided.

8-30.3(6) RESERVED

8-30.3(7) GROUNDING AND BONDING

All metallic appurtenances containing electrical conductors, including cabinets, metallic conduit, metal poles, pedestals, and junction boxes, shall be made mechanically and electrically secure to form a continuous system which shall be effectively grounded.

Where conduit (including steel conduit) systems are used, all metallic appurtenances shall be electrically bonded by a separate insulated ground conductor.

Where parallel electrical circuits exist in an electrical conduit, the equipment grounding conductor shall be sized as determined by the rating of the largest overcurrent device serving any circuit contained in the conduit (minimum size shall be #8 copper). Only one equipment grounding conductor is required in any conduit.

All conduit runs with phase conductors (with the exception of the run from the riser to the first handhole) shall have a ground wire installed in the conduit unless noted otherwise on the Drawings.

A ground wire shall interconnect all ground rods in each circuit.

Metal conduit, ground wires and the service neutral shall be bonded and grounded at the service entrance point as required under the NEC and the City of Seattle Electrical Code.

Only one wire shall be installed under any ground clamp.

Ground rods shall be installed in firm undisturbed earth. In areas with loose or soft soil conditions, extensions shall be coupled until the rod cannot be removed by hand. Minimum spacing between ground rods shall be 6 feet.

8-30.3(8) REMOVAL AND SALVAGE OF EXISTING EQUIPMENT

Refer to Section 2-02.3(3)G and 2-02.3(7)C.

8-30.3(9) FIELD TESTING

Prior to completion of the Work, the Contractor shall provide the Engineer 3 Working Days advance notice and make the following tests on all electrical circuits:

1. 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 meet the requirements of Article 250 of the National Electrical Code.
2. Insulation resistance test (with all readings recorded when requested by the Engineer). The insulation test shall be performed after all field connections have been made.
3. A functional test in which it is demonstrated that each and every part of the system functions as specified or intended herein. The functional test shall be performed after all field connections are completed.

8-30.3(10) FINAL INSPECTION

See Section 1-05.11.

8-30.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

8-30.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-30 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **"Luminaire, High Pressure Sodium, (Wattage), Roadway"**, per each.

The Bid item price for "Luminaire, High Pressure Sodium, (Wattage), Roadway" shall 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. **"Luminaire, High Pressure Sodium, (Wattage), Underdeck Mounted"**, per each.
3. **"Luminaire, High Pressure Sodium, (Wattage), Wall Mounted"**, per each.

The Bid item prices for "Luminaire, High Pressure Sodium, (Wattage), Underdeck Mounted" and for "Luminaire, High Pressure Sodium, (Wattage), Wall Mounted" shall include all costs for the work required to furnish and install complete luminaire units of the type specified including wiring to the conduit.

4. **"Relocate (Item)"**, per each.

The Bid item price for "Relocate (Item)" shall 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 relamping relocated luminaires.

5. **"Wiring, Street Lighting"**, per lump sum.

The Bid item price for "Wiring, Street Lighting" shall 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.

6. Other payment information.

All 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 no cost to the Contractor.

All costs for furnishing and installing hardware not specifically called out, but required to complete the constructions in Section 8-30 shall be included in the applicable Bid item prices and no separate or additional payment will be made.

Costs for Electrical Safety Observer shall be in accordance with Section 1-05.2(2).

SECTION 8-31 TRAFFIC SIGNAL SYSTEM

8-31.1 DESCRIPTION

8-31.1(1) GENERAL

This Work shall consist of furnishing and installing a complete and functional traffic control system consisting of controller assembly, signals, miscellaneous traffic devices, and appurtenances in accordance with the Contract.

The Contractor shall 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 signal(s) fail to function properly, the Contractor shall immediately call for an off duty Uniformed Peace Officer to control the intersection. The Contractor shall also immediately notify the Engineer and the Owner's Signal Maintenance Office (206-386-1206) of the nature of the malfunction. The Contractor shall 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 shall submit Shop Drawings including catalog cuts in accordance with 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
5. Miscellaneous
 - a. Telephone Station Protector
 - c. Pedestrian PushButton
 - b. Aerial Terminal Compartments
 - d. Ground Rods
6. Detector Loops
 - a. loop sealant
 - b. wire

The Contractor shall submit three prints and one transparency of the "as built" wiring diagrams to the Engineer for each signalized intersection at least 3 working Days prior to requesting the Engineer's approval for turn-on or cut-over. All prints and transparencies shall be reasonably readable.

Transparencies shall be of a quality providing clear and readable reproductions.

8-31.1(4)B SAMPLES

The Contractor shall submit a sample to the Engineer for approval of the type of vehicle and pedestrian signal heads, illuminated signs, and mounting hardware 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 RESERVED

8-31.1(5)B RESERVED

8-31.1(5)C RESERVED

8-31.1(5)D FIELD TESTING

The Contractor shall make the following tests on all new electrical circuits. Test equipment shall 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 shall be performed with all wiring installed but connections not made to controller, conflict monitor, load switches, or other plug connected accessories. The Contractor shall submit to the Engineer with 3 copies of the test results identifying observed readings with their respective circuits at least 3 Working Days prior to any checkout of the installation to be turned on or cut over. One copy shall be filed in the controller cabinet.

The insulation resistance on all electrical circuits whose nominal voltage is between 115 volts and 600 volts, other than direct burial cable, shall 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 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 shall 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 shall require written approval by the Engineer. Only those factors based on dielectric properties of conductor insulation, splicing insulations, terminal strips, etc., 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 or intended herein. The functional test will be performed after all field connections to the controller cabinet have been made.

Any fault in any Material or in any part of the installation revealed by these tests shall be justification for the Material to be replaced or for the part to be repaired by the Contractor in a manner approved by the Engineer, and the same test shall 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 shall meet the requirements of Section 9-32.

All welds on tubular steel shall comply with the requirements of ANSI/AWS D1.1 Section 10 Tubular Structures.

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 shall 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 shall have all traffic controls (i.e., pavement markings, channelization, and signage) in place prior to requesting Engineer's approval for turn-on or cut-over.

To maintain safe traffic conditions, existing signals shall 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 shall be installed on all approaches. These signs shall remain in place for not less than 7 Calendar Days nor more than 21 Calendar Days. All signs shall be highly visible and be placed in convenient and secure locations.

At the time of cut-over of revised signals having phasing which is different from the old signal operation (i.e., added phase, split phase, etc.) temporary "SIGNAL REVISION" signs shall be placed upstream on all approaches. These signs shall 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 shall be highly visible and placed in convenient and secure locations. See Sections 8-31.3(16), 1-07.23, and 1-10 for traffic safety and traffic control.

8-31.3(1)B TRAFFIC SIGNAL CONTROLLER CABINET AND HANDHOLE ACCESS REQUIREMENTS

Access to traffic signal controller cabinets and handholes shall 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 shall always have at least 3 feet clear on all sides. Clear and uncluttered access between the traffic signal controller cabinet and accompanying handhole shall 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 shall proceed as follows:

The Contractor shall check and tag all field circuits, and shall provide the Engineer at least 3 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 shall 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 shall be temporarily relocated in such a manner that the intersection operates in its present mode during foundation reconstruction or modification. The Contractor shall protect the traffic signal controller assembly within the Work area, as approved by the Engineer.

Following foundation reconstruction, the new traffic signal controller assembly shall be installed on the new or modified foundation.

8-31.3(2) TRAFFIC SIGNAL CONTROLLER ASSEMBLY

8-31.3(2)A GENERAL

The Contractor shall install the traffic signal controller cabinet. The Engineer will install the traffic signal controller and associated electronic equipment.

Auxiliary equipment added to existing traffic signal controller cabinets shall be installed as indicated on the Drawings and as specified herein.

Any field modifications shall require the Contractor to submit to the Engineer for approval a modification plan 3 weeks prior to scheduling the Work. The submittal shall 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 shall also be submitted at this time, along with information on measures to be taken to minimize adverse impacts on traffic.

The Engineer shall be notified 2 Working Days in advance of energizing the unit.

The Contractor shall coordinate with SDOT Signal Operations at the pre-construction meeting for traffic signal controller cabinet pick up schedule. The Contractor shall pick up the traffic signal controller cabinet at the Traffic Signal Shop (at 4200 Airport Way South, 206-386-1206) for installation.

For installation of the Type 2070 traffic signal controller cabinet, the contractor will be 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(3) SIGNAL HEADS, VEHICLE AND PEDESTRIAN

8-31.3(3)A GENERAL

Signal heads shall not be installed at any intersection earlier than 10 Working Days prior to turn-on or cut-over.

Mounting shall be bracket, mast arm, post top, span wire, or clamshell as indicated on the Drawings. Signals mounted on post tops shall utilize standard 4-inch slipfitters. Bracket-mounted signal heads shall utilize the signal bracket assembly and type of mounting indicated on the Drawings. The bracket assembly shall be installed in line with the pole center line.

Attachments such as visors, backplates or adapters shall conform and readily fasten to existing mounting surfaces without affecting the weatherproofing and light integrity of the signal.

Electrical service shall be neatly formed to the supporting structure with only sufficient slack for wind effect when span wire mounted.

All new vehicular and pedestrian signals shall 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.

Alignment of vehicular and pedestrian signal heads and the overall readiness of other traffic control devices and channelization will be approved by the Engineer prior to activating signal locations.

8-31.3(3)B VEHICLE SIGNAL HEADS

The bottom of vehicle signals mounted over roadways, excluding backplates shall have a range of clearance between 17 feet to 19 feet above roadway grade at the crown of the roadway. On designated truck and overhead trolley routes, the range of clearance shall be 18 feet to 19 feet. Under no circumstances shall the bottom of the vehicle green section be more than 19 feet above roadway grade at the crown of the roadway. Vehicle signals mounted on poles or pedestals shall be 12 to 15 feet above sidewalk grade. Pole plates used for bracket mounted installations shall be of the type that shall fit flush against the pole surface without altering the pole or pole plate.

The signal shall be mounted with standard 1-1/2 inch fittings as a single section or as a multiple section head. The signal section shall 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 shall permit external adjustment about the mounting axis in 5-degree increments. The signal shall be mountable with ordinary tools and capable of being lamped without tools.

Signal heads located over the roadway shall not be in conflict physically or visually with trolley wires, span wires, electrical wires or any other hardware existing or proposed for the location. A 3-foot edge to edge clearance shall be maintained between signal heads and trolley wires. Span wires and tether lines within 4 feet of trolley lines shall be properly insulated. If it becomes evident that a conflict exists, the Contractor shall immediately notify the Engineer and allow 5 Working Days to resolve the problem.

Balance adjusters shall not be installed when the approach grade is less than 10%.

When balance adjusters are required, the vehicular heads shall be adjusted in the field such that persons standing on the pavement, four times the speed limit in feet back from the stop bar, shall see the brightest image of the red section. Heads shall be plumbed as viewed from the direction in which they face.

Optically programmed type traffic signal heads shall be programmed before traffic signal system turn-on. Programming shall be performed in the presence of the Engineer (note - also a representative of the Traffic Signal Shop) by giving 2 Working Days advance notice.

Vehicle signal heads shall be attached to the mast arm with a signal coupling unit as detailed on Standard Plan nos. 510a and 510b. Mounts shall include elevator straight plumbizer units between the red and yellow signal sections, or 90 degree plumbizers.

Vehicle signal heads shall be attached to the span wire by means of a hanger clamp, balance adjuster, and suspension fittings as shown on the Standard Plans. The sag in the span wire after loading shall be within the range of 5 percent to 7 percent of the total span. Span wires shall 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 shall be approximately level when viewed from the approach direction.

For optically programmed signals which are span wire mounted, a tether cable with connections and hardware as recommended by the signal head manufacturer shall be used to provide and maintain proper optical visibility of all indications. The tether cable clamps used shall be designed to release under severe wind loads and impact. The tether cable shall be insulated, bright yellow, and shall be installed a minimum 18 feet above roadway grade.

8-31.3(3)C PEDESTRIAN SIGNAL HEADS

Pedestrian signal heads shall 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 shall 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 feet 6 inches above the sidewalk.

The Contractor shall use a "Clamshell" type mounting assembly for pedestrian signals.

Pedestrian signal heads mounted on the same pole (not pedestal) shall be installed so that the bottom of the housing of each head is a minimum 8 feet to a maximum 9 feet 6 inch above sidewalk grade. On poles where the signal housings interfere with each other, stagger mounting shall be required as indicated on the Standard Plans.

8-31.3(4) PEDESTRIAN PUSHBUTTON ASSEMBLY

The pushbutton assembly shall be located on the side of the pole as shown on the Drawings. The mounting height shall be as indicated on Standard Plan nos. 521 and 523.

8-31.3(5) DETECTOR LOOPS

8-31.3(5)A LOOP WIRE

Vehicle loop detectors indicated on the Drawings are located schematically and actual loop detector locations will be verified by the Engineer prior to sawcut or installation. The Contractor shall 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 shall be obtained by the Contractor prior to sawcut or loop detector installation. In general, loop locations shall be located behind existing or proposed stop bar pavement marking, and shall not be located where pavement dowel or tie bars or metal supports within the pavement are located. Loops located within or beyond the stop bar pavement marking will not be allowed. The Contractor shall not begin sawcutting pavement until loop locations have been approved by the Engineer. When parallel to a pavement joint or edge, the sawcut shall be at least 1 foot away from the edge or joint. All saw cuts shall be cleaned of all debris.

The Contractor shall sawcut pavement to a depth that provides a minimum 1 inch cover between the top of loop wire and pavement surface.

One single continuous length of loop wire shall be used to form a loop with the number of turns indicated on the loop schedule on the Drawings. The wire shall 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 shall sawcut all corners at least once to reduce the corner angle. This corner angle shall then be filed or smoothed acceptably free of sharp edges.

The sawcut in concrete shall be filled with a quick-drying high strength highway concrete patching Material. The Contractor shall 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.

In asphalt installations, the loop wire shall be sealed with an asphaltic sealant approved by the Engineer. Sealing shall not be performed when the pavement is damp.

When placing loops across joints or cracks in pavement, the portion of wires across the joint or crack shall be protected by placing it in tubing as indicated on the Standard Plans. The tubing shall be sliced open to insert the wire in the tubing and then placed across the joint or crack extending a minimum six inches each side of the joint or crack.

Loop wire, from the loop to the lead-in splice, shall be twisted a minimum of 3 turns per foot. Care shall be taken so that the twists are uniform.

A minimum of 60 inches of loop wire shall be brought into the handhole and spliced to the lead-in cable with a crimped soldered, waterproof splice.

8-31.3(5)B DETECTOR LOOP LEAD-IN CABLE

The Contractor shall sawcut pavement to a depth which provides a minimum 1 inch cover between the top of loop wire and pavement surface.

Lead in cable shall be one continuous length from the splice at the handhole to the termination point in the controller cabinet.

The cable shield and drain wire shall be grounded at the system ground only at the controller cabinet and shall be continuous and insulated.

Each loop lead-in wire shall have a permanent cloth or plastic tag with the label number shown on the loop detector wiring chart specified on the Drawings. These tags shall be placed at handhole splice and controller cabinet terminations.

As-built drawings: Before Turn-on/Cut-over, the Contractor shall 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 shall 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).

8-31.3(5)C INDUCTANCE TESTING AT THE HANDHOLE

Before splicing the loop wire to the loop lead-in cable, an inductance test shall be performed by the Engineer to ensure the inductance is within the acceptable range of plus or minus 15 percent of the calculated inductance. If the inductance does not fall within the acceptable range, the Contractor shall take necessary corrective measures until the desired readings are obtained or as approved by the Engineer.

As-built drawings: Before Turn-on/Cut-over, inductance readings shall be recorded on the as-built drawings showing the reading for each loop. After Turn-on/Cut-over acceptance by the Engineer, the as-built record in the controller cabinet shall reflect the final inductance readings. Also see Sections 1-05.3(11), 8-31.3(5)B, 8-31.3(5)E, and 8-31.3(16).

8-31.3(5)D LOOP CONTINUITY TESTING

Before cut-in/turn-over, the completed loop and lead-in configuration after splicing shall 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 shall 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 prior to placing the sealant is less than 10 megohms, all splices and wires should be checked for insulation damage. Corrective measures shall be taken until an acceptable resistance is obtained. After the slot has been sealed, the Contractor shall perform the resistance and continuity tests again. If the continuity and resistance tests do not meet the above-mentioned requirements, the Contractor shall take corrective measures until readings acceptable to the Engineer are obtained.

8-31.3(5)E INDUCTANCE TESTING AT THE CONTROL CABINET

After loop wire and lead-in cable splices have been made, and the continuity test has been completed, the Engineer shall test the inductance of the loop and loop lead-in cable at the controller cabinet. The inductance shall be within the acceptable range of plus or minus 15 percent of the calculated inductance. If the inductance does not fall within the acceptable range, the Contractor shall take corrective measures until acceptable readings are obtained.

As-built drawings: Final readings shall be recorded on the as-built drawings of the total inductance for each of the loops plus lead-in circuits. Also see Sections 1-05.3(11), 8-31.3(5)B, 8-31.3(5)C, and 8-31.3(16).

8-31.3(5)F ENCAPSULATED DETECTOR LOOP

The requirements of 8-31.3(5), excluding Section 8-31.3(5)A, shall apply to encapsulated detector loops except as follows:

The Contractor shall mark out proposed loop detector locations for the Engineer's approval at least 3 Working Days prior to installation. The loop detector location coordination requirements of Section 8-31.3(5)A shall be followed.

Encapsulated detector loops shall be installed and tested prior to the pavement being installed.

Loop and home-run locations referenced to the face of the nearest curb shall be noted on the as-built drawings.

The Contractor shall install the loop wire and conduit within the base course of the pavement system. A minimum of 60-inches of loop wire shall be brought into the handhole and spliced to the lead-in cable with a crimped/soldered waterproof splice.

Before paving operations begin, the Engineer will conduct an inductance test per Section 831.3(5)C. An inductance test will again be performed after the pavement has been installed and before turn-on or cut-over. Also, the Contractor shall conduct the tests required by Section 8-31.3(5)D after the pavement has been installed and before turn-on or cut-over. Such tests shall be performed in the presence of the Engineer.

8-31.3(6) OVERHEAD INTERIOR ILLUMINATED SIGN

Interior illuminated signs shall 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 shall be mounted as indicated on the Standard Plans unless indicated otherwise in Contract. The sign shall 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 shall be a minimum of 16-1/2 feet and a maximum of 19 feet. On designated truck routes, this clearance shall be a minimum 18 feet.

Signs shall be plumb.

8-31.3(7) RESERVED

8-31.3(8) INTERCONNECT CABLE

8-31.3(8)A GENERAL

The Contractor shall 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 shall be lubricated with an approved cable pulling compound.

The Contractor shall use grip or "come-along" to hold on to the jacketed messenger when pulling and tensioning. Pulling and tensioning shall 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 shall 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 shall be dead-ended with either automatic strand vises or preformed guy grip dead-end. When dead-ending with strand vises, the Contractor shall 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. A 1-bolt guy clamp shall be used to bond the strand ends together.

Interconnect cable shall not be spliced. The cable shall be a continuous run between the terminal strip of one controller to the terminal strip of the next controller. The messenger wire shall be removed from aerial figure 8 cable in pole risers and conduit.

The shield of all cables entering an aerial terminal compartment shall be terminated on a common terminal. The shield shall 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 shall 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, care shall be taken not to disrupt the integrity of the entire system. A plan of order for converting from an old to a new system shall be submitted for approval by the Engineer at least 10 Working Days in advance.

An extra six (6) feet of interconnect cable shall be coiled in the nearest handhole to the controller cabinet. After the cable has been pulled into the controller cabinet, the outside jacket shall be stripped back 3-feet. All exposed wiring shall have the gel removed from each wire individually. The Jacket end shall be sealed to prevent the gel from leaking out of the cable. Sealing shall be done by applying a small portion of duct seal, well pressed between the wires and jacket and then firmly taped with 4-6 wraps of friction type extending two (2) inches from each side of the jacket end to hold the seal in place. After cleaning and sealing, the exposed length of wiring shall be retwisted as a pair with the original mate. An approved shield grounding connector shall be used to ground the shielding.

Interconnect cable in conduit shall be installed in accordance with Section 8-30.3(5).

8-31.3(8)B TELEPHONE INTERCONNECT CONNECTION

The Contractor shall notify the Engineer at least 4 weeks, but not more than 6 weeks, in advance of the expected turn-on in order that the Engineer can request the telephone service provider to install the two-pair interconnect drop to the telephone station protector.

The Contractor shall have completed the telephone station protector, with associated wiring to the controller, before the phone connection can be installed and tested when the request is made.

8-31.3(9) SIGNAL WIRING**8-31.3(9)A CONDUCTOR INSTALLATION**

The Contractor shall be responsible for making all circuits fully functional after pulling in new cables.

Cable and wire which is damaged in pulling shall be promptly replaced with new cable at the sole expense of the Contractor.

When conductors and cables are being installed, care shall be exercised not to exceed tension limitations recommended by the manufacturer. Conductors may be pulled directly by hand. However, if conductors are pulled by any mechanical means, a dynamometer with drop-needle hand shall be used on every mechanical pull.

On mechanical pulls, sufficient insulation shall be stripped off the conductor to form a pulling eye and then firmly taped before pulling; or a cable grip shall be used. The pulling force applied directly to the conductor, when pulling eyes are used or when the conductor is formed into a loop, shall be limited to 0.008 pound per circular Mil area of copper conductor but shall not exceed the recommended limits of the conductor's manufacturer. When a cable grip is applied over nonmetallic sheathed cables, the maximum pulling force shall be limited 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 shall 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 shall be utilized. Lubricant shall be of a non-hardening type approved by the Engineer.

In existing conduits where new cable is to be installed which contain existing traffic and street light wiring as noted on the Drawings, the Contractor shall protect existing wiring from damage due to pulling new cable. Cable pulling compound shall be used to minimize cable pulling tensions and adverse effects on existing insulation, jackets and shields.

Enough cable shall 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.

Cable routings on span wire shall be securely attached to the span wire by means of 4-6 wraps of friction tape spaced no more than 18 inches apart. Drip loops shall 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 shall be secured to the pole to give a neat appearance.

All electrical cable for traffic signal facilities passing through handholes, junction boxes, conduit bodies, vaults and manholes shall be properly identified. Each cable shall be identified as to its function by using 3 wraps of colored plastic tape as follows:

Cable Function	Tape Color
Vehicular Signal Circuits	Red
Detector Circuits	Yellow
Pedestrian Signal Circuits	Green
Pushbutton Circuits	Brown
Interconnect	White
Telephone Circuit	Two White (White-White)
Service	Orange
Fire Pre-empt	Blue (light)

Colored tape identification shall also apply to cables spliced in pole and pedestal bases and aerial splices. Each cable shall be identified with the appropriate colored tape within 6 inches of a splice. Cable in handholes, junction boxes and conduit bodies shall be appropriately marked near the center of the enclosed section of cable. Cable passing through Seattle City Light handholes, manholes and vaults shall be identified with a permanent waterproof marker secured to the cable. The cable marker shall 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 manholes and vaults shall be done in accordance with the National Electric Safety Code and Seattle City Light Standards. Cable being installed in manholes and vaults with existing power cable should be racked on the wall opposite the power cable. If cable must be racked on the same wall with power cable, it shall be mounted above the power cable, maintaining a 6-inch minimum separation. Every effort should be made to minimize any negative impact of power cable noise and transients upon the new communications cable, while adhering to all safety regulations. See Section 1-07.28 item 6 regarding notifications required for work in or near Seattle City Light structures. In handholes, all cables and conductors shall be orderly to provide easy recognition and quick access.

Requirements for cable bending, training and racking shall be in accordance with Seattle City Light Construction Standard U4-2.8. For convenience, several of the frequently needed requirements are:

1. Rack opposite the primary.
2. Maintain proper cable separation.

3. Signal cable should be above all other existing cable.
4. Elevation changes shall be made behind other cable.
5. Use existing rack, if available or use stud gun for installation to wall at 4-foot spacing, with 2-foot spacing near cable entrances.
6. NEMA boxes should be on an end wall, 2-feet from the ceiling and be visible from the manhole opening.

Care shall be exercised in working near and within any Seattle City Light vaults. Voltages present are as high as 26,000 volts, and the vault wiring will not be de-energized while the Contractor is working. Seattle City Light safety and Electrical Safety Observer standards shall be adhered to 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 8.

8-31.3(9)B SPLICES

Signal cable shall be spliced only in poles, pedestal bases, or overhead within 2 feet of the poles. Aerial splices shall be covered by reverse wrapping of the first layer with electrician insulating tape, then a built-up rounded end of electrical tape, then a minimum of 2 layers forward with electrician tape.

At locations where existing signal cables are being utilized, the traffic signal cables shall be spliced in pole or pedestal bases and each individual conductor shall be insulated and the entire splice shall be waterproofed.

Each individual splice or termination of extra leads shall be insulated, taped and made waterproof.

Loop wire shall not be spliced, except with the loop lead-in wire within the handhole.

Service cable or master cable shall not be spliced except as indicated on the Drawings.

8-31.3(9)C TERMINATIONS

Except at a splice, conductors shall be terminated on a terminal strip or push-on connectors at the signal equipment which it is serving. Only terminal strips with screw-type pressure binding posts shall be used. Stranded conductors shall use compression-type pressure fittings at the terminal strip. Single solid conductors shall attach directly to the screw post; otherwise compression-type pressure fittings shall be used when more than one conductor is attached.

All electrical terminations shall be tightened to their prescribed torque value.

All terminals shall be marked with field wiring numbers printed on back or front-mounted marking strips.

8-31.3(9)D PEDESTRIAN PUSHBUTTON CABLE

Pedestrian pushbutton cable shall not be spliced and shall be one continuous length from the pedestrian pushbutton to the termination point in the controller cabinet. The cable shield shall be grounded to the system ground only at the controller end. The cable shield between cabinet and pedestrian pushbutton shall be continuous throughout intermediate junction boxes, shall completely cover the wires, and shall be insulated to prevent grounding in any junction box or in any conduit.

8-31.3(9)E ELECTRICAL SERVICE CONNECTIONS

The Contractor shall furnish and install equipment and wiring for 2 parallel 120 volts, 60 Hz AC electrical services. The electrical service cable shall be installed as indicated on the Drawings.

All final service connections of signal system to overhead secondaries or to secondaries in vaults or handholes will be made by Seattle City Light. The Contractor shall arrange a schedule with the Engineer for service connections at the preconstruction conference.

8-31.3(10) GROUNDING AND BONDING

All metallic appurtenances containing electrical conductors, including cabinets, metallic conduit, metal poles, pedestals, junction boxes, and handhole frames and lids shall be made mechanically and electrically secure by forming a continuous system which shall be effectively grounded.

Where conduit systems are employed, all metallic appurtenances shall be electrically bonded as required by Article 250-95 of the NEC.

The equipment grounding conductor shall in all cases be sized consistent with Table 250-95 of the NEC. All proportional adjustments in grounding conductor capacities shall be considered as accomplished by the installation of a ground rod at each handhole. The metal ring on the handhole and its metal cover shall also be grounded locally per NEC requirements.

Equipment grounding conductors, if insulated, shall employ insulation rated at 60 °C or higher and shall be chemically compatible to other insulations contained within the system.

Identification of the equipment grounding conductor shall conform to all NEC requirements.

Grounding of conduit and neutral at the service point shall be as required under the NEC.

Service ground and neutral shall be kept isolated from the logic ground circuits in the controller cabinet.

A ground wire shall bond all system ground rods. A ground clamp shall be used to secure the ground wire to the ground rod. The neutral bus on the service switch shall be connected to the closest ground rod.

8-31.3(11) POLE LINE HARDWARE INSTALLATION

Span wire portions that are directly above METRO trolley wires shall be covered with plastic cable guard. The cable guard shall extend a minimum of four (4) feet beyond each side of the trolley wire track. The cable guard will be furnished by the Owner. The Contractor shall give the Engineer at least 10 Working Days advance notice prior to installation. See Section 1-07.28 item 2 regarding notifications required for coordination of Work with METRO trolley lines.

Span wire shall be secured to steel strain poles by means of pole bands, and to timber poles by means of single strand guy eye bolts. Span wire sag shall be 5 to 7 percent of the total span. Pole bands and eye bolts shall be installed as detailed on the Standard Plans.

Span wire shall be secured to eye bolts or strain clamps at poles by use of self-locking cable clamp type dead-ending devices. Span wire shall be secured to bull rings and anchors by the use of cable guy wrap and guy thimbles. Span wire shall be secured to strain insulators by the use of cable guy wraps.

Strain insulators shall 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 shall be mounted a minimum of 18 feet above the roadway.

On steel poles, no lag or through bolts shall be used.

8-31.3(12) RELOCATING EQUIPMENT

When existing equipment is to be relocated, the Contractor shall 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 shall 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 shall be cleaned and relamped.

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 shall pickup equipment and Material, as specified and at pickup locations indicated in the Contract, and install such as indicated on the Drawings.

8-31.3(15) CHECK-OUT PROCEDURE

The Contractor shall 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 the associated wiring and connections as called for on the Drawings. The Contractor shall 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, shall 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 shall be submitted in writing to the Engineer at least 5 Working Days prior to the proposed date of an existing signal cut-over, and 5 Working Days prior to 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 shall submit an 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 and cut-overs will not be permitted on Friday, Saturday, Sunday, Monday, Holidays or a Day before a Holiday. Only one turn-on or cut-over will normally be permitted in a single Day. Turn-on or cut-over Work shall be scheduled and completed between the hours of 9:00 AM and 2:30 PM.

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 shall not energize the signals until the Engineer is on site and has authorized the Contractor to proceed. To maintain safe traffic conditions, existing signals shall 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 shall not obscure existing traffic controls.

The Contractor shall be present and shall be prepared at such turn-on time, with Materials and tools necessary to correct any malfunctions which may occur. Turn-on shall not take place if any subsequent Work necessitates turning off the signal system.

All new vehicular and pedestrian signals and illuminated signs shall be temporarily covered (sacked) completely with a 6 mil opaque polyethylene sheeting until the new signals are ready to be energized. A small diameter hole (i.e., 1

inch) shall be cut into the opaque plastic cover in front of each vehicular signal lens and a 1 inch by 3 inch 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 shall be sacked or removed. The old signal heads shall not obscure the new traffic controls at any time.

8-31.3(16) A NEW TRAFFIC SIGNAL ACTIVATION AT NEW CROSSWALK

Upon successful inspection of the new cross walk location by the Engineer, the Engineer will schedule the traffic signal activation with the City of Seattle Traffic Signal Control and Repair Shop (CR Shop). The Engineer will inform the Contractor of the scheduled traffic signal activation date(s).

The new or upgraded traffic signals will be activated only after the crosswalk pavement markings or temporary crosswalks have been installed and the traffic signal activation schedules have been coordinated with the Engineer and CR shop.

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 shall submit to the Engineer for approval, as-built wiring drawings indicating revised field wiring and revised controller assembly wiring. Final as-built wiring diagrams to be placed in controller cabinet(s) shall be in-place one 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).

8-31.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

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.

8-31.5 PAYMENT

Compensation for the cost necessary to complete the Work described in Section 8-31 will be at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **"Install Owner Furnished Traffic Signal Controller Cabinet, (Type)"**, per each.

The Bid item price for "Install Owner Furnished Traffic Signal Controller Cabinet, (Type)" shall 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)" shall 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. **"Pedestrian Pushbutton Assembly"**, per each.

The Bid item price for "Pedestrian Pushbutton Assembly" shall include all costs for the work required to furnish and install the pedestrian pushbutton assembly complete, including the button and housing, 1 or 2 directional signs as specified, and required mounting hardware as indicated on the Standard Plans. Payment for pedestrian pushbutton posts and foundations will be made in accordance with Section 8-32.5.

4. **"Detector Loop, (Size)"**, per each.

5. **"Detector Loop, Encapsulated, (Size)"**, per each.

The Bid item price for "Detector Loop, (Size)" and for "Detector Loop, Encapsulated, (Size)" shall include all costs for the work required to saw cut the pavement and furnish and install the loop detector wire and conduit complete to the first handhole from the loop, including pavement filler, splices, hardware, and restoration of the pavement surface.

6. **"Sign, Interior Illuminated, (Size)"**, per each.

The Bid item price for "Sign, Interior, Illuminated (Size)" shall include all costs for the work required to furnish and install the interior illuminated sign complete, including all mounting hardware and sign wiring.

7. **"Sign, Crosswalk, Illuminated"**, per each.

The Bid item price for "Sign, Crosswalk, Illuminated" shall include all costs for the work required to furnish and install the illuminated crosswalk signal complete, including all mounting hardware, photoelectric cell installed on a photoelectric control mounting bracket, service wiring, and sign wiring.

8. **"Interconnect Cable, (Type)"**, per linear foot.

The Bid item price for "Interconnect Cable, (Type)" shall include all costs for the work required to furnish and install the cable in conduits or on poles; and shall include all hardware, taps and splices for a complete, interconnected system.

9. "Aerial Terminal Compartment", per each.

The Bid item price for "Aerial Terminal Compartment" shall include all costs for the work required to furnish and install the complete compartment including mounting hardware and sealing.

10. "Signal Wiring, (Location)", per lump sum.

The Bid item price for "Signal Wiring (Location)" shall include all costs for the work required to furnish and install complete signal wiring at the location including signal lead wiring, pushbutton wiring, sign (attached to signal) wiring, service wiring, and loop lead-in cable. Payment for interconnect cable wiring will be by the Bid item "Interconnect Cable". Payment for internal controller wiring will be by the Bid item "Traffic Signal Controller".

11. "Span Wire", per linear foot.

12. "Span Wire, Catenary", per linear foot.

The Bid item price for "Span Wire" and for "Span Wire, Catenary", shall include all costs for the work required to furnish and install the spanwire complete, including wire, clamps, insulators and all hardware.

13. "Relocate (Item)", per each.

14. "Relocate (Item)", per linear foot.

15. "Relocate (Item)", per lump sum.

The Bid item price for "Relocate (Item)" shall include all costs for the work required to remove and reinstall the item complete, including hardware and rehabilitating signals and signs as required.

16. "Boom Truck and Operator For Inspector", per hour.

The Bid item price for "Boom Truck and Operator for Inspector" shall include all costs for the work required to provide a boom truck and operator for the field inspector as requested by the Engineer.

17. Other payment information.

Existing Materials required to be relocated and found to be unacceptable by the Engineer shall be replaced by new Material and will be addressed as extra Work per Section 1-04.4.

Payment for providing an off duty Uniformed Peace Officer will be in accordance with 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 no cost to the Contractor.

All costs for furnishing and installing hardware not specifically called out, but required to complete the Work and approved by the Engineer shall 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 shall consist of furnishing and installing poles, bracket arms, pedestals, posts, mast arms, concrete foundations and back guy assemblies in accordance with these Specifications and Standard Plans. The Contractor shall become thoroughly familiar with the electrical 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 shall submit Shop Drawings and catalog cuts in accordance with Section 1-05.3 for the following:

Metal poles and appurtenances	Anchor bolt extenders	Mast Arms
Anchor bolts, nuts, washers	Bracket Arms	Pedestals

All strain pole(s) or street light only pole(s) or both 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 shall meet all requirements of Section 9-33 and the requirements indicated 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 shall be in accordance with Section 1-05.3(5).

All strain poles (Type T, V, X, Z) are pre-approved by the following pole manufacturers:

Manufacturer	Drawing No.			
Union Metal	71035-C20	71035-C21	71035-C26	71035-C27
NW Signal Supply	NWS2298		NWS2299	
Valmont	DB00229			

If the Contractor chooses to buy poles from one of the above pole manufacturers, the Contractor shall submit the following information to the Engineer for review and approval prior to ordering the pole:

- 1) Project name;

- 2) Pole manufacturer's name;
- 3) Drawing number with current revision specified;
- 4) Quantity per each;
- 5) Pole type (T, V, X or Z);
- 6) Davit or bracket arm, and arm length,
- 7) Specify if second cable outlet with orientation, if festoon outlet, and number of guy clamps; and
- 8) Equipment delivery time frame.

8-32.1(4) ELECTRICAL AND ELECTRONIC WORDS AND PHRASES

See Section 1-01.3.

8-32.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Concrete for foundations	5-05 and 6-02
Non-Shrink Cement Sand Grout	9-04.3(2)
Poles, Mast Arms Pedestals, Foundations, and Back Guy Assemblies	9-33

All welds on tubular steel shall comply with the requirements of 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 shall lay out pole locations and grades as indicated on the Drawings. Poles shall be located to provide a minimum of 3 feet clearance measured from the face of the curb to the face of pole.

Poles shall be handled in loading, unloading and erecting in such a manner that they are not damaged.

Field repair of galvanized surfaces shall be accomplished by coating with a heated zinc alloy solder to a minimum thickness of 3 mils per ASTM A 780.

The Contractor shall repair or replace all rejected poles at no expense to the Owner. Should the Contractor elect to repair the rejected pole, the Contractor shall submit a repair plan at least 5 Working Days in advance to the Engineer for approval.

8-32.3(1)B METAL POLES AND PEDESTALS

Poles shall not be erected before concrete foundations have cured for a minimum 7 Days and have attained a minimum 70% of specified strength.

Strain and mast arm poles shall not be loaded before concrete foundations have:

- 1 cured for a minimum of 14 Days, and
- 2 have reached specified strength.

If the Contractor elects to use Type III cement (HES cement), the pole may be loaded after 7 Days curing and after reaching specified strength.

Strain poles type V, X, and Z with METRO loading shall not be loaded until the concrete has both attained design strength and 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.

Signal related poles shall not be grouted until after turn-on or cut-over.

Leveling nuts shall be used on all metal poles. Leveling nuts and washers shall be placed on anchor bolts to allow between 2 and 4 inches of non-shrink grout under the base plate. Poles shall be placed on the bolts and the leveling nuts and washers. The leveling nuts and washers shall then be adjusted to plumb the pole.

The pole shall be raked before loading such that it is plumb after all loads have been applied. Plumb shall be defined as the condition existing when 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 shall the pole lean toward the pavement. Nuts shall 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 shall be placed around the periphery of the anchor bolts and leveling nuts, then non-shrink cement sand grout shall 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 shall be sloped at approximately 60 degrees away from the base plate. There shall 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 Plan nos. 524a, 524b, and 563a).

Installation of pedestals shall meet the same requirements for installation of metal poles, except raking will not be required.

8-32.3(1)C WOOD POLES

Wood poles shall be set at the depth indicated in the following table:

Recommended Pole Setting Depth		
Length of Pole	Minimum Set Depth	Set Depth in Rock
20	5.0	3.0
25	5.0	3.0
30	5.5	3.5
35	6.0	4.0
40	6.0	4.0

After each wood pole is set in the ground to the specified depth as indicated on the Standard Plans, the space around the pole shall be backfilled with selected earth or sand, free of rocks and other deleterious material, placed in layers approximately 4 inches thick. Each layer shall be moistened and thoroughly compacted.

When wood poles are used as strain poles, the poles shall 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**

With the exceptions of strain poles types T, V, X, and Z, concrete mix for foundations shall meet the following requirements:

Type Pole or Pedestal	Class Concrete
Strain and Mast Arm Poles	Class 4000
Non-Strain Metal Poles	Class 5 (1 ½)
Chief Seattle Light Pole	Class 5 (1 ½)
Metal Street Light Pole	Class 5 (1 ½)
Pedestal	Class 5 (1 ½)
Pedestrian Pushbutton	Class 5 (1 ½)

Strain pole foundations for pole types T, V, X, and Z shall have air-entrained concrete Class 4000 per Section 6-02.3.

Foundations shall be augered and constructed against undisturbed soil. Concrete shall be placed against undisturbed earth within a dry hole. Should a dry hole not be maintained, the Contractor shall select a method of concrete placement which does not adversely impact the strength or durability of the concrete as approved by the Engineer. In unstable ground, forms shall be used for the top 18 inches of foundation, and the Contractor shall be prepared to install sonotube or other approved form Material to provide undisturbed concrete placement. Each foundation shall be poured in one continuous pouring operation. Where new excavations are near an existing foundation, the Contractor shall provide temporary support for the existing structure as appropriate.

Anchor bolts shall 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 shall all be at the same elevation. A steel template shall be used at the lower end, and a wood or steel template shall be used at the upper end of the anchor bolts, to maintain the correct bolt pattern and spacing until the concrete has set. Anchor bolts shall not be altered in any way after fabrication. Bending of anchor bolts shall be cause for rejection and removal of entire foundation.

Prior to placing concrete, all projecting anchor bolts shall 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 shall be in accordance with SCL Material Standard 7367.3 and shall remain permanently in place. Nuts and washers shall be installed over the tape. Immediately after concrete is placed, the location of the anchor bolts shall 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 shall be cleaned and kept free of concrete splatter and mortar.

Concrete shall 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 shall 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 shall submit the manufacturer's recommendations to the Engineer for approval at least 5 Working Days in advance. The cinch anchors shall be sized as recommended by the traffic signal controller manufacturer. A bead of waterproof sealant shall be installed under the lip of the traffic signal controller cabinet prior to installing the cabinet to prevent moisture penetration.

Tops of the traffic signal controller foundations shall be level, and shall be 6 to 8 inch above adjacent finished grade.

A 3/4-inch PVC conduit drain shall 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.

A 20 foot coil of #4 copper wire shall be installed within the foundation with a 3 foot tail.

8-32.3(2)C POLE, PEDESTAL AND PEDESTRIAN PUSHBUTTON POST FOUNDATIONS

Anchor bolts shall be supplied by the Contractor on foundation installations unless specified otherwise in the Contract.

Reinforcing steel shall be kept 3 inches clear from surrounding earth within the concrete pole foundation, and shall be set securely in place.

Where the foundation is in, or adjacent to, a proposed sidewalk/paved area, the top of the foundation shall be at or just below the bottom of the adjacent sidewalk or paving Material. The Contractor shall 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 shall be 1" above the finished ground level. The top 6 plus inches of foundation concrete shall be formed into a square.

Conduits shall extend 1 inch above the pole base plate. Anchor bolts shall 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 utilized, or complete removal and replacement of the foundation will be required at no expense to the Owner.

8-32.3(3) BACK GUY ASSEMBLIES

Back guy assemblies for wood poles shall be constructed in accordance with details on the Standard Plans.

All through bolts shall be properly trimmed and treated.

8-32.3(4) RELOCATING EQUIPMENT

When equipment is to be relocated, the Contractor shall 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 shall 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 on wood poles shall 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 shall be attached by one through bolt and two lag bolts. Through bolts on wood poles shall be cut off so no more than 4 threads nor less than 3 threads are left exposed beyond the captive nut. The exposed end shall be treated with galvanizing repair paint approved by the Engineer. This through bolt shall not be used to mount any other hardware.

8-32.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for davit poles and the attached davit arm will be per each as a combined unit.

Measurement for "Install (Item), Owner Furnished" will be per each.

8-32.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-32 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

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" shall 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.
4. "Pole, (Material) Lighting Davit (Length), with (Length) Arm", per each.

The Bid item price for "Pole, Steel Strain Davit, (Type) with (Length) Arm" and for "Pole, (Material) Lighting Davit (Length) with (Length) Arm" shall 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.

5. "Pole, Steel Lighting (Length)", per each.
6. "Pole, Aluminum Lighting (Length)", per each.

The Bid item price for "Pole, Steel Lighting (Length)" and for "Pole, Aluminum Lighting (Length)" shall 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.

7. "Pole, Wood, (Length), (Type), (Class)", per each.

The Bid item price for "Pole, Wood (Length), (Type), (Class)" shall include all costs for the work required to furnish and install the wood pole complete, including excavation, backfill, and compaction.

8. "Mast Arm (Length)", per each.

The Bid item price for "Mast Arm, (Length)" shall include all costs for the work required to furnish and install the mast arm complete with all necessary hardware, fittings and end cap.

9. **"Pedestal, Steel, (Length)"**, per each.

The Bid item price for "Pedestal, Steel, (Length)" shall include all costs for the work required to furnish and install the pedestal complete including pipe, cap, base, and all hardware.

10. **"Pedestrian Pushbutton Post"**, per each.

The Bid item price for "Pedestrian Pushbutton Post" shall 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.

11. **"Foundation, Traffic Signal Controller (Type)"**, per each.

12. **"Foundation, (Use)"**, per each.

The Bid item prices for "Foundation, Traffic Signal Controller (Type)" and for "Foundation, (Use)" shall 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, washers, nuts, nut covers, grout, wire, conduit, and drainage hardware.

13. **"Back Guy Assembly"**, per each.

The Bid item price for "Back Guy Assembly" shall 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.

14. **"Relocate (Item)"**, per each.

The Bid item price for "Relocate (Item)" shall include all costs for the work required to remove and reinstall the item complete including all new hardware and rehabilitation as required.

15. **"Bracket Arm, (Length)"**, per each.

The Bid item price for "Bracket Arm, (Length)" shall 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" shall 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. **Other payment information.**

When installation of a new pole, pedestal, or post disturbs existing surface improvement that remain, the cost of surface restoration shall 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 shall consist of trench excavation, furnishing and installing conduit, conduit, condulets, and handholes for illumination and signal systems as indicated in the Contract in accordance with these Specifications and Standard Plans.

The Contractor shall 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 shall promptly notify the Engineer who will then determine if sleeving of conduits is required so as 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 shall submit Shop Drawings and catalog cuts in accordance with Section 1-05.3 for the following items:

- | | |
|--------------------------------|---------------------------------------|
| 1. Conduit and Fittings | 6. Condulets Junction Box |
| 2. Stand-off Brackets | 7. Expansion Fittings |
| 3. Weatherhead | 8. Seals and Sealing Compounds |
| 4. Galvanizing Repair Material | 9. PVC Coatings to be field installed |
| 5. Handholes and handhole lids | 10. Flexible Conduit |

8-33.1(4) ELECTRICAL AND ELECTRONIC WORDS AND PHRASES

See Section 1-01.3.

8-33.2 MATERIAL

Materials shall meet the requirements of the following Sections:

Non-Shrink Cement Sand Grout	9-04.3(2)
Paint	9-08
Conduits and Handholes	9-34

8-33.3 CONSTRUCTION REQUIREMENTS

8-33.3(1) TRENCHING

Excavation required for the installation of conduit, foundations, and other Materials shall be performed in such a manner as to cause the least possible damage to the streets, sidewalks, and other improvements. Trenches shall not be excavated wider than necessary for the proper installation of the electrical appliances and foundations. Excavated soils shall be placed where the least interference to traffic and to surface drainage occurs.

Trenching, conduit and other in-common installation, backfilling, and either temporary surfacing or final surfacing as necessary, shall be scheduled on a daily basis and for minimum disturbance to traffic.

The Contractor shall take all necessary steps to keep excavated native Material deemed suitable by the Engineer from becoming unsuitable. The requirements of Section 2-03 shall apply.

Depth to top of conduit, or depth of cover, shall be as follows unless specified otherwise in the Contract:

Location of Conduit	Depth of Cover
Under Railroad	48 inches below bottom of railroad ties
Under Asphalt & Concrete Pavement And Any Roadway	36 inches
All Other Locations	18 inches

The bottom of the trench for all conduit shall be free of abrupt change of grade or alignment, and be free of objects and materials which could cause damage to conduit, conduit coating, or excessive bending of the conduit. The first 6 inches of backfill shall be free of rock, gravel, or other deleterious objects and materials 1 inch or larger. The Engineer shall approve all conduit installations prior to backfilling the trench.

Trench backfill shall be compacted to 95 percent in accordance with Section 2-03.3(14)E. The first loose lift of backfill over the conduit shall be 8 to 12 inches.

Excavations over 4 feet deep are subject to the provisions of Section 7-17.3(1)A7a, Trench Safety Systems.

8-33.3(2) CONDUIT INSTALLATION

8-33.3(2)A GENERAL

Conduit shall be installed as indicated on the Drawings. When installing conduit under existing pavement or sidewalks, removal shall meet the requirements of Section 2-02. Surface restorations shall 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 shall be considered to be in a Class I environment and all construction shall be in compliance with Article 501 of N.E.C.

Conduit shall be installed in the number, type, size and location indicated on the Drawings.

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 shall be 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 shall show the conduit run, conduit size, and conduit Material type in red and shall be dimensioned to the nearest 1 inch.

Conduit cable runs shall be parallel to building lines and grouped together where possible.

Conduit runs parallel to curbs shall be placed adjacent to back of curb unless detailed otherwise on the Drawings.

Changes of conduit direction shall be made with manufactured or fabricated elbows of radius not less than that noted in the NEC.

Conduit installed totally within the metering and disconnect enclosure shall be rigid metal and may be without PVC coating.

It shall be the option of the Contractor to use larger size conduit when approved by the Engineer. Where larger size conduit is used, it shall be for the entire length of the run from outlet to outlet.

Conduit terminating in enclosures (poles, cabinets, pedestals, etc.) shall 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 nos. 500a, 521, 524a, and 550a. Reducing couplings will not be permitted. Conduit shall not change size between handholes, or conduit access point.

Conduit entering through the bottom of a handhole shall be located near the end walls to leave the major portion of the box clear. Conduit shall enter from the direction of the run, terminating 6 to 8 inches below the handhole lid and near the box wall.

All conduit shall be thoroughly cleaned and a proper size mandrel pulled through it prior to installing wires or pull cord. Mandreling shall be done in the presence of the Engineer.

Existing conduit to be incorporated into a new system shall 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.

Conduit repairs: When small portions of damaged conduit repairs are necessary, repairs are permitted by using PVC in its place. The PVC shall 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 shall be installed connecting the metal sections together with bonding clamps approved by the Engineer.

Marker stakes or tacks shall 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 shall be capped.

Conduit entrances into metal junction boxes (Except NEMA 1) shall be drilled and tapped a minimum of 3 full threads for the size conduit used. Bosses shall be provided where the wall thickness is not sufficient for the minimum number of threads.

Entry to electrical vaults or other Structures shall be made such that the physical integrity of the vault or structure is not impaired. Any hole for entry to vaults or Structures shall 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 Electrical Safety Observer requirements.

Annular spaces around conduit, ground wire, ducts, at wall penetrations of vault or other structural walls shall be filled with non-shrink cement sand grout (see Section 9-04.3(2)). Threaded inserts shall be coated with an approved rust preventative compound which is soluble in petroleum solvent.

Conduit entering through the bottom of a handhole shall enter near the end walls so as to leave the major portion of the handhole clear. Conduit shall enter from the direction of the run, terminating 6 to 8 inches below the handhole lid and near the box wall.

At locations designated by the Engineer, fittings shall 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 shall also furnish all necessary covers and gaskets. Expansion/deflection fittings per Standard Plans shall be installed at all structure expansion joints.

Conduits shall 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) shall have a pull cord installed extending at least 3 feet beyond the conduit at each end.

Conduit entrances into metal junction boxes shall be drilled and tapped a minimum of 5 full threads for the size conduit used. Bosses shall be provided where the wall thickness is not sufficient for the minimum number of threads.

8-33.3(2)B RIGID STEEL CONDUIT AND PVC-COATED RIGID STEEL CONDUIT

When rigid steel conduit is cut, the ends shall be made square and true with conventional pipe cutting equipment. Conduit shall be threaded with a standard conduit cutting die. Burrs and sharp corners at the end of each conduit shall be removed with a tapered reamer. Threads shall be cleaned of all metal, lubricants, red lead, and any other Material which prevents joining with threaded counterparts. Conduit threads shall be coated with a conduit thread compound designed to ease assembly and disassembly, and to improve electrical conductivity. Conduit shall be joined by the use of rigid steel conduit couplings. Running threads will not be permitted for coupling conduit. When a standard coupling cannot be used, an approved threaded union coupling shall be used. Conduit shall 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 shall not damage the conduit or coupling. Where the galvanizing on the conduit or the coupling has been damaged, it shall be thoroughly painted with galvanizing repair paint Federal Spec. MIL-P-21035 per the manufacturer's recommendations. An Alternate repair method shall consist of applying a heated zinc alloy solder coating to a minimum thickness of 2 mils in accordance with ASTM A 780.

Bushings shall be of the insulated throat type. The entire conduit system shall be properly bonded and grounded in accordance with N.E.C.

Installation of the PVC-coated system shall be made in conformance with the following:

1. **Coupling and Joining:** All conduit connections shall 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 shall 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 shall be cause for rejection of that length of conduit.
2. **Cutting:** The conduit shall be tightened securely in a vise or chuck. The cut shall 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 shall be used and the portion of the coated conduit to be gripped in the

- vise shall 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 shall 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 shall be protected by the methods set forth above. For machine threading, the use of a threader designed for coated conduit shall be used.
 4. **Bending:** PVC-coated conduit may be bent with conventional bending equipment; however, the internal walls of the shoes shall be machined out approximately 0.050 inch. Bending shall be accomplished by segmented bending rather than a one-shot bend. For sharp bends, saddles, or offsets, a PVC-coated hickey shall be required. Any cuts, gouges, or abrasions shall be coated with touch-up compound. Coating the exterior of the conduit, prior to bending, with a slippery substance, such as wire-pulling compound, will be permitted.
 5. **Touch-up:** During the installation of the coated conduit, the Contractor shall assure that no metal is left exposed or uncoated. Metal exposed as the result of field cuts shall be coated with touch-up compound. If an uncoated accessory must be used, it shall also be coated.
 6. One hole malleable iron pipe strap, pipe spacers (clamp backs), and mounting brackets shall be PVC coated.

8-33.3(2)C PVC CONDUIT

PVC conduit shall be assembled with solvent welded joints in accordance with the manufacturer's written instructions. Bends and fittings shall be factory-produced.

8-33.3(3) CONDUIT RISERS

Conduit less than 2 inches in diameter mounted on wood poles shall be mounted by use of 2-hole malleable conduit clamps spaced per N.E.C. A minimum of 2 clamps shall be used per length of conduit.

Conduit sized 2 inches and larger, or more than 1 conduit installed on wood poles, shall be installed using stand-off type brackets. Stand-off brackets shall be installed per N.E.C. with a 10 foot maximum spacing. Attachment shall be near the top of each 10 feet length of conduit.

All conduit risers shall be grounded with a ground clamp installed 8 feet above finished grade. Where conduit risers are connected to a ground rod, a ground rod handhole well shall be provided.

The conduit shall be wrapped with corrosion protection tape conforming to SCL Material Standard 7367.3, 8 inches above and below finished grade.

Conduit risers shall be the size indicated on the Drawings. The 90 degree bend and conduit up the pole to 10 feet above the surface shall be rigid steel. The riser above the 10-foot level shall be PVC, Schedule 80. The riser shall be equipped with a PVC weatherhead and shall be grounded as indicated on Standard Plans.

8-33.3(4) HANDHOLES

Handholes shall be installed per Standard Plans. The frame (ring) and lid shall be grounded with an approved grounding clamp(s) to the ground rod at the locations shown on the Drawings. Unless dimensioned, handholes are located schematically, and shall always be located outside the pedestrian travel way. The Contractor shall provide the Engineer a minimum 1 Working Day advance notice regarding the exact handhole location.

When required by the Drawings, handhole extensions shall be provided and installed.

Unused conduit openings in handholes shall be capped to afford protection against debris from entering the conduits.

See Section 8-31.3(1)B for handhole access 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 non-metallic 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 shall 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 shall be in accordance with Section 7-22.

8-33.3(6) RESERVED

8-33.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Conduit, (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, (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 in accordance with Section 2-02.4.

Measurement for pavement restoration will be in accordance with Sections 5-04.4 and 5-05.4 as applicable.

8-33.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 8-33 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **"Conduit, (Material), (Size)"**, per linear foot.

The Bid item price for "Conduit, (Material), (Size)" shall include all costs for the work required to furnish and install the conduit complete including all bends, fittings, condulets and hardware.

2. **"Trenching, Conduit"**, per linear foot.

The Bid item price for "Trenching, Conduit" shall 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 replacement of native material determined unsuitable by the Engineer will be in accordance with Section 1-04.1(2). All costs for replacement of suitable native Material which becomes unsuitable due to Contractor operations shall be at the Contractor's sole expense.

3. **"Conduit Riser, (Size)"**, per each.

The Bid item price for "Conduit Riser, (Size)" shall include all costs for the work required to furnish and install the complete riser, including all conduit, fittings, clamps and hardware from and including the weatherhead to and including the 90 degree rigid steel bend underground.

4. **"Handhole (Type)"**, per each.

The Bid item price for "Handhole (Type)" shall 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. **"Relocate (Item)"**, per each.

The Bid item price for "Relocate (Item)" shall include all costs for the work required to relocate the specified item.

6. **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 shall be included in the Bid item prices of the applicable Bid items.

See Section 1-05.2(2) regarding payment for Electrical Safety Observer.

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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 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 described in Section 9-03.15.

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 in accordance with AASHTO M 232 will be zinc coatings mechanically deposited in accordance with AASHTO M298, providing the minimum thickness of zinc coating is not less than that specified in AASHTO M232, 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 POZZOLANS**9-01.1 TYPES OF CEMENT**

Cement other than masonry cement shall be classified as Portland cement Type II or Type III. A "sack" of cement shall mean one cubic foot of Portland cement weighing 94 pounds.

9-01.2 CEMENT SPECIFICATIONS**9-01.2(1) TYPE II PORTLAND CEMENT**

Type II cement shall conform to the requirements for Type II cement of the standard Specifications for Portland cement, AASHTO M85 or ASTM C 150, except that the content of alkalis shall not exceed 0.75 percent by weight calculated as Na_2O plus $0.658 \text{ K}_2\text{O}$.

Type II cement shall meet the requirements of the above Specifications for compressive strength and for time of setting by the Vicat method, AASHTO T 131.

9-01.2(2) TYPE III PORTLAND CEMENT

Type III Portland cement (H.E.S. or high early strength) shall conform to the requirements for Type III cement of the standard Specifications for Portland cement, AASHTO M85 or ASTM C 150, except that the content of alkalis shall not exceed 0.75 percent by weight calculated as Na_2O plus $0.658 \text{ K}_2\text{O}$. It shall meet the requirements of the above Specifications for compressive strength and for time of setting by the Vicat method, AASHTO T 131. Type III Portland cement in cloth bags shall not be used.

9-01.2(3) LOW ALKALI CEMENT

The percentage of alkalis in low-alkali cement shall not exceed 0.60 percent by weight calculated as Na_2O plus $0.658 \text{ K}_2\text{O}$. This limitation shall apply to all types of Portland cement. Percentage of alkalis shall be determined in accordance with ASTM C 114.

9-01.2(4) BLENDED HYDRAULIC CEMENT (BHC)

Blended hydraulic cement shall be either Type IP (MS), Type I (SM) (MS), or Type I (PM) (MS) cement conforming to AASHTO M 240 with the additional requirements that the use of ground granulated blast furnace slag and pozzolans other than fly ash are not allowed in Type IP (MS) and Type I (PM) (MS) cement and that the maximum amount of fly ash in Type IP (MS) is limited to 25% by weight of the total cementitious material, except when required for the mitigation of Alkali Silica Reactivity.

The source of the fly ash and slag, as well as the weight of fly ash and slag shall be certified on the cement mill test certificate and shall be reported as a percent by weight of the total cementitious material. The fly ash and slag constituent in the finished cement shall not vary more than $\pm 5\%$ by weight of the total cementitious material from the certified value.

Fly ash shall meet the requirements of Section 9-01.6(1) of these Standard Specifications.

Slag shall meet the requirements of Section 9-01.6(2) of these Standard Specifications.

Total cementitious material shall be as defined in Section 9-01.2(5) of these Standard Specifications.

9-01.2(5) TOTAL CEMENTITIOUS MATERIAL

Total cementitious material shall mean any combination of Portland cement, and pozzolan such as fly ash and ground granulated blast furnace slag. When the Contract allows the use of microsilica, then microsilica shall be considered a cementitious material. Also see Section 9-23 for curing materials and the incorporation of admixtures and pozzolans into the total cementitious material.

9-01.3 TESTS AND ACCEPTANCE

Cement may be accepted by the Engineer based on the manufacturer's Certification of Cement Shipment indicating full conformance to the Specifications. All shipments of the cement to the Contractor or concrete Supplier shall be accompanied by a Certification of Cement Shipment. The concrete Supplier or Contractor shall countersign three copies of this certificate and submit all three copies to the Engineer.

Each mixing facility or plant utilizing Portland cement shall be equipped with a suitable means or device for obtaining a representative sample of the cement. The device shall enable the sample to be readily taken in proximity to the cement weigh hopper and from a container or conveyor holding only cement.

9-01.4 ON-SITE STORAGE

The cement shall be stored on the site in a manner as to permit easy access for inspection and identification.

Cement shall be adequately protected at all times from rain and dampness. Cement which, in the opinion of the Engineer, contains lumps that can not be pulverized in the mixer will be rejected.

Type III Portland cement stored by the Contractor for a period longer than 30 Days, or Type II Portland cement stored by the Contractor for a period longer than 60 Days, shall be held for retest. If the cement has lost strength during the period of storage, as shown by tests conducted by the Engineer, sufficient additional cement shall be added to the mix to overcome such loss, or the cement may be rejected. The amount of cement to be added to the mix shall be determined by the Engineer.

9-01.5 CONTROLLED DENSITY FILL (CDF) – PIPE BEDDING AND TRENCH BACKFILL

For filling pipe and for filling the annular space between 2 pipes, see Section 9-05.15.

For pipe bedding, the following CDF mix design shall be used:

PIPE BEDDING CDF	
MATERIAL	QUANTITY
Portland Cement Type I-II	94 pounds per cubic yard
Fly Ash	300 pounds per cubic yard
Sand, Type 7	2800 pounds per cubic yard
Water	300 pounds per cubic yard
Air Entrainment	10 ounce per cubic yard

Slump shall not exceed 7 inch.

For trench backfill, the following CDF mix design shall be used:

TRENCH BACKFILL CDF	
MATERIAL	QUANTITY
Portland Cement Type I-II	30 pounds per cubic yard
Fly Ash	300 pounds per cubic yard
Sand, Type 7	2860 pounds per cubic yard
Water	300 pounds per cubic yard
Air Entrainment	10 ounce per cubic yard

Slump shall not exceed 7 inch.

Alternate CDF formulation: The Contractor may propose an alternate formulation and shall make a submittal on the alternate formulation in accordance with Section 1-05.3(5). This submittal shall include the following information:

- Reason for alternate formulation and impact on application;
- Mix design components and component quantities for a 1 cubic yard batch;
- Strength data at 24 hours, 7 days and 28 days. The strength at 24 hours shall be not less than 15 psi when tested in accordance with ASTM D 4832.
- Slump shall not exceed 7 inches;
- The mixture shall not produce excessive bleed water; and
- The 28 day strength shall be a minimum 50 psi and a maximum 100 psi when tested in accordance with ASTM D 4832.

An exception to one or more of items 3, 4, 5, and 6 immediately above may be allowed if the reason provided in item 1 confirms no harm may result from the use of the alternate CDF mix formulation. Use of such alternate CDF formulation will not be allowed unless the Engineer provides written acceptance of the alternate formulation submittal.

9-01.6 POZZOLANS**9-01.6(1) FLY ASH**

Fly ash shall meet the requirements of ASTM C 618-80, Class C or Class F. Also see Section 9-23.9 for constraints.

9-01.6(2) GROUND GRANULATED BLAST FURNACE SLAG ("SLAG")

Ground granulated blast furnace slag (also called "slag") shall meet the requirements of AASHTO M 302, Grade 100. The grade of the ground granulated blast furnace slag, the source, and type of manufacturing facility shall be certified on the cement mill test certificate. Also see Section 9-23.9 for constraints.

9-01.6(3) MICROSILICA FUME

Microsilica Fume shall conform to the requirements of 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.

SECTION 9-02 BITUMINOUS MATERIALS**9-02.1 ASPHALT MATERIAL****9-02.1(1) GENERAL**

Asphalt furnished under these Specifications shall not have been distilled at a temperature high enough to injure by burning or to produce flecks of carbonaceous matter, and upon arrival at the Work, shall show no signs of separation into lighter and heavier components.

9-02.1(2) MEDIUM-CURING (MC) LIQUID ASPHALT

Characteristics		AASHTO Test Method	MC-70	MC-250	MC-800	MC-3000
Kinematic Viscosity at 140°F (cSt)		T 201	70-140	250-500	800-1600	3000-6000
Flash Point (Tag Open Cup)	Min. °F	T 79	100	150	150	150
Water Content	Min. %	T 55	0.2	0.2	0.2	0.2
Distillation: volume % of total distillate		T 78				
to 680 °F			0-20	0-10	---	---
to 437 °F			20-60	15-55	0-35	0-15
to 500 °F			65-90	60-87	45-80	15-75
to 600 °F			55	67	75	80
Residue of 680°F distillation % volume by difference	Min.					
Properties of residue from distillation to 680 °F Absolute viscosity at 140°F (poise)		T 202	300-1200	300-1200	300-1200	300-1200
¹ Ductility, 5 cm/min. at 77°F	Min.	T 51	100	100	100	100
Solubility in trichloroethylene	Min. %	T 44	99.0	99.0	99.0	99.0

Note 1. If the ductility at 77°F is less than 100, the Material will be acceptable if its ductility at 60°F is more than 100.

The Material shall not foam when heated to the application temperature recommended in 2006 edition WSDOT standard specification section 5-02.3(3).

9-02.1(3) RAPID-CURING (RC) LIQUID ASPHALT

Characteristics		AASHTO Test Method	RC-70	RC-250	RC-800	RC-3000
Kinematic Viscosity at 140°F cSt		T 201	70-140	250-500	800-1600	3000-6000
Flash Point (Tag Open Cup)	Min. °F	T 79	---	80	80	80
Water Content	Min. %	T 55	0.2	0.2	0.2	0.2
Distillation: volume % of total distillate to 680°F		T 78				
to 374°F	Min.		10	---	---	---
to 437°F	Min.		50	35	15	---
to 500°F	Min.		70	60	45	25
to 600°F	Min.		85	80	75	70
Residue of 680°F distillation % volume by difference	Min.		55	65	75	80
Properties of residue from distillation to 680°F						
Absolute viscosity at 140°F	poise	T 202	600-2400	600-2400	600-2400	600-2400
Ductility, 5 cm/min. at 77°F, cm	Min.	T 51	100	100	100	100
Solubility in trichloroethylene	Min. %	T 44	99.0	99.0	99.0	99.0

The Material shall not foam when heated to application temperature recommended in 2006 edition WSDOT standard specification section 5-02.3(3).

9-02.1(4) ASPHALT CEMENT

9-02.1(4)A PAVING ASPHALT

Asphalt cement binder shall meet the requirements of AASHTO M 320 and shall be of the grade specified in the Contract.

9-02.1(4)B PERFORMANCE GRADE (PG) ASPHALT CEMENT

BINDER GRADE	PG 58-			PG 64-			PG 70-			PG 76-	
	-22	-28	-34	-22	-28	-34	-22	-28	-34	-22	-28
ORIGINAL BINDER											
Flash Point Temp., AASHTO T 48	230 °C MIN.										
Rotational Viscosity, AASHTO T 316	3 Pa s Max. @ 135 °C										
Dynamic Shear, AASHTO T 315	G*/Sin d = 1.00 kPa Min.; Frequency = 10 rad/s										
	Test Temp. (°C)										
	58 °C	64 °C	70 °C	76 °C							
ROLLING THIN FILM OVEN RESIDUE, AASHTO T 240											
Mass Loss, AASHTO T 240	1.00 Percent Max.										
Dynamic Shear, AASHTO T 315	G*/Sin d = 2.20 kPa Min.; Frequency = 10 rad/s										
	Test Temp. (°C)										
	58	64	70	76							
PRESSURE AGING VESSEL RESIDUE, AASHTO R 28											
PAV Aging Temp., AASHTO R 28	100 °C										
Dynamic Shear, AASHTO T 315	G*/Sin d = 5,000 kPa Max.; Frequency = 10 rad/s										
	Test Temp. (°C)										
	22	19	16	25	22	19	28	25	22	31	28
Creep Stiffness, AASHTO T 313	S= 300 Mpa Max.; m-value= 0.300 Min.										
	Test Temp. @ 60s (°C)										
	-12	-18	-24	-12	-18	-24	-12	-18	-14	-12	-18

Note: All Performance Grade binders not included in this chart shall meet the requirements of Table 1 contained in AASHTO M 320, "Performance-Graded Asphalt Binder".

9-02.1(5) REJUVENATING (RECYCLING) AGENTS

The rejuvenating agent shall be a liquid emulsion of selected resin petroleum oil approved for use by the Materials Laboratory. Rejuvenating agents shall meet the following Specifications for the grade designated:

HOT MIX RECYCLING AGENTS¹

Test	ASTM Test Method	RA 5		RA 25		RA 75		RA 250		RA 500	
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Original Test											
Viscosity @ 140°F. cSt	D 2170 or D 2171	200	800	1000	4000	5000	10,000	15,000	35,000	40,000	60,000
Flashpoint, COC, °F	D 92	400	---	425	---	450	---	450	---	450	---
Saturates, Wt. %	D 2007	---	30	---	30	---	30	---	30	---	30
Specific Gravity	D 70 or D 1298	Report		Report		Report		Report		Report	
Residue test from RTFC	D 2872 ²										
Viscosity Ratio ³		---	3	---	3	---	3	---	3	---	3
Weight Change ± %		---	4	---	3	---	2	---	2	---	2

¹The final acceptance of recycling agents meeting this Specification is subject to the compliance of the reconstituted asphalt blends with the requirements in Section 9-02 for the class of asphalt mix required.

²The use of ASTM D 1754 has not been studied in the context of this Specification; however, it may be applicable. In cases of dispute, the reference method shall be ASTM D 2872.

³Viscosity Ratio = $\frac{\text{RTFC Viscosity at 140°F. cSt}}{\text{Original Viscosity at 140°F. cSt}}$

9-02.1(6) CATIONIC EMULSIFIED ASPHALTS

See the following Cationic Emulsified Asphalt Table.

CATIONIC EMULSIFIED ASPHALT																	
Grade	Type AASHTO Test Method	Rapid Setting				Medium Setting						Slow Setting				Special Track	
		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 shall 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 will be acceptable.

9-02.1(6)B POLYMERIZED CATIONIC EMULSIFIED ASPHALT – CRS-2P

The asphalt CRS-2P shall be a polymerized cationic emulsified asphalt. The polymer shall be milled into the asphalt or emulsion during the manufacturing of the emulsion. The asphalt CRS-2P shall meet the following Specifications:

	AASHTO Test Method	Specifications	
		Minimum	Maximum
Viscosity @122°F, 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°F	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 °F ± 9 F° and maintained for 20 minutes.
 2. The Torsional Recovery test shall 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 °F, 20 in. per minute pull. Tension head $\frac{7}{8}$ in. 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 shall 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 shall conform to the requirements of AASHTO M 238 except that the minimum softening point shall be 170°F.

9-02.1(8) HOT MELT TRAFFIC BUTTON ADHESIVE

The bitumen adhesive Material shall 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 shall be calcium carbonate and shall conform to the following fineness:

Sieve Size	Percent Passing
No. 100	100
No. 200	95
No. 325	75

Hot melt bitumen adhesive shall develop bond pull-off strength greater than 100 psi between 0°F and 120°F.

9-02.1(9) COAL TAR PITCH EMULSION

Coal tar pitch emulsion shall conform to all requirements of Federal Specification R-P-355. The emulsion shall be prepared from straight run, high temperature, coke oven tar meeting the requirements of Federal Specification RC 1424. The emulsion shall be homogeneous and shall show no separation or coagulation of components that cannot be overcome by moderate stirring. It shall be Capable of being applied completely by squeegee, brush, or other approved mechanical methods to the surface of bituminous pavements when spread at the specified rates.

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 shall include a statement certifying Specification compliance for each delivery of product shipped. Failure to provide this certification with the shipment shall be cause for rejection of the Material. The following information is required on this Bill of Lading:

1. Date shipped.
2. Project Name and PW No.
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 shall 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 shall be sent with the shipment for the sole use of Engineer.

9-02.2(2) SAMPLES

When requested by the Engineer, the asphalt Supplier shall submit, by prepaid express or US mail, samples of asphalt binder that represent current production to the SPU Materials Laboratory in accordance with Section 1-05.3(3) 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 shall 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 shall not be changed without approval of the Engineer.

The amount of liquid anti-stripping additive designated by the Engineer to be used shall 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 shall 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 (4) 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: www.upm.com
2. Qualified Patch Material (QPR)
3. E Z Street Lakeside Industries
PO Box 7016
Issaquah, WA 98027
Phone: (425) 313-2681
FAX: (425) 313-2622
E-Mail: rickr@lakesideind.com
Web-site: www.lakesideind.com
4. U.S. Cold Patch. Phone: (425) 244-5000
FAX: (425) 423-9120
Web-site: www.uscoldpatch.com

Other temporary patching products may be submitted to the Engineer for approval.

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 (No.)". See the definition of "Mineral Aggregate" in Section 1-01.3. Requirements for each Mineral Aggregate identified by a Type number are contained in Sections 9-03.1, and 9-03.9 through 9-03.16. Mineral Aggregates shall be composed of clean, uniform (in quality) particulate size groups essentially free from wood waste and other deleterious Materials. They shall be obtained only from sources approved by the Engineer. Written requests for source approval shall be submitted to the Engineer not less than 10 Days prior to the intended use of the Mineral Aggregate. Should the proposed source be 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 meet Contract requirements.

Mineral aggregates shall meet the Standard Specifications for grading and quality for use in the Work; however, allowable exceptions may be specified in Contract. The Engineer shall reserve the right to sample and test Mineral Aggregate at any time including at the source.

Crushed concrete shall meet the requirements specified in Sections 4-01.2 and 4-04.2 as applicable.

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 shall be manufactured from ledge rock, talus, or sand and gravel in accordance with the provisions of Section 3-01. They shall 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 all other provisions of 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 shall be altered as required by the Engineer.

If, in the judgment of the Engineer, based on previous experience or on Laboratory tests, concrete aggregates from a given source are detrimentally reactive with alkalis in Portland cement, corrective measures, including use of only low-alkali cement may be required as a condition of approval.

9-03.1(2) FINE AGGREGATE FOR PORTLAND CEMENT CONCRETE**9-03.1(2)A GENERAL**

Fine aggregate for Portland cement concrete shall 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 shall 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 shall not exceed the following values:

1. Particles having a specific gravity less than 1.95 shall not exceed 1.0 percent of total weight.
2. Organic matter, by calorimetric test, shall 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 shall be graded to conform to the following requirements expressed as percentages by weight:

	(Paving/State)		(Building/Concrete)	
	Class 1		Class 2	
	Max.	Min.	Max.	Min.
3/8 Square	---	100	---	---
% Passing U.S. No.4	100	95	100	95
% Passing U.S. No.8	86	68	95	85
% Passing U.S. No.16	65	47	80	45
% Passing U.S. No.30	42	27	60	40
% 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

Sieve Number	Permissible Variation in Individual Tests
No. 30 and coarser	2.0 percent
No. 50 and finer	0.5 percent

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.

Under no circumstances shall fine aggregate Class 1 be used which 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(3) COARSE AGGREGATE FOR PORTLAND CEMENT CONCRETE**9-03.1(3)A GENERAL**

Coarse aggregate for Portland cement concrete shall 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 shall be washed thoroughly to remove clay, silt, bark, sticks, alkali, organic matter, or other deleterious Material. When required by the Engineer, coarse aggregate shall be handpicked to remove harmful Material.

9-03.1(3)B DELETERIOUS SUBSTANCES

The amount of deleterious substances shall not exceed the following values:

Amount finer than U.S. No. 200	0.5 percent by weight
Pieces with a specific gravity less than 1.95	2.0 percent by weight
Clay lumps	0.5 percent by weight
Shale	2.0 percent by weight
Wood Waste	0.05 percent by weight

9-03.1(3)C WEAR IN LOS ANGELES MACHINE

Coarse aggregate shall not have a percentage of wear in the Los Angeles machine in excess of 35 after 500 revolutions in accordance with ASTM C 131.

9-03.1(3)D GRADING

Coarse aggregate for Portland cement concrete shall conform to one of the following gradings:

Sieve Size	Percent Passing							
	Grading No. 2		Grading No. 4		Grading No. 5		Grading No. 6	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
1-1/2" square	100	100	---	---	---	---	---	---
1-1/4" square	95	100	90	100	---	---	---	---
1" square	---	---	---	---	100	---	---	---
3/4" square	40	70	0	20	80	100	100	---
1/2" square	---	---	---	---	---	---	90	100
3/8" square	5	20	0	2	10	40	40	90
U.S. No. 4	0	2	---	---	0	4	5	30
U.S. No. 200	0	0.5	0	0.5	0	0.5	0	0.5

In individual tests, a variation of four percent under the minimum percentages or over the maximum percentages will be allowed. The average of three successive tests shall be within the percentages stated above. Coarse aggregate shall 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 meets 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 before producing the aggregate. If the aggregate comes from commercial sources, the Contractor shall supply this information and have it approved before proportioning and mixing the concrete.

In place of Grading No. 2, the Contractor may substitute a 50-50 mix of Grading Nos. 4 and 5.

9-03.1(3)E USE OF SUBSTANDARD GRADINGS

Coarse aggregate containing 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 sole expense. The cement content shall be increased) 0.25 percent for each 1 percent the amount passing each of the 3/4 inch, 3/8 inch, and No. 4 sieves is in excess of the maximum specified in 903.1(3)D. Coarse aggregate No. 2 shall not be used under any circumstances when the combined amount passing any of the following sieve sizes exceeds the following:

Sieve Size	Percent Passing
3/4" square	70
3/8" square	30
U.S. No. 4	5

Coarse aggregate No. 5 shall not be used under any circumstances when the combined amount passing any of the following sieve sizes exceeds the following:

Sieve Size	Percent Passing
3/8" square	50%
U.S. No. 4	8%

9-03.2 AGGREGATES FOR NATURAL DRAINAGE SYSTEMS

9-03.2(1) GENERAL

In general, soil aggregate shall be free of wood, waste, coating, or any other deleterious material, and all aggregate passing the No. 200 sieve size shall be non-plastic.

9-03.2(2) DRAINAGE AGGREGATE FOR BIORETENTION SOIL TYPE 1

Drainage aggregate for Bioretention Soil Type 1 (see Sections 7-21.3(2) and 9-14.1(3)B) shall meet the following gradation:

Sieve Size	Percent Passing
No. 4	100
No. 6	88 - 100
No. 8	79 - 97
No. 50	11 - 35
No. 200	5 - 15

The sand equivalent of the drainage aggregate shall be a minimum 35, and any portion passing the No. 200 sieve shall be non-plastic as described in ASTM D 2488.

9-03.2(3) DRAINAGE AGGREGATE FOR BIORETENTION SOIL TYPE 2

Drainage aggregate for Bioretention Soil Type 2 (see Sections 7-21.3(3) and 9-14.1(3)C) shall meet the following gradation:

Sieve Size	Percent Passing
2 inch	100
¾ inch	70 - 100
½ inch	50 - 80
No. 40	15 - 40
No. 200	0 - 3

9-03.3 STREAMBED AGGREGATE

9-03.3(1) QUALITY

Aggregates for streambed construction shall be washed, naturally formed, round to sub angular hard, strong, sound, durable, fracture free pieces of igneous and metamorphic rock. Aggregate shall be free of soft, weathered materials and seams of soft rock, shall not contain any wood and other waste, and shall be free of any coating.

The Contractor shall submit certified test reports indicating streambed aggregate complies with the following requirements:

All sand size aggregate (passing a ¼ inch screen and retained on a US No. 200 screen) shall meet the following requirements:

Specific Gravity	ASTM C-127	Minimum 2.65
------------------	------------	--------------

All gravel (passing a 3 inch screen and retained on a ¼ inch screen) and cobble (passing a 12 inch screen and retained on a 3 inch screen) aggregate shall meet the same requirements for sand size aggregate and the following additional requirements:

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) shall meet the same requirements for gravel and cobble and the following additional requirements:

Accelerated expansion	CRD-C-148	Not greater than 15% breakdown
Absorption	ASTM C 127	Not greater than 2%

9-03.3(2) GRADATIONS

Aggregate gradations for streambed construction shall be on a weight basis and shall be as follows :

Streambed Aggregate Type 1	
Sieve Size	Percent Passing
8 inch	95 – 100
3" square	45 – 60
1 ½" square	30 – 40
¾" square	10 – 20
¼" square	0 – 5

The portion passing the ¼ inch sieve size shall have a minimum sand equivalent of 60.

Streambed Aggregate Type 2	
Sieve Size	Percent Passing
16 inch	95 - 100
8 inch	55 - 75
3 inch	20 - 35
1 ½ inch	0 - 15
¾ inch	0 - 5

Streambed Aggregate Type 3	
Sieve Size	Percent Passing
32 inch	95 - 100
24 inch	60 - 75
16 inch	40 - 55
8 inch	10 - 20
3 inch	0 - 10
¾ inch	0 - 2

9-03.4 AGGREGATE FOR BITUMINOUS SURFACE TREATMENT

9-03.4(1) GENERAL REQUIREMENTS

Aggregate for bituminous surface treatment shall be manufactured from ledge rock, talus, or gravel, in accordance with Section 3-01, which meets the following 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 shall conform to the requirements in the following table for grading and quality. The particular type or grading to be used shall be as shown on the Drawings. All percentages are by weight.

The Material shall meet the requirements for grading and quality when placed in hauling vehicles for delivery to the roadway, or during manufacture and placement into a temporary stockpile. The exact point of acceptance will be determined by the Engineer.

SIEVE SIZE	Crushed Cover Stone	Crushed Screening - Percent Passing				
	Percent Passing	3/4" - 1/2"	5/8" - 1/4"	1/2" - 1/4"	3/8" - #10	1/4" - 0"
1" square	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
1/4" square	30-50	---	0-10	0-15	50-75	90-100
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.	75	75	75	75	75	75
Sand equivalent min.	40	---	---	---	---	---
Static Stripping Test	Pass	Pass	Pass	Pass	Pass	Pass

The fracture requirement shall be at least one fractured face and applies to Material retained on each sieve size U.S. No. 10 and above if that sieve retains more than 5 percent of the total sample.

The finished product shall be clean, uniform in quality, and free from wood, bark, roots, clay, any organic material, and other deleterious materials.

Crushed screenings shall be substantially free from adherent coatings. The presence of a thin, firmly adhering film of weathered rock shall not be 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 1/4 inch sieve shall not contain more than 0.1 percent deleterious materials by weight.

9-03.5 RESERVED

9-03.6 AGGREGATES FOR ASPHALT TREATED BASE (ATB)

9-03.6(1) GENERAL REQUIREMENTS

Aggregates for asphalt treated base shall be manufactured from ledge rock, talus, or gravel, in accordance with the provisions of Section 3-01 that meet the following test requirements:

Los Angeles Wear, 500 Rev.	30% max.
Degradation Factor, Wearing Course	15 min.

9-03.6(2) GRADING

Aggregates for asphalt treated base shall 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

9-03.6(3) TEST REQUIREMENTS

When the aggregates are combined within the limits set forth in Section 9-03.6(2) and mixed with the designated grade of asphalt, the mixture shall be Capable of meeting the following test values:

% of Theoretical Maximum Specific Gravity (GMM) (approximate)	93 @ 100 gyrations
Modified Lottman Stripping Test	Pass

The sand equivalent value of the Mineral Aggregate for asphalt treated base shall not be less than 35.

9-03.7 RESERVED

9-03.8 AGGREGATES FOR HOT MIX ASPHALT

9-03.8(1) GENERAL REQUIREMENTS

Aggregates for hot mix asphalt shall be manufactured from ledge rock, talus, or gravel, in accordance with the provisions of Section 3-01, shall meet the following test requirements:

Los Angeles Wear, 500 Rev.	30% max.
Degradation Factor, Wearing Course	30 min.
Degradation Factor, Other Courses	20 min.

The aggregate shall be uniform in quality, and shall be free from wood, roots, bark, extraneous materials, and adherent coatings. The presence of a thin, firmly adhering film of weathered rock will not be 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 shall 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 shall not contain more than 0.1 percent by weight of material with a specific gravity less than 1.0.

9-03.8(2) HMA TEST REQUIREMENTS

Aggregate for HMA shall meet the following test requirements:

1. The aggregate shall meet the Flat and Elongated shape requirements, measured as percent by weight of flat-elongated in accordance with ASTM D 4791. The percent shall not exceed 10 percent and the ratio shall be 5:1.
2. The fracture requirements for the combined coarse aggregate in the table below shall apply to the aggregate retained on each sieve U.S. No. 4 and larger, if that sieve retains more that 5% of the total sample, when tested in accordance with WAQTC TM-1:

“Design ESALs” (millions)	No. Fractured Faces	% Fracture
<10	1	90
=10	2	90

3. The fine aggregate angularity for the combined fine aggregate is tested in accordance with Test Method for AASHTO T 304, Method A. The minimum voids shall be 45%.
4. The minimum sand equivalent shall be 45 for coarse aggregate.

During verification by the Laboratory, the mix design shall produce HMA mixtures that when combined within the limits set forth in Section 9-03.8(6) and mixed with the designated grade of asphalt binder, using the Superpave gyratory compactor in accordance with AASHTO T 312, and at the required gyrations for N design with the following properties:

	HMA Class							
	3/8 Inch		1/2 Inch		¾ 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	
ESAL's (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
Modified Lottman Stripping Test	Pass		Pass		Pass		Pass	
	HMA Class							
	3/8 Inch		1/2 Inch		¾ Inch		1 Inch	
	ESAL's (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, fracture and sand equivalent requirements shall apply at the time of HMA production.

9-03.8(3) GRADING**9-03.8(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, shall be such that the completed mixture complies in all respects with the pertinent requirements of Section 9-03.8(6).

Acceptance of the aggregate gradation will be based on samples taken from the final mix.

9-03.8(3)B RECYCLED ASPHALT PAVEMENT (RAP)

Asphalt concrete planings or old asphalt concrete utilized in the production of asphalt concrete shall be sized prior to 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 modify the maximum size entering the mixer. No contamination by deleterious materials will be allowed in the old asphalt concrete used.

The gradation for the new aggregate used in the production of the asphalt concrete shall be the responsibility of the Contractor, and when combined with recycled material, the combined material shall meet the gradation specification requirements for the specified class of HMA as listed in Section 9-03.8(6) and 9-03.8(7) unless the Contract specifies otherwise. The new aggregate shall meet the general requirements listed in Section 9-03.8(1) and shall meet the appropriate fracture requirements specified in Section 9-03.8(2) item 2 for coarse aggregate, and sand equivalent requirements specified in Section 9-03.8(2) and in Section 9-03.8(4) for blending sand.

9-03.8(4) BLENDING SAND

Blending sand shall 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 shall be such that, when it is mixed with an aggregate, the combined product shall meet the requirements of Section 9-03.8(6) for the class of HMA involved. Blending sand shall meet the following quality requirement:

Sand Equivalent 30 min.

9-03.8(5) MINERAL FILLER

Mineral filler, when used in HMA, shall conform to the requirements of AASHTO M 17.

9-03.8(6) HMA PROPORTIONS OF MATERIALS

The materials of which HMA is composed shall consist of such sizes, grading, and quantity that when proportioned and mixed together, produce a well graded mixture meeting the requirements that follow.

The Contractors HMA mix design shall be between the control points.

HMA Aggregate Gradations				
Sieve Size	Percent Passing			
	HMA Class 3/8 Inch	HMA Class ½ Inch	HMA Class ¾ Inch	HMA Class 1 Inch
1 ½" square				100
1" square			100	90-100
¾" square		100	90-100	90 Maximum
½" square	100	90 – 100	90 Maximum	
¾" square	90 – 100	90 Maximum		
U.S. No. 4	90 Maximum			
U.S. No. 8	32 – 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

9-03.8(7) HMA TOLERANCES AND ADJUSTMENTS

- Job Mix Formula Tolerances.** After the JMF is determined as required in 5-04.3(7)A, the constituents of the mixture at the time of acceptance shall conform to the following tolerances:

Aggregate, percent passing ¹	Tolerance
1", ¾", ½" and ¾" 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 9-03.8(2)
VFA ²	min. and max. as listed in Section 9-03.8(2)
V _a ³	2.5% minimum and 5.5% maximum

- Notes:**
1. The tolerance limit for aggregate shall not exceed the limits of the control points specified in Section 9-03.8(6), except the tolerance limits for sieves designated as 100% passing shall be 99-100. The tolerance limits on sieves shall 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.
2. **Job Mix Formula Adjustments:** Adjustments beyond the limits below require approval by the Engineer and shall 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 shall 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 shall be within the range of the control points.
 - 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.

9-03.9 AGGREGATES FOR BALLAST AND CRUSHED SURFACING

9-03.9(1) BALLAST

Roadway ballast shall be manufactured from ledge rock or talus obtained from sources approved by the Engineer. Roadway ballast shall meet the requirements of Section 9-03.16 for Mineral Aggregate Type 14.

That portion of roadway ballast retained on a 1/4 inch square sieve shall not contain more than 0.2 % wood waste.

The Material from which ballast is to be manufactured shall meet the following test requirements:

Los Angeles Wear, 500 Rev	40% max.
Degradation Factor	15 min.
Sand Equivalent	35 min.
Dust ratio	2/3 max.

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 shall be a crushed Material with no naturally occurring surfaces. The term, "ballast" shall apply to Material retained on each sieve size 1/4 inch and above if that sieve retains more than 5 percent of the total sample.

9-03.9(2) SHOULDER BALLAST

Shoulder ballast shall meet the requirements of Section 9-03.9(1) for ballast except the gradation shall meet the requirements of Section 9-03.16 for Mineral Aggregate Type 13. The sand equivalent and dust ratio requirements shall not apply; however, the L. A. Abrasion and Degradation Factor requirements shall apply.

9-03.9(3) CRUSHED SURFACING

Except as otherwise specified in the remainder of this Section, crushed surfacing shall be manufactured from ledge rock or talus and shall meet the grading, sand equivalent, and L. A. Abrasion requirements of Section 9-03.16 for Mineral Aggregate Type 1, Type 2, and Type 3.

Crushed surfacing shall be a totally crushed Material with no naturally occurring faces and shall 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 surfacing may be manufactured from gravel if its use meets the requirements set forth in Section 9-03.11 for Mineral Aggregate Type 1G and 2G (see Section 4-04.2 for limitations regarding substituting crushed gravel for crushed rock).

The portion of crushed surfacing retained on sieves 1/4 inch and larger shall contain less than 0.15 % wood waste.

9-03.9(4) MAINTENANCE ROCK

Maintenance rock shall meet all requirements of Section 9-03.9(3) for crushed surfacing top course except that it shall meet the following Specifications for grading:

Sieve Size	Percent Passing
1/2" square	100
1/4" square	55 – 70
U.S. No. 40	10 – 25
U.S. No. 200	7 max.

Maintenance rock shall have a maximum 35% L. A. Abrasion (see Section 9-03.16, Mineral Aggregate Type 3).

9-03.9(5) SAND FILLER

Sand filler shall be natural deposit angular grains complying with Mineral Aggregate Type 11 per Section 9-03.16.

9-03.10 AGGREGATE FOR GRAVEL BASE

Gravel base shall meet the requirements of Section 9-03.12(2) for Mineral Aggregate Type 17.

9-03.11 CRUSHED GRAVEL

Crushed gravel shall be manufactured from mechanically crushed clean, washed gravel, and shall meet the grading requirements of Section 9-03.16 for Mineral Aggregate Types 1G, 2G, and 21 through 24. The number of fractured surfaces and the minimum percent of crushed particles required to have the fractured surfaces specified are as follows:

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	1 or more	75%
23	1 or more	75%
24	2 or more	95%

These fracture requirements shall apply to aggregates retained on all sieves sized 1/4 inch and larger, retaining at least 5 percent of total Mineral Aggregate weight.

Mineral Aggregates Type 1G and Type 2G may be used as base course in lieu of a crushed rock Mineral Aggregates Type 1 and Type 2 only when specified for use in the Contract and when meeting one or more of the following:

1. Covered and confined with Portland cement concrete pavement; or confined within a trench; and
2. Costs shall be adjusted in accordance with Section 4-04.

Crushed gravel shall not be substituted for crushed rock as a base course for asphalt concrete pavement. Only crushed rock shall be used under asphalt concrete pavement. Crushed gravel is acceptable as a base course only under asphalt concrete pavement overlying Portland cement rigid pavement base.

Crushed gravel and crushed rock shall be substantially free from adherent coatings. The presence of a thin, firmly adhering film of weathered rock shall not be 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 all sieves of 1/4 inch openings shall not contain more than 0.1 percent wood waste by weight. The portion of Material passing a U.S. No. 10 sieve shall not have wood waste that results in more than 250 parts per million of organic matter by calorimetric tests when tested. The color shall be measured after the sample has been in the test solution for 1 hour.

9-03.12 PIT RUN SAND, WASHED SAND, AND GRAVEL BACKFILL

Gravel backfill shall consist of crushed, partially crushed, or naturally occurring granular Material depending on the Type of Mineral Aggregate specified in the Contract.

9-03.12(1) GRAVEL BACKFILL FOR FOUNDATIONS**9-03.12(1)A CLASS A BACKFILL**

Class A gravel backfill for foundations shall meet the requirements of Section 9-03.9 and 9-03.16 for Type 2 or Type 14 Mineral Aggregates. When not specified in the Contract, Class A gravel backfill shall be Mineral Aggregate Type 2.

9-03.12(1)B CLASS B BACKFILL

Class B gravel backfill for foundations shall Mineral Aggregates Type 17 or Type 27 per Section 9-03.16.

9-03.12(2) GRAVEL BACKFILL FOR WALLS

Gravel backfill for walls shall 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 meets the requirements of Section 9-03.16 for Mineral Aggregate Type 17.

The combined portion of Material retained on all sieves of 1/4 inch openings and larger, shall contain no more than 0.20 percent by weight of wood waste.

9-03.12(3) GRAVEL AND SAND BACKFILL FOR PIPE BEDDING

The Contract specified class of Sewer and Storm Drain pipe bedding shall comply with both Standard plan no. 285 and Section 7-17.3(1)B, and shall be Mineral Aggregate Type 9 and Type 22 as specified in this Section and Section 9-03.16.

Water Main distribution pipe bedding Material shall meet the requirements of Section 9-03.16 for Mineral Aggregates Type 6 or Type 7 and Section 9-03.1(2). Water Main transmission pipe bedding shall meet the requirements of Section 9-03.16 for Mineral Aggregate Type 9 as shown on Standard Plan no. 350 and this Section. The bedding Class specified on the Drawings shall be as shown on Standard Plan no. 350.

Pea gravel bedding, Mineral Aggregate Type 9, shall consist of screened sand, gravel, or other inert Materials, or combinations thereof, from sources approved by the Engineer, and shall have hard, strong, durable particles free from adherent coatings. The Material shall 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 shall not exceed values specified in Section 9-03.1(2)B.

Crushed gravel bedding, Mineral Aggregate Type 22 shall be manufactured from screened crushed gravel. The finished product shall be clean, uniform in quality, and free from wood, bark, roots, and other deleterious Materials. The crushed screenings shall be substantially free from adherent coatings. The presence of a thin, firmly adhering film of weathered rock shall not be 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 all sieves with a 1/4 inch opening and larger shall not contain more than 0.1 percent deleterious Materials by weight.

9-03.12(4) GRAVEL BACKFILL FOR DRAINS

Gravel backfill for drains shall meet the requirements for Mineral Aggregate Type 26 in Section 9-03.16.

9-03.12(5) PIT RUN SAND AND GRAVEL

Pit run sand and gravel shall consist of free draining granular Materials obtained from naturally occurring deposits or manufactured from screened gravel.

Pit run sand shall meet the requirements of Section 9-03.16 for Mineral Aggregate Type 10.

Pit run sandy gravel shall meet the requirements of Section 9-03.16 for Mineral Aggregate Type 15.

9-03.12(6) WASHED SAND AND GRAVEL

Washed sand and gravel shall meet the gradation requirements of Section 9-03.16 for Mineral Aggregate Types 4, 5, 6, 7, and 26, whichever is specified in the Contract.

Washed sand and gravel shall 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 shall 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 shall not exceed the values specified in Section 9-03.1(2)B for Mineral Aggregate Types 6, 7, and 26 and Section 9-03.1(3)B for Mineral Aggregate Types 4 and 5.

9-03.12(7) QUARRY RUN CRUSHED ROCK

Quarry run crushed rock shall:

1. be Mineral Aggregate Type 27 meeting the gradation, sand equivalent, dust ratio, and L.A. abrasion requirements of Section 9-03.16,
2. be 100% crushed,
3. have a plasticity index of 4 maximum, and
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 9-03.12(1)B.

9-03.13 BACKFILL FOR SAND DRAIN

9-03.13(1) SAND DRAIN BACKFILL

Sand drain backfill shall conform to the following gradation (Note - not a Mineral Aggregate Type in Section 9-03.16):

Sieve Size	Percent Passing
1/2" square	90 – 100
1/4" square	65 – 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

9-03.13(2) SAND DRAINAGE BLANKET

Aggregate for the sand drainage blanket shall consist of granular Material, free from wood and other extraneous Material and shall meet the following requirements for grading (Note – not a Mineral Aggregate Type in Section 9-03.16):

Sieve Size	Percent Passing
2-1/2" square	90 – 100
1/4" square	30 – 100

The portion passing 1/4" shall meet the following requirements for grading:

Sieve Size	% 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 all sieves 1/4 inch openings and larger shall contain not more than 0.05 percent by weight of wood waste.

9-03.14 GRAVEL BORROW

Unless otherwise specified in the Contract, gravel borrow shall meet the requirements of Section 9-03.12(2) and the grading requirements in Section 9-03.16 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.

9-03.15 TEST METHODS FOR AGGREGATES

Material properties in these Specifications shall be determined in accordance with the following test methods:

Title	Test Method
Sampling	AASHTO T 2
Organic Impurities	WSDOT No. 21
Clay Lumps in Aggregates	AASHTO T 112
Abrasion of Coarse Aggregates by Use of the Los Angeles Machine	AASHTO T 96
Material Finer than U.S. No. 200 Sieve in Aggregates	AASHTO T 11
Sieve Analysis of Fine and Coarse Aggregates	AASHTO T 27
Determination of Degradation Value	WSDOT No. 113
Determination of Fineness Modulus	AASHTO T 27
Lightweight Pieces in Aggregates	WSDOT No. 122
Mortar Strength	WSDOT No. 311
Percentage of Particles Smaller than 0.025 mm and 0.005 mm	AASHTO T 88
Stabilometer R Value, Untreated Materials	WSDOT No. 611
Swell Pressure and Permeability	WSDOT No. 611
Stabilometer S Value, Treated Materials	WSDOT No. 703
Cohesimeter	WSDOT No. 703
Compressive Strength of Concrete	AASHTO T 22
Flexural Strength of Concrete	WSDOT No. 802
Specification for Wire-Cloth Sieves for Testing Purposes	AASHTO M 92
Standard Method of Test for Plastic Fines in Graded Aggregate and Soils by Use of the Sand Equivalent Test	AASHTO T 176

9-03.16 MINERAL AGGREGATE CHART

Commonly used mineral aggregates can be 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 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	1/4	3/8	1/2	5/8	3/4	1	1-1/4	1-1/2	2	2-1/2	3			
1.	5/8" Minus Crushed Rock	Top Course & Keystone	9-03.9(3)	0-10	....	8-24	....	....	....	....	55-75	....	....	100	....	....	....	....	....	....	....	40	....	35
1G.	5/8" Minus Crushed Gravel	Top Course & Keystone	9-03.11	0-10	....	8-24	....	....	....	....	55-75	....	....	100	....	....	....	....	....	....	....	40	....	35
2.	1-1/4" Minus Crushed Rock	Base Course	9-03.9(3) 9-03.12(1)	0-7.5	....	3-18	....	....	....	....	30-50	....	....	50-80	....	....	100	....	....	....	....	40	....	35
2G.	1-1/4" Minus Crushed Gravel	Base Course	9-03.11	0-7.5	....	3-18	....	....	....	....	30-50	....	....	50-80	....	....	100	....	....	....	....	40	....	35
3.	1/2" Minus Crushed Rock		9-03.9(3) 9-03.9(4)	0-7	....	10-25	....	....	....	....	55-70	....	100	....	....	....	....	....	....	....	....	....	....	35
4.	1-1/2" Washed Gravel		9-03.1(3)D	0-0.5	....	....	....	....	....	....	0-2	....	....	0-20	....	90-100	100	....	....	....	....	....	....	35
5.	1" Washed Gravel		9-03.1(3)D	0-0.5	....	....	....	....	....	0-4	....	10-40	....	....	80-100	100	....	....	....	....	....	....	....	35
6.*	Washed Sand		9-03.1(2)C	0-2.5	9-20	....	....	68-86	82-98	95-100	....	100	....	....	....	....	....	....	....	....	....	....	....	....
7.*	Building Sand		9-03.1(2)C	0-2.5	15-30	....	....	85-95	93-100	100	....	....	....	....	....	....	....	....	....	....	....	....	....	....
9.	3/8" Washed Gravel	Pipe Bedding	9-03.12(3)	0-3	....	....	....	0-10	....	....	....	80-100	....	....	100	....	....	....	....	....	....	....	....	....
10.	Pit Run Sand	Backfill Embankment	9-03.12(5)	0-10	10-60	....	....	40-100	....	....	90-100	100	....	....	....	....	....	....	....	....	....	....	....	....
11.	Sand Filler		9-03.9(5)	0-15	....	15-40	40-75	....	....	....	90-100	100	....	....	....	....	....	....	....	....	....	....	....	....
13.	2-1/2" Minus Crushed Rock	Shoulder Ballast	9-03.9(2)	....	....	....	....	....	....	....	0-5	....	....	....	40-80	....	....	....	....	....	....	....	....	40
14.	2-1/2" Crushed Rock	Roadway Ballast	9-03.9(1) 9-03.12(1)	0-9	....	0-16	....	....	....	....	30-50	....	....	....	....	50-85	....	....	65-100	100	....	35	2/3	40
15.	Pit Run Sandy Gravel	Backfill Embankment	9-03.12(5)	0-10	....	....	....	....	....	....	20-40	....	....	....	100	....	....	....	....	....	....	....	....	30
17.	Bank Run Gravel	Selected Backfill	9-03.10 9-03.12(2) 9-03.14	0-5	....	....	....	....	....	....	25-75	....	....	....	....	....	....	....	....	....	95-100	60	2/3	....
21.	1-1/2" Crushed Gravel		9-03.11	....	....	....	....	....	....	....	0-25	....	45-70	85-100	....	....	....	100	....	....	....	....	....	30
22.	3/4" Crushed Gravel	PVC & CMP Pipe Bedding	9-03.11 9-03.12(3)	....	....	....	....	....	....	....	0-25	....	75-100	....	100	....	....	....	....	....	....	....	....	....
23.	1/2" Minus Crushed Gravel	Cover Rock	9-03.11	2-12	....	....	40-75	....	....	....	70-100	....	100	....	....	....	....	....	....	....	....	....	....	30
24.	1/2" Minus Crushed Gravel	Chip Rock	9-03.11	0-3	....	0-5	0-10	....	0-20	25-55	50-90	98-100	100	....	....	....	....	....	....	....	....	....	....	30
26.	3/4" Washed Gravel	Filter Material	9-03.12(4)	0-1	3-12	....	....	20-50	....	....	30-60	....	....	....	100	....	....	....	....	....	....	....	....	....
27.	Pit Run Crushed Rock	Select Fill	9-03.12(7)	0-15	....	0-50	....	....	....	....	25-75	....	....	....	70-100	....	....	....	100	....	....	25	2/3	35

9-03.17 ROCK FACING MATERIAL

Rock for constructing new rock facing shall be large, broken pieces of igneous and metamorphic rock types. Each rock shall be rectangular, intact, fracture free, 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 shall be as follows:

Size	Approx. Weight	Min. Approx. Dimensions	Approx. Volume
One-man rock	200 – 400 lbs.	12 inches	2 cf
Two-man rock	500 – 800 lbs.	13 inches	4 cf
Three-man rock	900 – 1200 lbs.	16 inches	6.6 cf
Four-man rock	1300 - 2000 lbs.	18 inches	12.5 cf
Five-man rock	2000 – 4000 lbs.	24 inches	18.5 cf
Six-man rock	4100 – 6000 lbs.	30 inches	31 cf

Rocks less than 1.5 cubic foot (cf) in volume shall not be used.

The Contractor shall 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:

Specific Gravity	ASTM C 127	Minimum 2.65
Soundness	AASHTO T 104 (section 5.2.2)	Not greater than 5 % loss
Accelerated Expansion	CRD-C-148	Not greater than 15% breakdown
Absorption	ASTM C 127	Not greater than 2%
L. A. Abrasion	ASTM C 131	Maximum 20% loss @ 500 revolutions

All rock to be delivered to and incorporated into the project where rock facing is over 6 feet high, shall meet the minimum testing requirements noted above; the rock shall be stockpiled in a separate pile at the quarry prior to delivery to the Project Site and shall be protected from contamination with other, untested rock sources.

SECTION 9-04 JOINT AND CRACK SEALING MATERIALS**9-04.1 PREMOLDED JOINT FILLERS****9-04.1(1) FILLER FOR CONTRACTION AND LONGITUDINAL JOINTS IN CONCRETE PAVEMENT**

Premolded joint filler for use in concrete contraction and longitudinal joints shall consist of a suitable asphalt mastic encased in asphalt-saturated paper or asphalt-saturated felt. It shall be sufficiently rigid for easy installation in summer months and not too brittle for handling in cool weather. It shall 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 shall 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 shall be as shown in the Standard unless the Contract specifies otherwise. Where no premolded joint filler thickness is indicated, the premolded filler thickness shall be 3/8 inch.

9-04.1(2) FILLER FOR THROUGH, CONSTRUCTION, AND EXPANSION JOINTS IN CONCRETE PAVEMENT

Premolded joint filler for expansion or through joint applications shall 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. The thickness and width of premolded joint filler for expansion, through, and construction joints shall be as indicated on the Standard unless otherwise specified in the Contract. Where no premolded filler thickness is indicated, the thickness shall be 3/4 inch.

9-04.1(3) RESERVED**9-04.1(4) ELASTOMERIC EXPANSION JOINT SEALS**

Premolded elastomeric expansion joint seals shall conform to the requirements of AASHTO M220 and shall be formed by an extrusion process with uniform dimensions and smooth exterior surfaces. The cross-section of the seal shall be shaped to allow adequate compressed width of the seal, as approved by the Engineer.

9-04.2 JOINT SEALANTS**9-04.2(1) JOINT SEALANTS FOR SAWED CONTRACTION JOINTS**

Joint sealants for sawed contraction joints shall meet the requirements of one of the following types: (1) AASHTO M 173, Concrete Joint Sealer, Hot Poured Elastic Type, or (2) ASTM D 1190, Concrete Joint Sealer, Cold Application Type; except that the test for evaluation of the bond requirements in each of the above requirements shall be in accordance with the bond test methods referred to in Section 9-04.2(2). Unless otherwise stated in the Contract, the Contractor shall have the option of using either of the above two types.

9-04.2(2) POURED JOINT SEALER FOR PAVEMENT AREAS

The physical properties of the joint sealer, when mixed in accordance with the manufacturer's recommendations, shall be as follows:

1. Color: Gray or black.
2. ¹Viscosity: Shall be pourable and self-leveling at 50°F.
3. ¹Application Life: Not less than 3 hours at 72°F and 50 percent 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 percent.
7. Hardness Rating (Durometer "Shore A"): 5-35.
8. Resiliency: Not less than 80 percent.
9. Bond test methods shall be in accordance with WSDOT Test Method No. 412A.

¹Viscosity 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, shall be furnished with each joint sealer. The primer shall be suitable for brush or spray application at 50°F or higher and shall cure sufficiently at 50°F to pour the joint within 24 hours. It shall be considered as an integral part of the sealer system. Any failure of the sealer in the test described herein, attributable to the primer, shall be grounds for rejection of the sealer.

Acceptance of joint sealing compound for use on a project shall 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 shall be allowed for completion of these tests. Each container of the compound shall be clearly identified as to manufacturer and batch number.

9-04.2(3) POURED JOINT SEALER FOR WALKWAYS

Poured joint sealer used to seal sawed joints in sidewalks, stairs, plazas, and other walkways shall 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 shall be produced using Type II or III Portland cement, fine aggregate Class 1 or Class 2 (see Section 9-03.1(2)), and water in proportion applicable to the application. Generally the proportions are one part Portland cement to two or three parts fine aggregate with just enough water to make a stiff consistency. The mortar mix shall be approved by the Engineer before use.

9-04.3(2) NON-SHRINK CEMENT SAND GROUT**9-04.3(2)A GENERAL**

Prior to placing the grout, the contact surface shall be thoroughly cleaned, roughened and wetted with water. The grout shall 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 other than pipe connections, may be a prepackaged grout, or produced using Type I, II, or III Portland cement; fine aggregate Class 1 or Class 2 (see Section 9-03.1(2)); and sufficient water to make a workable mix with flowability suitable for the intended application. Compressive strength shall be a minimum 4000 psi @ 3 Days.

9-04.3(2)C GROUT FOR PIPE CONNECTIONS AND POLES & PEDESTALS

Non-shrink cement sand grout for pipe connections to manholes, catch basins, inlets, and similar utility appurtenances; installing tees; grouting under poles and pedestals; and similar uses shall meet the following requirements:

1. 1-part, by weight, Type III (H.E.S.) cement;
2. 2-parts, by weight, clean fine aggregate Class 1 or Class 2 (see Section 9-03.1(2)); and
3. Sufficient water complying with Section 9-25.1 to obtain a stiff consistency. The use of calcium chloride will not be allowed.

Unpolished aluminum powder shall be added to the dry cement in the proportion of one heaping teaspoonful per sack of cement no more than 30 minutes before the grout mixture reaches its final in-place position. The required compressive strength shall be a minimum 4,000 psi @ 7 Days.

9-04.3(2)D GROUT FOR TENDONS

Non-shrink cement sand grout used for grouting tendons shall be as specified in Section 6-02.3(26)G. Compressive strength shall be determined by fabricating cubes per WSDOT Method 813 and testing their compressive strength per AASHTO T 106.

The strength shall be confirmed by Schmidt hammering of the pads.

9-04.4 RUBBER GASKETS**9-04.4(1) RUBBER GASKETS FOR CONCRETE PIPES AND PRECAST MANHOLES**

Rubber gaskets for use in joints of concrete Culvert or storm Sewer pipe and precast manhole sections shall conform to the applicable requirements of ASTM C 443.

9-04.4(2) RESERVED**9-04.4(3) RUBBER GASKETS FOR ALUMINUM OR STEEL CULVERT OR STORM SEWER PIPE**

Gaskets for use with metal Culvert or storm Sewer pipe shall be continuous closed cell, synthetic expanded rubber gaskets conforming to the requirements of ASTM D 1056, Grade 2B3.

9-04.4(4) RUBBER GASKETS FOR ALUMINUM OR STEEL DRAIN PIPE

Gaskets for metal drain pipe shall be self-adhering, butyl-based scrim-supported type. When specified, the gaskets shall be as described in the Standard.

9-04.4(5) PROTECTION AND STORAGE

Rubber gasket Material shall be stored in a clean, cool place, protected from contaminants. They shall be protected from direct sunlight at all times except during actual installation. Pipes with gaskets affixed shall 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 shall submit an invoice from the manufacturer stating date of delivery.

9-04.5 FLEXIBLE PLASTIC GAS KETS

The gasket Material shall be produced from blends of refined hydrocarbon resins and plasticizing materials reinforced with inert mineral filler and shall contain no solvents. It shall not depend on oxidizing, evaporating, or chemical action for adhesive or cohesive strength. It shall be supplied in extruded rope-form of such cross-section and size as to adequately fill spaces between the precast sections.

The gasket Material shall 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 shall conform to those set forth as follows:

	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 shall 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 shall conform to ASTM D 1056, Grade No. 2B3.

9-04.8 RESERVED**9-04.9 SOLVENT CEMENTS**

Solvent Cements for PVC underdrain pipe shall conform to the requirements of ASTM D 2564.

9-04.10 CRACK SEALING - RUBBERIZED ASPHALT

Rubberized asphalt for crack sealing asphalt concrete pavement shall conform to AASHTO M 173 (ASTM D 1190) and have a COC flash point (AASHTO T 48) of 400°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

9-05.0 ACCEPTANCE BY MANUFACTURER'S CERTIFICATION

Certain drainage Materials may be accepted by the Engineer based on a Manufacturer's Certificate of Compliance meeting the requirements of Section 1-06.3. These Materials are as follows:

- Metal drain and underdrain pipe,
- PVC drain pipe and underdrain pipe,
- Metal Culvert, Storm Drain pipe and pipe arch less than 30 inches in diameter,
- Metal Culvert end sections,
- Corrugated metal structural plate pipe, pipe arch, and under passes,
- Ductile iron pipe, and
- Vitrified clay pipe.

9-05.1 CONCRETE PIPE**9-05.1(1) GENERAL**

Concrete pipe shall be manufactured by plants certified by the National Precast Concrete Association (NPCA). Concrete pipe shall meet the requirements of 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 shall 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 shall be in accordance to Section 7-02.3(1)B4.

9-05.1(2) BASIS FOR ACCEPTANCE OF CONCRETE PIPE**9-05.1(2)A GENERAL**

The basis for acceptance of non-reinforced concrete pipe shall 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 three 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 shall 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 shall perform as specified in these Specifications; allow for the Engineer to visit the Supplier and observe the "other criteria", and shall allow the Engineer to have a minimum three (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 shall be determined by the results of the **three 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, shall 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 shall be conducted as follows:

The pipe selected by the Engineer for testing shall be placed plumb with either end down on a soft rubber impermeable pad and filled with water. The pipe shall 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 herein 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 inch and no larger than 60 inch 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 shall be delivered with this "Certification of Inspection". The Contractor shall notify the Engineer a minimum 15 Working Days prior to 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 shall provide a Manufacturer's Certificate of Compliance stating that the gaskets for all concrete pipe meet the requirements of ASTM C 443, and that the pipe age at shipment meets the requirements of Section 9-05.1(3). The Contractor shall also submit actual shop drawings detailing pipe reinforcement and joint design.

9-05.1(2)B PIPE ACCEPTANCE REPORT (PAR)

Concrete pipe with diameters of 27 inch and smaller shall 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 shall meet all Contract requirements.

9-05.1(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 shall 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.

9-05.1(4) RESERVED**9-05.1(5) BEVELED CONCRETE END SECTIONS**

Beveled concrete end sections shall be plain concrete conforming to AASHTO M86 or reinforced concrete conforming to the applicable sections of AASHTO M170 with the design requirements as listed in Table 2, Wall B, Circular Reinforcement in circular pipe, and WSDOT Standard Plan no. B-7a.

9-05.1(6) CONCRETE PIPE JOINTS AND TESTING**9-05.1(6)A GENERAL**

All concrete pipe shall be joined with rubber gaskets. The joints and gasket material shall meet the requirements of ASTM C 443. Gasket Material shall be protected as specified in Section 9-04.4(5).

Both bell and spigot shall be reinforced in all pipe 30 inch or larger in diameter.

9-05.1(6)B TESTING CONCRETE PIPE JOINTS**9-05.1(6)B1 GENERAL**

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 following tests shall be made on one test length of the assembled concrete pipe, or test length assembly as defined in Section 9-05.1(6)B2, 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 shall be conducted at the Supplier and the Contractor shall make available space and facilities to accommodate the testing in an efficient and workmanlike manner.

9-05.1(6)B2 HYDROSTATIC PRESSURE ON PIPES IN STRAIGHT ALIGNMENT

Hydrostatic pressure tests on pipes in straight alignment shall be made in accordance with the procedure outlined in paragraph 8(a) of AASHTO M 198, except that they shall be performed on a test length assembly consisting of not less than three nor more than five pipe sections selected from stock by the Engineer and assembled in accordance with Contract requirements. The end sections shall be bulkheaded and restrained to prevent leakage.

9-05.1(6)B3 HYDROSTATIC PRESSURE TESTS ON PIPES IN MAXIMUM DEFLECTED POSITION

Upon completion and acceptance by the Engineer of testing in accordance with Section 9-05.1(6)B2, the test length assembly shall be deflected until at least two of the pipe joints are deflected to the maximum as indicated in the manufacturer's installation instruction. When thus deflected, the test length assembly shall be braced and the end sections shall be bulkheaded and restrained to prevent leakage. The test length assembly shall then be pressurized to an internal hydrostatic pressure of 5 psig minimum, and no leakage at any joint for a 15 minute test duration will indicate acceptance by the Engineer.

9-05.1(6)B4 HYDROSTATIC PRESSURE TEST ON 15 INCH DIAMETER AND LARGER PIPE UNDER DIFFERENTIAL LOAD

For concrete pipe 15 inch or larger, upon completion and acceptance of testing in accordance with Section 9-05.1(6)B3, the test length assembly shall be suitably supported so that one of the pipes of the test assembly is suspended freely between adjacent pipes, be supported only by the joint connections. The suspended pipe shall then be loaded at its midpoint with an additional "point load" in accordance with the following schedule:

Pipe Diameter	Load
15 inches	7,400 lbs.
18 inches	8,800 lbs.
21 inches	10,000 lbs.
24 inches and larger	11,000 lbs.

"Point load" shall be interpreted as not more than two (2) linear feet spread over not more than one (1) linear foot beyond the midpoint of the pipe section supported.

While under this load, the test length assembly shall be braced and the end sections shall be bulkheaded and restrained to prevent leakage. The stressed joints, or joints at each end of the supported test section, shall show no leakage when subjected to an internal hydrostatic pressure of 5 psi for a 15 minute time duration. At the option of the Supplier or Contractor, 1/2 of the specified load may be applied on the bell end of the suspended pipe in lieu of the full load at the midpoint of the suspended pipe if the total half-load is applied over not more than an 18 inch length measured from the end of the pipe.

9-05.1(7) PERFORATED CONCRETE SUBSURFACE DRAIN PIPE

Perforated concrete subsurface drain pipe shall meet the requirements of AASHTO M175, Type I, except that the perforations shall be approximately 1/2 inch in diameter. Strength requirements shall be as shown in Table I of AASHTO M 86.

9-05.2 DUCTILE IRON PIPE

Ductile iron pipe shall conform to ANSI A21.51 or AWWA C151 and shall be cement mortar lined, push-on joint, or mechanical joint. The ductile iron pipe shall be Class 50 unless indicated otherwise in the Contract.

Joints for ductile iron pipe shall be rubber gasketed conforming to the requirements of ANSI A21.11 or AWWA C111.

Cast iron fittings may be used with ductile iron pipe with Engineer's approval, and require the Contractor to submit a minimum of 10 Working Days in advance, the proposed fittings 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 will not be acceptable on any new ductile iron pipe installation (see Section 7-17.3(2)C3 item 3.). All fittings shall be the same material as the pipe being connected. Fittings using other material or constructed with more than one material may be used subject to the approval of the Engineer. At least 10 Working Days in advance, the Contractor shall submit to the Engineer for approval, the proposed alternate material(s) and shall include a Manufacturer's Certificate of Compliance stating the strength and performance meets or exceeds the handling and load stresses of that specified.

9-05.3 POLYVINYL CHLORIDE (PVC) PIPE

PVC pipe shall conform to the requirements 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 shall be 46 lb/in/in.

Joints for PVC pipe shall conform to ASTM D 3212 using an elastomeric gasket conforming to ASTM F 477.

Fittings for PVC pipe shall conform to ASTM D 3034, ASTM F 679, or ASTM F 1336. All fittings shall 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 shall submit at least 10 Working Days in advance, the proposed alternate material(s) and shall include a Manufacturer's Certificate of Compliance stating the alternate material meets or exceeds the handling and load stress performance of that specified.

9-05.3(1) PERFORATED PVC SUBSURFACE DRAIN PIPE

Perforated polyvinyl chloride sub-surface drain (SSD) pipe and fittings shall be ASTM D 2241 SDR 21 (Class 200) with rubber gasket joints. Pipe shall have slotted perforations 0.040 inch wide by 1.0 inch long and spaced 0.25 inch apart on center. The slotted perforations on the pipe shall be oriented as indicated in the Contract. Pipe size shall not exceed 8 inch diameter unless indicated otherwise in the Contract.

9-05.4 VITRIFIED CLAY PIPE (VCP)

Vitrified clay pipe shall conform to ASTM C 700, and all joints shall be factory manufactured in accordance with ASTM C 425. When a low-pressure air test is conducted, VCP shall be tested in accordance with ASTM C 828 (also see Sections 7-17.3(4)D and 7-17.3(4)E(1)).

Vitrified clay pipe shall be installed as specified in the Contract.

When not specified in the Contract, proposed installation of vitrified clay pipe as part of the City of Seattle Sewer and Storm Drain system shall require a submittal to obtain approval of the Engineer. Installation without the Engineer's approval will not be allowed.

9-05.5 POLYETHYLENE PIPE**9-05.5(1) CORRUGATED POLYETHYLENE DRAINAGE TUBING PIPE****9-05.5(1)A CORRUGATED POLYETHYLENE DRAINAGE TUBING DRAIN PIPE**

Corrugated polyethylene drainage tubing drain pipe shall meet the requirements of AASHTO M252. The maximum size pipe allowed shall not be larger than 10 inch diameter.

9-05.5(1)B PERFORATED CORRUGATED POLYETHYLENE DRAINAGE TUBING SUBSURFACE DRAIN PIPE

Perforated corrugated polyethylene drainage tubing subsurface drain pipe shall meet the requirements of AASHTO M 252 Type 5. The maximum size pipe shall be 10 inch in diameter.

9-05.5(2) CORRUGATED POLYETHYLENE DRAIN PIPE**9-05.5(2)A GENERAL**

Corrugated polyethylene drain pipe shall be high density polyethylene (HDPE) meeting the requirements of AASHTO M 294, Type S. The size of pipe allowed shall range from a minimum 12 inch diameter through a maximum 48 inch diameter. All HDPE pipe delivered and used shall be certified through the Plastic Pipe Institute (PPI) Third Party Certification program and shall bear the Third Party Administered PPI seal.

9-05.5(2)B COUPLING BANDS

Joints for corrugated polyethylene drain pipe shall be made with a bell/bell or bell and spigot coupling using elastomeric gaskets conforming to ASTM F 477. Joints for Storm Drain pipe shall be made with a bell/bell or bell and spigot

coupling and shall conform to ASTM D 3212 using elastomeric gaskets conforming to ASTM F 477. All gaskets shall be factory installed on the pipe in accordance with the Material Person's recommendations.

9-05.5(3) RESERVED

9-05.5(4) PERFORATED CORRUGATED POLYETHYLENE SUBSURFACE DRAIN PIPE

9-05.5(4)A GENERAL

Perforated corrugated polyethylene subsurface drain pipe shall be high density polyethylene (HDPE) meeting the requirements of AASHTO M 294, Type S. The size of pipe allowed shall range from a minimum 12 inch in diameter through a maximum of 48 inch diameter. Perforations shall be in accordance with AASHTO M 294. All HDPE pipe delivered and used shall be certified through the Plastic Pipe Institute (PPI) Third Party Certification program and shall bear the Third Party Administered PPI seal.

9-05.5(4)B COUPLING BANDS

Joints for perforated corrugated polyethylene subsurface drain pipe shall be made with a bell/bell or bell and spigot coupling using elastomeric gaskets conforming to ASTM F 477. All gaskets shall be factory installed on the coupling or on the pipe by the Material Person.

9-05.5(5) POLYETHYLENE END SECTIONS

High density polyethylene (HDPE) end sections shall be manufactured out of polyethylene resin complying with ASTM D 3350.

9-05.6 ALUMINUM PIPE

9-05.6(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 shall conform to the applicable requirements of AASHTO M196.

The protective coating for aluminum pipe shall be Treatment 5 as specified in Section 7-02.3(1)C3a, and the pipe shall 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 (controlled density fill (CDF), concrete, grout, mortar, etc.) shall 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 two feet beyond the area of contact with the Portland cement product. The paint shall conform to Federal Specification TT-P-645 (Primer, Paint, Zinc Chromate, Alkyd Vehicle).

9-05.6(1)A BASIS FOR ACCEPTANCE FOR ALUMINUM PIPE

The basis for acceptance of aluminum pipe will be the same as specified in Section 9-05.0, 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 Material Person 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.

9-05.6(1)B COUPLING BANDS

9-05.6(1)B1 COUPLING BANDS FOR DRAIN PIPE

Coupling bands for corrugated aluminum alloy drain pipe shall meet the requirements of coupling bands for Type I pipe of AASHTO M196, except that bands using projections (dimples) will not be allowed. The bands shall be fabricated of the same material as the pipe.

Coupling bands for aluminum corrugated pipe shall be 24 inch, two-piece half-circle corrugated pipe held together with angles and bolts. A neoprene gasket shall be placed between the pipe and the bands. The bands shall be made of the same material and have the same corrugation as the pipe, and shall meet the requirements of Section 9-05.6(1)B2.

9-05.6(1)B2 COUPLING BANDS FOR CULVERT PIPE

Coupling for bands shall meet applicable requirements of AASHTO M196. Bands having projections in lieu of corrugations will not be allowed.

Steel bolts and nuts for coupling bands shall meet the requirements of ASTM A307 and shall be galvanized in accordance with AASHTO M232 or AASHTO B 633.

Aluminum angles shall be of the same material as the coupling bands.

Rods, when required, shall meet the requirements of ASTM B 221, Alloy 6061-T6.

Asphalt coating shall not be used on coupling bands.

Coupling bands and aluminum pipe shall be the product of the same Material Person.

9-05.6(1)B3 COUPLING BANDS FOR ALUMINUM PIPE

Section 9-05.7(4)B shall apply to aluminum pipes, except the band shall have a range of thicknesses from not less than 0.60 inch to not larger than 0.105 inch.

Coupling bands and aluminum pipe shall be the product of the same Material Person.

9-05.6(1)C ELLIPTICAL FABRICATION

Section 9-05.7(2)B shall apply to aluminum culvert pipes.

See Section 7-16.2 for restrictions on the use of corrugated metal pipe.

9-05.6(1)D MITERED ENDS

Section 7-02.3(1)C2c shall apply to aluminum pipe.

9-05.6(1)E ASPHALT COATINGS

Asphalt coatings for aluminum Culvert pipe shall meet the requirements of Section 9-05.7(2)C.

9-05.6(1)F ALUMINUM END SECTIONS

The applicable provisions of AASHTO M196 shall apply to the construction of end sections and toe plate extensions for aluminum pipes. In addition, they shall conform to the requirements of Section 9-05.7(2)G.

Asphalt coating shall not be used on aluminum end sections.

9-05.6(2) PERFORATED CORRUGATED ALUMINUM SUBSURFACE DRAIN PIPE

9-05.6(2)A GENERAL

Perforated corrugated aluminum subsurface drain pipe shall meet the requirements of AASHTO M196, except that the perforations may be located at any location on the tangent of the corrugations providing the other perforation spacing meet Specifications.

See Section 7-16.2 for restrictions on the use of corrugated metal pipe.

9-05.6(2)B COUPLING BANDS

Coupling bands for corrugated aluminum subsurface drain pipe shall meet the requirements of coupling bands for Type III pipe of AASHTO M 196. The bands shall 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 meeting the requirements of Section 9-05.6(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.

9-05.6(3) ALUMINUM SPIRAL RIB PIPE

9-05.6(3)A GENERAL

See Section 7-16.2 for restrictions on the use of corrugated metal pipe.

Aluminum spiral rib pipe shall meet the requirements of AASHTO M196 and these Specifications. The size, alloy, and protective treatment shall be as indicated in the Contract.

The Material Person of spiral rib pipe shall 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 shall be furnished with pipe ends cut perpendicular to the longitudinal axis of the pipe. Pipe ends shall be cut evenly. Spiral rib pipe shall be fabricated by using a continuous helical lock seam with a seam gasket.

For spiral rib pipe, helical ribs shall project outwardly from the smooth pipe wall and shall be fabricated from a single uniform thickness material. The ribs shall be 3/4 inch wide by 3/4 inch deep with a nominal spacing of 7-1/2 inches center to center. Pipe shall be fabricated with ends that can be acceptably jointed with coupling bands.

For narrow pitch spiral rib pipe, helical ribs shall project outwardly from the smooth pipe wall and shall be fabricated from a single thickness of material. The ribs shall be 3/8 inch \pm 1/8 inch wide (measured outside to outside) and a minimum of 0.4375 inch high (measured as the minimum vertical distance from the outside of pipe wall to top surface of the rib). The maximum spacing of ribs shall be 4.80 inch center to center (measured normal to the direction of the ribs). The radius of bend of the metal at the corners of the ribs shall be a minimum of 0.0625 inch with an allowable tolerance of plus or minus 10 percent.

For wide pitch spiral rib pipe, helical ribs shall project outwardly from the smooth pipe wall and shall be fabricated from a single thickness of material. The ribs shall be 3/4 inch \pm 1/8 inch 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 ribs shall be 11.75 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 shall be 0.0625 inch with an allowable tolerance of + 10 percent.

9-05.6(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 shall be formed in the flat between ribs and shall conform to Section 13.2.1 through 13.2.5 of AASHTO M 196.

9-05.6(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 Material Person 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 shall be sampled and tested in accordance with AASHTO T249 and a Manufacturer's Certificate of Compliance stating the results shall be submitted to the Engineer.

9-05.6(3)D COUPLING BANDS

Coupling bands shall be of the same material as the pipe. Coupling bands and gaskets shall conform to Section 9-05.7(4)B.

9-05.6(4) ALUMINUM PIPE FOR DETENTION

See Section 7-16.2 for restrictions on the use of corrugated metal pipe.

Aluminum detention pipe shall be helical or annular corrugated aluminum pipe, meeting the requirements of AASHTO M 196, Type I with the gauge as indicated on the Drawings. The end plate and all end plate reinforcement shall be aluminum alloy 6061-T6 structural plate with the thickness as indicated on the Drawings.

Coupling bands for corrugated aluminum detention pipes shall be Type "D" per WSDOT Standard Plan no. B-13a.

9-05.7 STEEL PIPE**9-05.7(1) GALVANIZED STEEL DRAIN PIPE**

Galvanized steel pipe shall be 4 inch inside diameter, Schedule 40 pipe meeting the requirements of ASTM A53.

9-05.7(2) STEEL CULVERT PIPE AND PIPE ARCH**9-05.7(2)A GENERAL**

Steel Culvert pipe and pipe arch shall meet the requirements of AASHTO M36, 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.

9-05.7(2)B ELLIPTICAL FABRICATION

When elongated pipes are specified, circular pipes shall be fabricated 5 percent out of round to form an elliptical section. The vertical or longer axis of the elliptical section shall be clearly marked before shipping.

9-05.7(2)C ASPHALT COATINGS AND PAVED INVERTS

Asphalt for asphalt coatings and paved inverts shall meet the requirements of AASHTO M 190, Section 4. The coatings for Treatments 1, 2, and 5 as specified in Section 7-02.3(1)C3a shall be uniform, inside and out, and applied as specified in the following.

The metal shall be free from grease, dirt, dust, moisture, or other deleterious contaminants. Either preheated or non-preheated process may be used as follows:

1. **Pipe Not Preheated:** The temperature of the asphalt at the time of pipe immersion shall be 400 °F (± 5 F°), and the duration of the immersion shall conform to the following schedule:

Thickness in Inches		Minimum Immersion Time-Minutes
Steel	Aluminum	
.064	.060	2.5
.079	.075	3.0
.109	.105	5.0
.138	.135	6.5
.168	.164	8.0

2. **Pipe Preheated:** The asphalt shall have a temperature of 380 °F (± 5 F°), and the pipe shall be brought to a temperature of 300 °F to 350 °F before immersion.

Paved inverts for Treatments 2 and 4 as specified in Section 7-02.3(1)C3a shall consist of bituminous material applied in such a manner that one or more smooth pavements are formed in the invert filling the corrugations for at least 40 percent of the circumferential length. The pavement shall have a minimum thickness of 1/8 inch above the crest of the corrugations except where the upper edges intercept the corrugation. The pavement shall be applied following the coating with asphalt or fiber bonding.

Treatment 5 may be substituted for Treatment 2, and Treatment 6 for Treatment 4 at the option of the Contractor; however, the Contractor shall provide written notice to the Engineer of which treatment is used.

9-05.7(2)D SPUN ASPHALT LINING

Asphalt for spun linings over 100 percent periphery shall conform to AASHTO M 190, Section 4. Asphalt spun linings shall provide a smooth surface for the full interior of the pipe by completely filling the corrugations to a minimum thickness of 1/8 inch above the crests. The interior lining shall be applied by centrifugal or other methods resulting in the specified product.

The interior shall be free from sags or runs, but slight residual corrugations due to cooling shrinkage of the lining will not be cause for rejection. At the three-sheet laps, an interior nonuniformity equal to the thickness of the sheet is allowable. The thickness of the lining shall be maintained to the ends of the pipe.

The thickness of the lining over the crest of the corrugation shall not vary by an amount in excess of 1/2 inch total over the entire area of the spun lining.

In the case of helical corrugated pipe manufactured with a continuous lock seam, an interior nonuniformity over the lock seam equal to the thickness of two culvert sheets is allowable.

9-05.7(2)E COUPLING BANDS

Coupling bands shall be flange bands or corrugated bands as shown on the Drawings, WSDOT Standard Plan no. B-13 Type D or as specified in the Contract, and shall be fabricated of the same material as the pipe and with the same metallic protective treatment as the pipe. The corrugated bands shall conform to the pipe and shall meet all applicable requirements of AASHTO M36 except that coupling bands for all sizes of steel pipe arch with 3 inch x 1 inch corrugations shall be 24 inches wide. Bands having projections in lieu of corrugations will not be allowed.

Steel bolts and nuts for coupling bands shall meet the requirements of ASTM A307 and shall be galvanized in accordance with ASTM A153.

Steel angles, when required for coupling bands, shall meet the requirements of AASHTO M36.

Asphalt coating shall not be used on coupling bands.

Coupling bands meeting the requirements of Section 9-05.7(4)B will also be acceptable.

Coupling bands and pipe shall be made by the same Material Person.

9-05.7(2)F STEEL CULVERT PIPE ARCH

Steel pipe arch shall meet the requirements for steel pipe and pipe arch of these Specifications except in the method of fabrication. Circular pipe shall be fabricated in two semi-circles, and the pipe arch shall 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 shall 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, shall be provided to hold the segments firmly together.

Individual plates shall 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 shall be coated with one of the treatments as provided in Section 7-02.3(1)C3a.

9-05.7(2)G STEEL END SECTIONS

9-05.7(2)G1 GENERAL

The applicable provisions of AASHTO M36 shall apply to the construction of steel end sections, except that the end sections shall be fabricated of the same material with the same metallic protective treatment as the pipe.

Asphalt coating shall not be used on steel end sections.

9-05.7(2)G2 FABRICATION

The shape, thickness, dimensions, and number of pieces shall conform to WSDOT Standard Plan no. B-9 for the size and shape of pipe shown on the Drawings. They shall be manufactured as integral units or so formed that they can be readily assembled and erected in place. When bolts are used for assembly, they shall be 3/8 inch diameter or larger and shall be galvanized. No field welding or riveting will be permitted.

9-05.7(2)G3 GALVANIZED HARDWARE

Bolts, nuts, and miscellaneous hardware shall be galvanized in accordance with the provisions of AASHTO M232.

9-05.7(2)G4 TOE PLATE EXTENSIONS

Toe plate extensions shall be furnished only when so specified in the Contract. When required, the toe plate extensions shall 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 shall be the same material and thickness as the end section and shall be fabricated of the same material with the same metallic protective treatment as the end section.

9-05.7(3) STEEL SPIRAL RIB DRAIN PIPE

9-05.7(3)A GENERAL

See Section 7-16.2 for restrictions on the use of corrugated metal pipe.

Steel spiral rib drain pipe shall meet the requirements of AASHTO M36 and these Specifications. The size, coating, metal and protective treatment shall be as specified in the Contract.

The Material Person of spiral rib drain pipe shall 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 shall be furnished with pipe ends cut perpendicular to the longitudinal axis of the pipe and shall be cut evenly. Spiral rib pipe shall 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 shall have helical ribs that project outwardly, shall be formed from a single thickness of material, and shall conform to one of the following configurations:

1. AASHTO M36, Section 7.2.2.
2. 0.375 inch, $\pm 1/8$ inch wide by 0.4375 inch (minimum) deep at 4.80 inch center to center.
3. 3/4 inch wide by 5/8 inch deep at 12 inch center to center.

Pipe shall be fabricated with ends that can be acceptably jointed with coupling bands.

When required, spiral rib pipe shall be bituminous treated or paved. The bituminous treatment for spiral rib pipe shall conform to the requirements of Sections 7-02.3(1)C3a and 9-05.7(2)C.

9-05.7(3)B CONTINUOUS LOCK SEAM PIPE

9-05.7(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 shall be formed in the flat between ribs and shall conform to Sections 7.5.1 through 7.5.3 of AASHTO M36.

For narrow pitch spiral rib pipe, the lap width specified in AASHTO M 36, Section 7.5.1 shall be 1/4 inch.

For use in applications without bituminous treatment, the continuous lockseam shall require prior acceptance by qualification testing conducted by the Engineer. The Contractor shall provide the Engineer at least 3 Working Days advance notice to arrange for this testing.

9-05.7(3)B2 BASIS FOR ACCEPTANCE

The basis for acceptance will be a qualification test conducted by the Engineer for each Material Person 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 shall be sampled and tested in accordance with AASHTO T249 and a Manufacturer's Certificate of Compliance shall be submitted to the Engineer indicating compliance of the pipe with these Specifications.

9-05.7(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 shall be so controlled that the combined width of the weld and adjacent spelter coating burned by the welding does not exceed three times the thickness of the metal. If spelter is burned outside these limits, the weld and burned spelter shall be acceptably repaired for damaged galvanizing. Testing for welded seam quality control shall conform to AASHTO T241. Welded pipe fabricated from aluminized steel pipe shall 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 shall be thoroughly cleaned by wire brushing and all traces of the welding flux and loose or cracked galvanizing removed, after which the areas shall be repaired by flame spray metallizing both inside and out.

9-05.7(3)D COUPLING BANDS

Coupling bands shall be of the same material as the pipe. Coupling bands and gaskets shall conform to Section 9-05.7(4)B.

9-05.7(4) STEEL PIPE FOR SEWERS

9-05.7(4)A GENERAL

See Section 7-16.2 for restrictions on the use of corrugated metal pipe.

Steel pipe shall conform to the requirements of Section 9-05.7(2) for steel Culvert pipe, except that protective coating shall be Treatment 5 as specified in Section 7-02.3(1)C3a, and shall be constructed of either helically corrugated lock seam or helically corrugated continuous welded steel pipe. When gasketed helically corrugated lock seam steel pipe is called for, Treatment 5 is not required. Welded seam aluminum coated (aluminized) steel pipe shall require metallized aluminum coating inside and out following welding and shall not require Treatment 5.

9-05.7(4)B COUPLING BANDS

Coupling bands for steel pipe shall conform to the details shown in WSDOT Standard Plan no. B-13 Type D and to these Specifications, unless the Contract specifies otherwise.

Bands shall be made of the same base metal as the pipe. Band thickness shall not be thicker than 0.109 inch and may be two nominal thicknesses lighter than used for the pipe but in no case shall be not thinner than 0.64 inch. Corrugations on the bands shall be the same size and shape as those on the pipe to be connected. Steel bolts and nuts shall meet the requirements of ASTM A307, and galvanized in accordance with AASHTO M232. Welds shall develop the full strength of the parent metal.

Type F bands may be used as an alternate to all other band types shown for steel pipe sizes 12 inch to 84 inch diameter inclusive, provided that two annular corrugations are formed on each pipe end to be joined. The end corrugation shall be 2 inch x 1/2 inch and the inside adjacent corrugation shall be 2-2/3 inch x 1/2 inch.

When annular corrugated bands are used to connect lock-seam helically corrugated pipes, the seam shall be welded at the pipe ends prior to recorrugating to prevent unraveling of the seam.

Coupling bands and steel pipe shall be made by the same Material Person.

9-05.7(4)C BASIS FOR ACCEPTANCE

The basis for acceptance of steel pipe will be the same as specified in Section 9-05.0, except when gasketed helically corrugated lock seam steel pipe is called for. A qualification test conducted by the Materials Laboratory will be required for each manufacturer of gasketed helically corrugated lock seam steel pipe. Only those specific pipe sizes and gasket materials approved under the qualification test will be accepted.

9-05.7(5) STEEL PIPE FOR DETENTION

See Section 7-16.2 for restrictions on the use of corrugated metal pipe.

Steel detention pipe shall be galvanized helical or annular corrugated steel pipe, meeting the requirements of AASHTO M 36, Type 1, asphalt coated to requirements of AASHTO M 190, Type A with the gauge as indicated in the Contract. The end plate and all end plate reinforcement shall be structural steel plate of the type and thickness as designated in the Contract. Coupling bands for steel detention pipes shall be Type "D" per WSDOT Standard Plan no. B-13 unless the Contract specifies otherwise.

9-05.8 STRUCTURAL PLATES

9-05.8(1) STRUCTURAL PLATE PIPE, PIPE ARCH, ARCH, AND UNDERPASS

9-05.8(1)A GENERAL

See Section 7-16.2 for restrictions on the use of corrugated metal pipe.

Structural plate pipes shall be full circle of the type, gage or thickness, and diameter specified.

Structural plate pipe arches shall be a multi-centered shape, made up of four circular arcs tangent to each other at their junctions and symmetrical about the vertical axis, and of the type, gauge or thickness, and span specified in the Contract.

Structural plate arches shall be a single-centered circular arc shape placed on a reinforced concrete foundation, and of the design, type, gage or thickness, and span specified in the Contract.

Structural plate underpasses shall be a multi-centered shape, made up of a variable number of circular arcs tangent to each other at their junctions and symmetrical about the vertical axis, and of the design, type, gage or thickness, and span specified in the Contract.

9-05.8(1)B FABRICATION

The plates at longitudinal and circumferential seams shall be connected by bolts; the bolt holes shall be staggered in rows 2 inches apart, one hole being punched in the valley and one in the crest of each corrugation along both edges of each plate. Bolt holes on circumferential seams shall be spaced at approximate 12 inch intervals. No hole shall be closer to the edge of the plate than twice the diameter of the bolt.

The ends of structural plate pipes, pipe arches, arches, or underpasses shall not be mitered unless specified in the Contract. If mitered ends are specified, the slope shall conform to the slope of the embankment in which the Culvert is to be placed. The miter on pipe arches shall be limited to the top arc only.

9-05.8(1)C ELLIPTICAL FABRICATION

When elongated structural plate pipes are specified in the Contract, they shall be fabricated 5 percent out of round to form an elliptical cross section. The vertical axis (the longer axis of the elliptical section) shall be clearly marked on the plates before shipping.

9-05.8(1)D STRUCTURAL PLATE PIPE ARCH

Plates for structural plate pipe arches shall be formed so that the top shall be an arc of not more than 180 degrees nor less than 155 degrees; the bottom shall be an arc of not more than 50 degrees nor less than 10 degrees; and the top shall be joined at each end to the bottom by an arc having a radius between 18 and 31 inches and of not more than 87-1/2 degrees nor less than 75 degrees.

9-05.8(1)E STRUCTURAL PLATE ARCH

Structural plate arches and their foundations shall be as specified in the Contract.

9-05.8(1)F STRUCTURAL PLATE UNDERPASS

Structural plate underpasses shall be as specified in WSDOT Standard Plan nos. B-8 and B-8a, or, unless a special design is specified in the Contract.

9-05.8(1)G CONCRETE FOR STRUCTURAL PLATE AND ARCH FOUNDATION

Concrete required for constructing structural plate arch foundations shall be Class 3000 concrete in conformance with the requirements of Section 6-02.3.

Steel reinforcing bars shall conform to the requirements of Section 9-07.

9-05.8(1)H PLATES

9-05.8(1)H1 CORRUGATED STEEL PLATES

Galvanized corrugated steel plates for constructing structural plate pipe, pipe arches, arches, and underpasses, and nuts and bolts used in their assembly shall conform to the requirements of AASHTO M167 except that the minimum mass of spelter coating on the plates shall be 3 ounces of zinc per square foot of double exposed surface. The Engineer will find a lot unacceptable and will reject the lot if the average spelter coating as determined from any 3 samples of a lot is less than 3.0 ounce or if any one sample is less than 2.7 ounce. Nuts, bolts, and miscellaneous hardware shall be galvanized in accordance with AASHTO M232.

See Section 7-16.2 for restrictions on the use of corrugated metal pipe.

9-05.8(1)H2 CORRUGATED ALUMINUM PLATES

Aluminum alloy plates and fasteners intended for use in the construction of structural plate pipe, pipe arches, arches, and underpasses shall conform to the requirements of AASHTO M219. Nuts, bolts, and miscellaneous hardware shall be galvanized in accordance with AASHTO M232.

See Section 7-16.2 for restrictions on the use of corrugated metal pipe.

9-05.9 PIPE COATINGS

9-05.9(1) ZINC COATED (GALVANIZED) OR ALUMINUM COATED (ALUMINIZED) CORRUGATED IRON OR STEEL DRAIN PIPE

9-05.9(1)A GENERAL

Zinc coated (galvanized) or aluminum coated (aluminized) corrugated iron or steel drain pipe shall meet the requirements of AASHTO M36. The galvanized or aluminized sheet thickness shall 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 (aluminized) 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 zinc coated (galvanized) or aluminum coated (aluminized) corrugated iron or steel drain pipe shall meet the requirements of coupling bands for Type I pipe of AASHTO M36, except that bands using projections (dimples) shall not be permitted. The bands shall 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 shall 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, be of the same material and corrugations as the pipe, and meet the requirements of Section 9-05.7(2)E.

9-05.9(2) ZINC COATED (GALVANIZED) OR ALUMINUM COATED (ALUMINIZED) CORRUGATED IRON OR STEEL SUBSURFACE DRAIN PIPE

9-05.9(2)A GENERAL

Zinc coated (galvanized) or aluminum coated (aluminized) corrugated iron or steel subsurface drain pipe shall meet the requirements of AASHTO M36, 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 requirements meet Specifications. Welded seam aluminum coated (aluminized) 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 M36, and perforations in Class I, Class II, and Class III pipe may be drilled or punched. The galvanized or aluminized sheet thickness shall 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 zinc coated (galvanized) or aluminum coated (aluminized) corrugated iron or steel subsurface drain pipe shall meet the requirements of coupling bands for Type III pipe of AASHTO M36. The bands shall 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 requirements of Section 9-05.7(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 (ETHAFOAM)

Polyethylene plastic foam used in underground utility separation shall meet the Federal Specification PPP-C-1752C Type 1, Class 2, (Ethafom).

9-05.11 ABS COMPOSITE PIPE

ABS (acrylonitrile butadiene styrene) material shall not be used unless specified in the Contract or permitted by the Engineer.

ABS composite pipe shall meet the requirements of AASHTO M 264.

ABS composite pipe shall be provided with Type OR (flexible gasketed) joints. Rubber gasketed joints shall conform to applicable provisions of ASTM C 443.

Fittings for ABS composite pipe shall be specifically designed for connection to ABS composite pipe with solvent cement. Normally, all fittings shall 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 advance approval of the Engineer. Fittings shall 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 shall conform to the requirements of ASTM A53, Grade B. Steel tubing used as safety bars shall conform to ASTM A500, Grade B. Steel plate shall conform to ASTM A36. All parts shall be galvanized after fabrication in accordance with AASHTO M111.

9-05.13 FLOW CONTROL STRUCTURE

See Section 7-16.2 for restrictions on the use of corrugated metal pipe.

The flow control Structure shall be made from a standard manhole section as shown on Standard Plan no. 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 shall be as shown on Standard Plan no. 264, and the precast slab shall be as shown on Standard Plan nos. 243a and 243b with opening details to fit the diameter of the chamber. In all other cases, standard ring and cover (see Standard Plan no. 230) shall be used with a precast slab conforming to 200 Series Standard with a 24 inch round opening. Manhole sections, castings and slabs shall meet the requirements of Section 7-05.

The flow control device and connection shall 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 shall be the same as the diameter of the outlet pipe as indicated in the Contract. The PVC pipe used for the cross and connection shall comply with ASTM D 1785, Schedule 40. The PVC material used for the orifice plate and the shear gate shall be plate material in compliance with ASTM D 1784, PVC Class 12454-B. The orifice plate material shall be 1/4 inch thick and the shear gate material shall be 1/2 inch thick. The shear gate pin shall be of the same PVC material as the shear gate. The sheargate chain shall be 12 gauge galvanized steel straight link chain permanently attached to the Structure.

9-05.14 GALVANIZED IRON PIPE

Galvanized iron pipe 4 inch diameter and smaller shall be ASTM A 53 schedule 40 pipe.

9-05.15 CEMENT SLURRY - ABANDONING PIPE AND FILLING ANNULAR SPACE BETWEEN 2 PIPES

Cement slurry used to fill the annular space between an inner and outer pipe shall be pumpable, flowable, and shall completely fill the annular space. Materials shall have the following properties:

Material Reference	Material Property
Cement, ASTM C 150	Type I / II
Slurry Density, ASTM C 138	65 pcf (minimum)
Foamed Slurry Density, ASTM C 138	45 pcf (minimum)
Water / Cement Ratio	0.90 (maximum)
Flow, ASTM C 939	18 seconds (maximum)
Shrinkage, ASTM C 827	non-shrink
Bleeding, ASTM C 232	no bleed
Set Time, ASTM C 403	3 - 6 hours ¹
Compressive strength	
ASTM C 403 @ 24 hours	75 psi (minimum)
ASTM C 495 @ 7 Days	150 psi (minimum)
ASTM C 495 @ 28 Days	250 psi (minimum)

¹Set time depends on temperature and site conditions.

9-05.16 SIDE SEWER AND SERVICE DRAIN

Sanitary side sewer Material shall be in accordance with the Joint Ruling DPD Director's Rule 2-2006 and SPU Director's Rule 01-06 "Requirements for Design and Construction of Side Sewers (Wastewater Discharges)".

Service drain side Sewer Material shall be in accordance with the Joint Ruling DPD Director's Rule 3-2006 and SPU Director's Rule 02-06 "Requirements for Design and Construction of Service Drains (Drainage Water Discharges)".

SECTION 9-06 STRUCTURAL STEEL AND RELATED MATERIALS**9-06.1 STRUCTURAL CARBON STEEL**

Structural carbon steel shall conform to the requirements of AASHTO M270, 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 shall conform to the requirements of AASHTO M270, Grades 50 or 50W as specified in the Contract, unless the Contract specifies AASHTO M 223 or AASHTO M222.

9-06.3 STRUCTURAL HIGH STRENGTH STEEL

Structural high strength steel shall be high yield strength, quenched and tempered structural steel conforming to the requirements of AASHTO M270, Grades 70W, 100, or 100W as called out in the Contract, unless the Contract specifies AASHTO M 244.

9-06.4 RESERVED**9-06.5 BOLTS****9-06.5(1) UNFINISHED BOLTS**

Unfinished bolts (ordinary machine bolts) shall conform to the specification requirements of ASTM A 307, Grade A or B. Nuts shall comply with ASTM A563, Grade A requirements. Washers, unless otherwise specified in the Contract, shall meet ASTM F 844 specifications.

The Contractor shall submit a Manufacturer's Certificate of Compliance for the bolts, nuts, and washers prior to installing any of them.

9-06.5(2) RESERVED**9-06.5(3) HIGH STRENGTH BOLTS**

High strength bolts for structural steel joints shall conform to the requirements of AASHTO M164 or AASHTO M253, Type 1, Type 2, or Type 3.

Bolts conforming to AASHTO M164 that are galvanized in accordance with AASHTO M232 shall be tested for embrittlement after galvanization. Test for embrittlement shall be in accordance with ASTM F606, Section 7. Bolts conforming to AASHTO M253 shall not be galvanized. AASHTO M253 Type 1 and Type 2 bolts shall be painted with two coats of zinc rich paint, formula A-9-73, consisting of a minimum dry film thickness of 2 mils per coat.

Unpainted and nongalvanized bolts shall conform to AASHTO M164 and AASHTO M 253, Type 3.

Nuts for high strength bolts shall meet the following requirements:

Bolt Type	Requirement
AASHTO M164 Bolts	
Black Type 1	AASHTO M291 Grade C, C3, HD, DH3
AASHTO M292 Grade 2H	
Black weathering Type 3	AASHTO M291 Grade C3 and DH3
Galvanized Type 1	AASHTO M291 Grade DH AASHTO M292 Grade 2H
AASHTO M253 Bolts	
Black Type 1 and 2	AASHTO M291 Grade DH, DH3 AASHTO M292 Grade 2H
Black weathering Type 3	AASHTO M291 Grade DH3

Nuts that are to be galvanized shall be tapped oversized the minimum required for proper assembly. The amount of overlap shall be such that the nut assembles freely on the bolt in the coated condition and shall meet the mechanical requirements of AASHTO M291 and the rotational capacity test specified in AASHTO M164. The overlapping requirements of AASHTO M291 Section 7.4 shall be considered maximum values.

Galvanized nuts shall be lubricated in accordance with AASHTO M291 including supplementary requirement S2. Documentation shall include the name, method of application, and dilution of the lubricant applied to the nuts.

Washers for AASHTO M164, Type 1 and Type 3 bolts, and AASHTO M253, Type 1, Type 2, and Type 3 bolts shall meet the requirements of AASHTO M293. The surface condition and weathering characteristics of the washers shall be the same as for the bolts being specified.

Direct Tension Indicators shall conform to the requirements of ASTM F959 and may be used with either AASHTO M164 or AASHTO M 253 bolts. Direct tension indicators shall be galvanized by mechanical deposition in accordance with AASHTO M298, Class 55. Hot dip galvanizing will not be allowed.

All bolts, nuts, and direct tension indicators shall be marked and identified as required in the pertinent Specifications.

Lock-pin and collar fasteners which meet the materials, manufacturing, and chemical composition requirements of AASHTO M164 or AASHTO M253, and which meet the mechanical property requirements of the same 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 shall submit a detailed installation procedure to the Engineer for approval. Should approval to use a lock-pin and collar fastener be given by the Engineer, it will be given prior to use on these types of fasteners.

The Contractor shall provide Manufacturer's Certificate of Compliance for all bolts, nuts, washers, and load indicators. The Manufacturer's Certificate of Compliance shall include certified mill test reports and test reports performed on the finished bolt confirming that all of the Materials provided meet the requirements of the applicable AASHTO or ASTM specification. See Section for testing and reporting requirements. The test report shall also include the date of testing, the lot identification of the bolts and nuts, and coating thickness for galvanized bolts and nuts. Shipping containers (not lids) shall be marked with the lot identification of the item contained therein.

Bolts shall be sampled prior to incorporating into a Structure. For the purposes of selecting samples, a lot of bolts shall 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 shall be as follows:

Lot Size	Sample Size ^{1,2}
0 to 50	Note 3
51 to 150	4
151 to 1,200	6
1,201 to 10,000	10
10,001 to 35,000	16
35,001 and over	24

- Notes**
1. 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 shall 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 shall be performed on specimens as they are to be installed.

All samples shall include a Manufacturer's Certificate of Compliance for each lot of bolts provided as defined in Section 1-06.3.

9-06.5(4) ANCHOR BOLTS

Anchor bolts shall meet the requirements of ASTM A449. Galvanized anchor bolts shall be tested for embrittlement after galvanization in accordance with ASTM A143. For galvanized anchor bolts with a length less than five times the nominal bolt diameter, the bolts shall be tested for embrittlement in accordance with ASTM F 606, Section 7.

Nuts for ASTM A 449 black anchor bolts shall conform to AASHTO M291, Grade C. Nuts for ASTM A 449 galvanized bolts shall conform to AASHTO M291, Grade DH and shall conform to the lubrication requirements of Section 9-06.5(3). Nuts for AASHTO M164 black anchor bolts shall conform to AASHTO M291, Grade C, C3, DH, and DH3 or AASHTO M292, Grade 2H. Nuts for AASHTO M164 galvanized anchor bolts shall conform to AASHTO M291, Grade DH or AASHTO M292, Grade 2H. Washers for ASTM A449 anchor bolts shall conform to AASHTO M293. Washers for AASHTO M 164 anchor bolts shall conform to ASTM F 436.

The bolts shall be tested by the manufacturer in accordance with the requirements of the pertinent specification and as specified in these Specifications. Anchor bolts, nuts, and washers shall be inspected prior to shipping to the Project Site. The Contractor shall 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. If the Engineer deems it appropriate, the Contractor shall provide a sample of the anchor bolt, nut, and washer for testing.

All bolts, nuts, and washers shall be marked and identified as required in the pertinent specification.

9-06.6 RESERVED

9-06.7 RESERVED

9-06.8 STEEL CASTINGS

Steel castings shall conform to the requirements of AASHTO M 103, Mild to Medium Strength Carbon-Steel Castings for General Application, grade 70-36, unless otherwise designated in the Contract.

9-06.9 GRAY IRON CASTINGS

Gray iron castings shall conform to the requirements of AASHTO M105. The class of castings to be furnished shall be as designated in the Contract.

9-06.10 MALLEABLE IRON CASTINGS

Malleable iron castings shall conform to the requirements of ASTM A47.

9-06.11 STEEL FORGINGS AND STEEL SHAFTING

Steel forgings shall conform to the requirements of AASHTO M102. The classes of forgings to be furnished shall be those specified in the Contract.

Steel shafting shall conform to the requirements of AASHTO M169, Grade Designation 1016 to 1030 inclusive, unless otherwise specified in the Contract.

9-06.12 BRONZE CASTINGS

Bronze castings shall conform to the requirements of AASHTO M 107, Bronze Castings for Bridges and Turntables.

9-06.13 COPPER SEALS

Copper sheets for seals shall conform to the requirements of AASHTO M138. They shall be UNS C12500, light cold rolled, and furnished in flat sheets each not less than 0.018 inch in thickness.

All splices or joints shall be carefully brazed or soldered to produce a continuous watertight seal for the full length of each unit.

9-06.14 DUCTILE IRON CASTINGS

Ductile iron castings shall conform to the requirements of ASTM A536, Grade 80-55-06, unless otherwise specified in the Contract.

9-06.15 WELDED SHEAR CONNECTORS

Welded shear studs shall be made from cold drawn bar stock conforming to the requirements of AASHTO M169, Grades 1010 through 1020, inclusive, either semi-killed or killed deoxidation.

The Material shall conform to the following mechanical properties:

Tensile Strength	60,000 psi min.
Yield Strength	50,000 psi min.
Elongation	20% min.
Reduction of Area	50% min.

Mechanical properties shall be determined in accordance with AASHTO Methods and Definitions T 244.

At the manufacturer's option, mechanical properties of the studs shall be determined by testing either the steel after cold finishing, or the full diameter finished studs.

9-06.16 ROADSIDE SIGN STRUCTURES

Materials in this Section apply to Division 6 Structures. See Section 9-28 for signing Materials and fabrication.

All bolts shall conform to AASHTO M164. Washers for bolts shall be per AASHTO M 293.

Posts for single post sign structures shall meet the requirements of ASTM A 500, Grade B or ASTM A53, Grade B.

Posts for multiple post sign structures shall meet the requirements of AASHTO M 183. Posts meeting the requirements of AASHTO M222 or AASHTO M223, Grade 50 may be used as an acceptable alternate to the AASHTO M 183 posts. All steel not otherwise specified shall conform to AASHTO M 183.

Triangular base stiffeners for one-directional multi-post sign posts shall meet the requirements of AASHTO M222 or AASHTO M223, Grade 50.

Base connectors for multiple directional steel breakaway posts shall conform to the following:

Bracket	Aluminum Alloy 6061 T-6
Bosses for Type 2B Brackets	ASTM A582
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 shall have a tensile breaking strength range as follows:

Type 2A	17,000 to 21,000 lb.
Type 2B	47,000 to 57,000 lb.

For multi-directional breakaway base connectors, shims shall be fabricated from pregalvanized sheet steel. For one-directional breakaway base connectors, single post or multi-post, shims shall be fabricated from brass conforming to ASTM B 36.

9-06.17 RESERVED**9-06.18 METAL BRIDGE RAILING**

Metal bridge railing shall 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 shall be in accordance with Section 6.9 of the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, Fourth Edition-2001.

9-06.19 RESERVED

9-06.20 RESERVED

9-06.21 RESERVED

9-06.22 BOLTS, WASHERS, AND OTHER HARDWARE

Ordinary machine bolts and flat head bolts shall be made from commercial bolt stock meeting the specifications of ASTM A307, and shall 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 shall 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 shall be in accordance with AASHTO M232.

Split rings for log cribbing of 4 inches inside diameter shall be manufactured from hot rolled, low-carbon steel conforming to ASTM A711 AISI, Grade 1015. Each ring shall 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 shall be 0.195 inch plus or minus 0.010 inch and the section shall be beveled from the central portion toward the edges to a thickness of 0.145 inch plus or minus 0.010 inch. It shall be cut through in one place in its circumference to form a tongue and slot. Split ring connectors shall be galvanized in accordance with AASHTO M232.

Spike-grid timber connectors shall be manufactured according to ASTM A47 for malleable iron castings. They shall 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.

Nails shall be round wire of standard form. Spikes shall be wire spikes or boat spikes, as specified on the Drawings. Bolts, dowels, washers, and other hardware, including nails, shall be black or galvanized as specified on the Drawings, but if not so specified shall be galvanized when used in treated timber Structures.

SECTION 9-07 REINFORCING STEEL

9-07.1 GENERAL

Deformed steel bar shall be free from loose mill scale, dirt, grease, or other defects affecting the strength of bond with concrete. Deformed steel bar coated with rust shall be vigorously wire brushed clean. Size numbers shall be taken to represent the diameter of the bar in 1/8 inch units, except where standard wire gauge sizes are indicated 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(2) BENDING

Steel reinforcing bars shall be cut and bent by careful and competent workmen. They shall be bent cold to templates, which shall not vary appreciably from the shape and dimension shown on the Drawings.

Hooks and bends of steel reinforcing bars shall 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 requirements of AASHTO M31 for bend tests shall apply to size No. 14 and No. 18 steel reinforcing bars which have hooks or bends.

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.

The following bend deductions per 90 degrees bend have been subtracted from the gross length:

Bar Size	Stirrups and Ties	All Other Bars
No. 3	3/4"	1"
No. 4	1"	1-1/4"
No. 5	1-1/4"	1-1/2"
No. 6	1-7/8"	1-7/8"
No. 7	2-1/4"	2-1/4"
No. 8	2-1/2"	2-1/2"
No. 9	---	3-3/8"
No. 10	---	3-3/4"
No. 11	---	4-1/8"
No. 14	---	5-3/4"
No. 18	---	7-5/8"

For bends other than 90 degrees, a direct proportion of these deductions will be used. The following bend deductions will apply, except where bending radii are shown on the Drawings.

For standard hooks on the ends of bars, the following hook lengths, in addition to the out to out detailed dimension, have been provided:

Bar Size	Length Added for One Hook				
	180° Hook	135° Hook		90° Hook	
	All Bars	Seismic Ties	All Other Bars	Stirrup and Ties	All Other Bars
No. 3	5-1/8"	4-7/8"	3-5/8"	2-7/8"	5-1/8"
No. 4	6"	6-1/2"	4-1/2"	3-1/2"	6-3/4"
No. 5	6-7/8"	8"	5-3/8"	4-3/8"	8-1/2"
No. 6	8-1/4"	10-3/4"	7-3/4"	10-1/8"	10-1/8"
No. 7	9-5/8"	1' 0-1/2"	9"	11-7/8"	11-7/8"
No. 8	11"	1' 2-1/4"	10-1/4"	1' 1-1/2"	1' 1-1/2"
No. 9	1' 2-7/8"	---	---	---	1' 3-7/8"
No. 10	1' 4-5/8"	---	---	---	1' 5-7/8"
No. 11	1' 6-1/2"	---	---	---	1' 7-7/8"
No. 14	2' 1-7/8"	---	---	---	2' 0-3/4"
No. 18	2' 10-1/2"	---	---	---	2' 9-1/8"

9-07.1(4) INSPECTION

Before rolling work begins, the Contractor shall provide enough advance notice that the Engineer may arrange to inspect it. The Contractor shall inform the Engineer of who shall do the work and where it shall be done. No Material shall be rolled until the Engineer gives written notice to proceed.

9-07.2 DEFORMED STEEL BARS

Deformed steel bars for concrete reinforcement shall conform to the requirements of AASHTO M31, Deformed and Plain Billet Steel Bars for Concrete Reinforcement, Grade 60, or ASTM A706, Low-Alloy Steel, Deformed Bars for Concrete Reinforcement. 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 shall be used in calculating the yield stress; the nominal area of the bar, as given in Table 1 of AASHTO M31 or ASTM A706, shall be used in this computation.

Deformed steel bars are referred to in the Contract by number: for example, No. 3, No. 4, No. 5, etc.

9-07.3 EPOXY-COATED STEEL REINFORCING BARS

Epoxy-coated rebar shall be coated according to AASHTO M284 with the additional following modifications:

1. The list of steel reinforcing bars acceptable for coating shall include ASTM A706.
2. The Contractor shall furnish a Manufacturer's Certificate of Compliance 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 meets the requirements of AASHTO M284.
3. The Contractor shall supply to the Engineer an 8 ounce representative sample of the coating material from each batch of coating material. The sample shall be packaged in an airtight container and identified as epoxy coating material by batch number.
4. Prior to coating the bars, the Contractor shall submit to the Engineer for review, the coating material manufacturer's recommendation on the proper use and application requirements of the coating material.
5. A Manufacturer's Certificate of Compliance stating that all bars have been coated in accordance with the coating material manufacturer's recommendations and these Specifications shall be furnished with each

shipment. This certification shall include for each bar size the preheat temperatures, cure times, thickness checks, holidays detected, and test results. Two copies of these certifications shall be furnished to the Engineer.

6. The Contractor shall give advance notice to the Engineer of the coating schedule at the coating plant so that Engineer inspection for approval may be provided.
7. The patching material, compatible with the coating material and inert in concrete, shall be supplied to the purchaser.
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 shall not exceed 0.25 percent of the surface area of each bar.
9. The thickness of epoxy-coating shall be 10 mils \pm 2 mils.
10. All samples shall be submitted to the SPU Materials Laboratory (see Section 1-05.3(3)).

9-07.4 PLAIN STEEL BARS

Where plain steel bars are specified, they shall conform to the chemical and physical properties of AASHTO M31, Grade 60, unless specifically noted otherwise. Plain steel bars are indicated in the Contract by fractions of an inch; for example, 3/8 inch \emptyset , 1/2 inch \emptyset , 5/8 inch \emptyset , etc.

9-07.5 DOWEL BARS (FOR CEMENT CONCRETE PAVEMENT)

Dowel bars shall be plain steel bars of the dimensions shown in the Standard. They shall conform to AASHTO M31, Grade 60 or AASHTO M255, Grade 60, and shall be coated in accordance with AASHTO M284. The ends of the bars shall be coated to a minimum of 4 mils. In addition, the requirements of Section 9-07.3, items 2, 3, 4, 5, 6, 7, and 10 shall apply.

9-07.6 TIE BARS (FOR CEMENT CONCRETE PAVEMENT)

Tie bars shall conform to the requirements of the Standard Specifications for Deformed Billet-Steel Bars for Concrete Reinforcement, AASHTO M31, Grade 40 and shall be coated in accordance with AASHTO M284. Deformed bar shall be 5/8 inch diameter and 30 inch long.

The form of the deformed bar shall be subject to approval by the Engineer.

Tie bars shall be free from dirt, grease, or other defects affecting the strength or bond with the concrete. Tie bars shall be epoxy encapsulated.

9-07.7 WIRE MESH

Wire mesh for concrete reinforcement shall conform to the requirements of AASHTO M55, Welded Steel Wire Fabric for Concrete Reinforcement or AASHTO M221, Welded Deformed Steel Wire Fabric for Concrete Reinforcement. All wire mesh shall be of an approved kind and quality of manufacture.

9-07.8 DEFORMED WIRE

Deformed wire shall conform to the requirements of AASHTO M225, 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, D20, etc.

9-07.9 COLD DRAWN WIRE

Cold drawn wire shall conform to the requirements of AASHTO M32, 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, W20, etc.

9-07.10 PRESTRESSING REINFORCEMENT

Prestressing reinforcement shall be 1/2 inch diameter for prestressed concrete girders or precast-prestressed concrete piles and 1/2 inch or 0.6 inch diameter for cast-in-place prestressed concrete.

Prestressing reinforcement shall be mill bright high-tensile-strength seven wire low-relaxation strand conforming to the requirements of AASHTO M203, Grade 270.

Prestressing reinforcement shall not be coupled or spliced.

All prestressing reinforcement furnished for a given structural member shall 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 shall be accompanied by a Manufacturer's Certificate of Compliance, a mill certificate, and a test report. The mill certificate and test report shall include the chemical composition, 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 shall be based on test values and actual sectional areas of the material being certified.

For each reel furnished, a sample, not less than 5 feet long, shall be sent to the SPU Materials Laboratory for testing. See Section 1-05.3(3).

SECTION 9-08 PAINTS

9-08.1 RAW MATERIALS

The acceptance of particular lots of raw materials shall in no way obligate the Engineer to accept lots of finished paint that do not conform to the requirements of these Specifications. When not specifically detailed, the raw Materials shall meet the requirements of the applicable Federal Specification in effect at the time of manufacture. Products not covered by State or Federal Specifications shall be of top quality, meeting prevailing commercial standards. Raw Materials for paints shall conform to the requirements of the Specifications as follows:

- Alkyd resin solution, Federal TT-R-266, Type I or Type II.
- Aluminum paste, ASTM D 962, Type 2, Class B. Paints made with the paste shall be smooth and highly lustrous.
- Anti-skinning agent shall have no deleterious effect on the drying time of the finished paint. It shall effectively prevent skinning when added in the amounts specified in each formula and tested in accordance with Federal Test Std. No. 141a, Method 3021.
- Aromatic petroleum thinner - water white low aniline petroleum solvent Kauri-Butanol value70 (min.).
- Barium sulfate pigment, ASTM D 602.
- Chrome oxide green, ASTM D263. The tinting properties shall be such that the standard color of the formulas using chrome oxide green can be produced without departing from the limits of composition given in those formulas.
- Chrome yellow pigment and paste, ASTM D 211, Type III.
- Fibrous magnesium silicate (talc), ASTM D 605.
- Lampblack pigment and paste, ASTM D 209.
- Liquid drier, ASTM D 600.
- Mineral spirits, ASTM D 235.
- Raw linseed oil, ASTM D 234.
- Red iron oxide pigment, ASTM D 3721, ASTM D 3722 & ASTM D 3724.
- Silica shall be finely ground amorphous or crystalline material. It shall have a maximum oil absorption of 50 when tested in accordance with ASTM D 281.
- Soya lecithin shall be pure.
- Spar varnish, Federal TT-V-119.
- Titanium pigments, ASTM D 476. Titanium dioxide for use in exterior white paints shall conform to Type II. Titanium pigments used in tinted paints and enamels shall be exterior chalk resistant, Type III.
- Turpentine shall be gum spirits of turpentine, ASTM D 13.
- Yellow iron oxide, hydrated, ASTM D 768.
- Zinc oxide pigment and paste, ASTM D 79.
- Zinc yellow (zinc chromate), ASTM D 478.
- Raw materials not specifically covered shall meet current Federal Specifications for said material.

9-08.2 PAINT FORMULAS - GENERAL

All paints shall be made from materials meeting the requirements specified in Section 9-08.1. The paint shall be made in accordance with the following formulas and shall meet the requirements set forth as well as the special requirements set forth for each formula. The formulas are stated in terms of dry pigment. Each formula shall contain the specified raw materials which shall be proportioned to give the compositions in percentages by weight or parts by weight, as shown in the formulas that follow.

1. Formula A-5-61 - Vinyl Pretreatment:

The primer shall meet the requirements of Federal Specification MIL-P-15328B or MIL-P-15328C, Primer Pretreatment (Formula 117B for Metals).

Vinyl Wash Primer shall be mixed by adding 1 volume of acid component (diluent) to 4 volumes of resin component (base solution) slowly and with constant stirring. The material shall be used within 8 hours of mixing. The wash primer coat shall be spray applied to all surfaces at a coverage rate of 250 to 300 square feet per gallon to yield a dry film of 0.5 to 0.9 mils thickness. If necessary to maintain a wet spray, additional thinning with normal Butanol or 99 percent Isopropanol will be allowed. Acid component above the required amount shall not be used for thinning. A drying time of 1 hour is required before recoating.

- a. Butanol shall meet Federal Specification TT-B-846b Butyl Alcohol; Normal.
- b. Isopropanol (99 percent) shall conform to ASTM D 770 Isopropyl Alcohol.

2. Formula A-6-86 - Zinc Dust Zinc Oxide Primer:

The primer shall meet the requirements of Federal Specification TT-P-641 Primer-Paint: Zinc Dust-Zinc Oxide Type III.

3. Formula A-9-73 - Galvanizing Repair Paint, High Zinc Dust Content:

The galvanizing repair paint shall meet the requirements of Federal Specification MIL-P-21035 (Ships) Paint, High Zinc Dust Content, Galvanizing Repair.

4. Formula C-6-90 - Green Phenolic Finish Coat for Steel:

Zinc chromate (dry pigment)	13.8 parts
Chrome green oxide (dry pigment)	16.1 parts
Titanium dioxide (dry pigment)	16.7 parts
Yellow iron oxide (dry pigment)	1.3 parts
Fibrous magnesium silicate (dry pigment)	5.0 parts
Aluminum stearate (dry pigment)	0.2 parts
Spar varnish	22.1 parts
Raw linseed oil	21.4 parts
Driers	1.0 parts
Anti-skinning agent	0.1 parts
Mineral spirits	2.3 parts
Weight per gallon (minimum)	12.5 pound
Viscosity at 70°F	80 ± 8 K.U.
Grind (Minimum)	6
Set to touch	4 hours
Dry hard	18 hours
Sag Index	7 min.
Test Requirements	Prior to shipment
Viscosity Adjustment	Mineral spirits to be added at the factory to achieve the specified viscosity

The proportions of tinting pigments may be varied to achieve the desired color. The color of the paint when dry shall match the color of a standard C-6-90 color chip. Additional tinting pigments may be required.

5. Formula C-9-90 - Phenolic Finish Coat for Steel:

Zinc Oxide (dry pigment)	10.0 parts
Titanium Dioxide (dry pigment)	21.0 parts
Fibrous Magnesium Silicate (dry pigment)	3.2 parts
Barium Sulfate (dry pigment)	12.8 parts
Tinting Pigments	5.9 parts
Treated Bentonite Clay (dry pigment)	0.2 parts
Anti-Sag Agent	1.9 parts
Raw Linseed Oil	12.6 parts
Spar Varnish	29.0 parts
Anti-Skin Agent	0.1 parts
Driers	1.0 parts
Mineral Spirits	1.8 parts
Xylene	0.5 parts
Weight per gallon (minimum)	12.3 lbs.
Viscosity	80 ± 8 K.U.
Dry Hard (maximum)	18 hours
Set to Touch (maximum)	4 hours
Grind (N.S.) (minimum)	5
Sag Index (minimum)	4
Total Solids by Weight	80 ± 5%
Test Requirements	Prior to shipment

Adjustments for tinting pigments and talc, solvents and chemical additives shall be made at the factory to achieve the desired color and physical characteristics. A fungicide, N-(Trichloromethylthio) phthalimide shall be added at the rate of 3 pounds per 100 gallons.

6. Formula C-10-83 - Vinyl Finish Coat:

Vinyl Finish Coat shall conform to the following Specifications:

- a. **Pigment (12 Percent Minimum by Weight)** - A combination of titanium dioxide and colored pigments or a combination of colored pigments such that the resultant paint when dry matches the color sample available at the SPU Materials Laboratory.
- b. **Vehicle (88 Percent Maximum by Weight).**

Vinyl Resin Type II ¹	9.1 parts
Vinyl Resin Type III ²	9.1 parts
Tricresyl Phosphate	3.4 parts
Methyl Isobutyl Ketone	39.2 parts
Toluene	<u>39.2 parts</u>
Total	100.0

¹Vinyl Resin Type II shall be hydroxyl containing vinyl chloride-acetate copolymer. It shall contain 89.5 to 91.5 percent (by weight) vinyl chloride, 2.0 to 5.5 percent vinyl acetate and 5.3 to 7.0 percent vinyl alcohol. It shall produce results in the specified formulations equal to the Bakelite Corporation Vinylite resin VAGH.

²Vinyl Resin Type III shall be a vinyl chloride-acetate co-polymer of medium average molecular weight and shall contain 85 to 88 percent vinyl chloride and 12 to 15 percent vinyl acetate by weight. It shall produce in the specified formulations results equal to Bakelite Corporation Vinylite resin VYHH.

Lampblack shall be ground in the Vinyl Finish Coat vehicle to yield a smooth well ground paint, Black Vinyl Tinting Paste, acceptable for tinting the Vinyl Finish Coat.

The Vinyl Finish Coat and Vinyl Tinting Paste shall be ground to a fineness of not less than 5 when testing in accordance with Federal Test Method Standard No. 141b, Method 4411.1.

Vinyl Thinner shall be composed of the following Materials:

Toluene	90 percent by volume
Methyl Isobutyl Ketone	10 percent by volume

The paints as received require thinning with from 20 to 35 percent by volume of Vinyl Thinner to maintain a wet spray.

7. Formula D-1-57 - Aluminum Paint:

Aluminum paste Type 2 Class B	2.0 pounds
Spar Varnish	1.0 gallon

Aluminum paint shall be mixed on the Job Site, and only enough for one Day shall be mixed at a time. The weighed amount of paste shall be placed in a suitable mixing container and the measured volume of vehicle then poured over it. The paste shall be incorporated by vigorous stirring with a paddle.

Test Requirements: Prior to mixing.

8. Formula D-4-57 - Black Enamel:

The enamel shall meet the requirements of Federal TT-E-529 Black Enamel, Synthetic, Semi Gloss.

Test requirements: This enamel will be sampled and tested in the ready-mixed form.

9. Formula D-5-83 - White Guard Rail Paint (Alkyd Vehicle):

Titanium dioxide (dry pigment)	28.1 parts
Zinc oxide (dry pigment)	10.9 parts
Fibrous magnesium silicate (dry pigment)	4.3 parts
Aluminum stearate (dry pigment)	0.5 parts
Alkyd vehicle	37.0 parts
24% lead naphthenate drier	0.4 parts
6% Cobalt naphthenate drier	0.2 parts
6% Manganese naphthenate drier	0.2 parts
Anti-skinning agent	0.2 parts
Mineral spirits	18.2 parts
Weight per gallon (minimum)	11.0 pound
Viscosity at 70°F.	80-90 K.U.
Nonvolatile content (minimum)	70.2%
Grind (minimum)	4
Hiding power (maximum scale reading)	30
Set to touch	4 hours
Dry hard	18 hours
Sag Index	7 min.
Test Requirements	Prior to shipment
Viscosity Adjustment	Mineral spirits shall be added at the factory to achieve the specified viscosity

This formula is to be used over primed or previously painted surfaces.

10. **Formula E-1-57 - White for Wood Structures:**

The Material shall conform to Federal TT-P-102, Class A.

Test Requirements: This paint will be sampled and tested in the ready-mixed form.

Primer: Turpentine may be added to the above paint in quantities not to exceed 1-1/2 pints per gallon of paint for use as a primer.

11. **Formula E-2-62 - Primer for Wood:**

The primer shall be a ready mixed priming paint for use over unpainted wood surfaces. It shall meet the requirements of Federal Specification TT-P-25 Primer, Paint, Exterior.

Test Requirements: This paint shall be sampled and tested in the ready mixed form.

12. **Formula F-3-64 - Orange Equipment Enamel:**

The enamel shall meet the requirements for Enamel, Alkyd, Gloss, Federal Specification TT-E-489, except that the Sag Index shall be seven minimum. The color, when dry, shall match that of Federal Standard No. 595, color 12246.

Test Requirements: When manufactured on Contract or Purchase Order for maintenance use, the enamel will be sampled and tested in the ready-mix form. No factory inspection will be required; however, a one pint sample representing the batch shall be submitted to the SPU Materials Laboratory for approval before use.

For factory application to individual items of new equipment, samples of the enamel will not be required; however, the equipment manufacturer shall match the color and certify the quality of enamel used.

13. **Formula H-1-83 - Primer for Concrete:**

Titanium dioxide	5.0 parts
Calcium carbonate	19.7 parts
Fibrous magnesium silicate	6.8 parts
Silica	6.8 parts
Spar varnish	52.3 parts
Mineral spirits	9.4 parts
Weight per gallon (minimum)	9.8 pounds
Drying time (for testing purposes only)	18 hours
Viscosity at 70° F	65-75 K.U.
Consistency:	The paint shall not thicken after manufacture to an extent sufficient to impair its brushing qualities.
Test Requirements:	Prior to shipment

14. **Formula H-2-83 - White Masonry Paint for Precast Curbs**

Titanium dioxide (dry pigment)	11.9 parts
Calcium carbonate (dry pigment)	25.6 parts
Mica (dry pigment)	7.4 parts
Diatomaceous silica (dry pigment)	7.0 parts
Bentone (body agent)	0.5 parts
Pliolite S5-A	8.0 parts
Chlorinated Paraffin 40%	4.0 parts
Chlorinated Paraffin 70%	4.0 parts
Aromatic brushing thinner	31.6 parts
Viscosity at 70°F	90-100 K.U.
Weight per gallon (minimum)	12.1 pounds
Drying time (for test purposes only)	18 hours
Test requirements	Prior to shipment

15. **Formula H-3-83 - Yellow Masonry Paint for Precast Curbs**

Titanium dioxide (dry pigment)	1.0 parts
Medium chrome yellow (dry pigment)	10.9 parts
Calcium carbonate (dry pigment)	25.6 parts
Mica (dry pigment)	7.4 parts
Diatomaceous silica (dry pigment)	7.0 parts
Bentone (body agent)	0.5 parts
Pliolite S5-A	8.0 parts
Chlorinated paraffin 40%	4.0 parts
Chlorinated paraffin 70%	4.0 parts
Aromatic brushing thinner	31.6 parts
Viscosity at 70°F	90-100 K.U.
Weight per gallon (minimum)	12.1 pounds
Drying time (for test purposes only)	18 hours
Test requirements	Prior to shipment

16. **Formula K-1-83 - Exterior Acrylic Latex Paint-White:**

This paint shall meet the requirements of Federal Specification TT-P-19, Paint, Acrylic Emulsion, Exterior, except that the viscosity shall 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.

Test Requirements: This paint will be sampled and tested in the ready-mixed form.

17. **Formula K-2-83 - Traffic Signal Yellow Enamel:**

Traffic signal yellow enamel shall meet the provision of Federal Specification TT-E-489 - Enamel, Alkyd, Gloss - and shall match the color of "Standard Interstate Yellow".

18. **Paint Formulas – Moisture Cured Urethane Paint**18-A. **General**

The color of the coating system will be specified in the Contract.

Materials shall meet the requirements of those applicable Specifications in SSPC-PA1, "Shop, Field and Maintenance Painting", which are not in conflict with these Standard Specifications.

The coating system for the "Moisture Cured Urethane" painting process shall coat the steel surfaces with three single component moisture-cured polyurethane coats. The various coats of paint shall be applied in thicknesses as specified in this Section.

Coating Systems which have a maximum recoat window on primer of less than seven Days shall not be used. Coating systems for steel surfaces shall incorporate a primer Capable of being applied at a relative humidity of up to 98 percent, and steel and air temperatures between 35°F and 110°F. The intermediate and top coats shall be full coverage with coating applied to all steel surfaces. All steel coating Materials shall be furnished by the same manufacturer and shall be compatible with one another. The Contractor shall provide a Manufacturer's Certificate of Compliance for approval at least 5 Working Days before the need arises stating:

- a) The coating Materials meet the Materials Specifications.
- b) The coating Materials in the coating system are compatible.
- c) The manufacturer has manufactured at least one coat of the coating Material in the coating system specified and furnished for the project. Coating Materials for the other coats shall be from the manufacturer's product line and recommended for use in the coating system.

Application of coating Materials shipped to the Project Site will not be permitted until the coating Materials have been approved.

18-B. **Above Ground Application**

Paint supplied for the project shall conform to the following requirements:

- (1) Primer (Full Coverage)

Generic Type	Zinc filled, single component, moisture-cured polyurethane
Vehicle Type	Moisture Cured Polyurethane
Pigment Type	Zinc Dust
Pigment content	80% minimum zinc by weight in dry film
Volume Solids	60% plus or minus 2%3% WSDOT
Dry Film thickness	3 mils minimum

All Primer shall be tinted sufficiently with color so as to easily distinguish the dry primer from the blast cleaned steel surface.

(2) Intermediate Coat (Full Coverage)

Generic Type	Micaceous iron oxide filled, single component, moisture-cured polyurethane
Vehicle Type	Moisture Cured Polyurethane
Pigment Type	4.0 lbs/gal micaceous iron oxide
Volume Solids	60% minimum
Finish	Flat (Low Gloss)
Color	Tinted to distinguish from Primer and Top Coat
Dry Film thickness	3 mils minimum

(3) Top Coat (Full Coverage)

Generic Type	Micaceous iron oxide filled, single component, moisture-cured, aliphatic polyurethane
Vehicle Type	Moisture Cured Polyurethane
Pigment Type	Micaceous iron oxide
Volume Solids	60% minimum
Finish	Flat (Low Gloss)
Dry Film thickness	3 mils minimum

The Proportions of the tinting pigments shall be varied to closely match the color of the existing Structure. Three color chip options shall be submitted to the Engineer for a final tinting selection.

Steel coating products furnished for the project shall be manufactured by the same manufacturer and shall be compatible with one another.

18-C. Below Ground Application

Paint supplied for the project shall conform to the following requirements:

Surface Preparation: Per SSPC-10

(1) Primer (Full Coverage)

Generic Type:	Zinc filled, single component, moisture-cured polyurethane
Vehicle Type:	Moisture-cured polyurethane
Pigment Type:	Zinc dust
Pigment Content:	80% minimum zinc by weight in dry film
Volume Solids:	60% plus or minus 2%
Dry Film Thickness:	3 mils minimum

All primer shall be tinted sufficiently with color so as to easily distinguish the dry primer from the blast cleaned steel surface.

(2) Top Coat (Full Coverage)

Generic Type:	Single component, moisture-cured, urethane tar with micaceous iron oxide
Color:	Black
Solids by Volume:	61% plus or minus 2%
Flash Point:	> 90°F
Temperature Resistance:	Wet - 180°F continuous, Dry - 240°F continuous
Dry Film Thickness:	4.0 to 6.0 mils

Manufacturing: Steel coating products furnished for the project shall be manufactured by the same manufacturer and shall be compatible with one another.

9-08.3 INSPECTION REQUIREMENTS - GENERAL

The manufacturer shall notify the Engineer of the date on which manufacture is started, and the Engineer shall have the right to inspect all details of the manufacturing process.

Quantities of 20 gallons or less of the above formulas will be accepted without inspection upon the notarized Manufacturer's Certificate of Compliance. This certificate shall contain a statement by the manufacturer to the effect that the Material meets the formula Specification, and shall include a list of materials and quantities used. One copy of the certificate shall accompany the paint when shipped and one copy with a sample of the paint shall be sent to the SPU Materials Laboratory. The paint may be used at once without further release from the SPU Materials Laboratory.

9-08.4 PROCESS OF MANUFACTURE

9-08.4(1) GENERAL

The following process of manufacture shall be used for each paint except aluminum paint. Pigments shall be ground thoroughly in appropriate portions of the specified vehicle to form a paste meeting the requirements set forth in Section 9-08.4(7).

The grinding shall be done in a mill approved by the Engineer. The use of the "colloid" type of mill will not be approved. Weighed quantities of the paste and weighed or measured quantities of the vehicles shall then be mixed thoroughly and strained, if necessary, to form a paint free from skins, lumps, and foreign materials.

9-08.4(2) VISCOSITY ADJUSTMENT

The volatile thinner content of the paint shall be adjusted at the factory to meet the required viscosity, but in no case shall the resultant weight per gallon and nonvolatile content of the paint be below that specified in the formula.

9-08.4(3) WEIGHT VARIATIONS

The weight per gallon of the paint in any lot shall not be less than that stated in the formula. A "lot" as used in this section shall be the quantity of paint ground at one time by any one mill.

9-08.4(4) DRYING TIME AND QUANTITY OF DRIER

The paint shall dry within the length of time stated in each formula but shall not contain sufficient quantities of drier to cause the paint to dry to a nonuniform or nonelastic film. The manufacturer will be permitted to vary the quantity of drier given in the formula sufficiently to accomplish the above results.

9-08.4(5) WORKING PROPERTIES

The paint shall contain no caked material that cannot be broken up readily by stirring. When applied to a clean vertical surface, the paint shall dry without running, streaking, or sagging.

9-08.4(6) STORAGE PROPERTIES

Paints manufactured under these Specifications shall show no skin over the surface after 48 hours in a partially filled container, when tested as outlined in Federal Test Method Standard No. 141. 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.

9-08.4(7) FINENESS OF GRINDING

The paint shall be ground so that all particles of pigment are dispersed and be coated with vehicle, and the residue on a 325 sieve does not exceed 1 percent by weight of the pigment.

9-08.4(8) RESERVED

9-08.4(9) CONTAINERS

Each container shall be filled with paint and sealed airtight. Each container shall be filled with the amount of paint required to yield the specified quantity when measured at 70°F.

All paint shall be shipped in new suitable containers having a capacity not greater than 5 gallons. Each container shall be marked with a suitable number to identify the particular batch from which it was filled.

9-08.5 TEST METHODS

As set forth in Section 9-08.2, all paints shall meet the special requirements set forth for each formula. The test methods used to check those special requirements shall be as specified by Federal Specification TT-P-141. When test methods are not covered by the above, applicable ASTM methods shall be followed.

9-08.6 SHIPPING

Except for lots of paint in quantities of 20 gallons or less which are accepted upon the Manufacturer's Certificate of Compliance, the manufacturer shall not ship any lot of paint until the paint has been tested and released by the Materials Laboratory. This release will not constitute final acceptance of the paint. Final acceptance will be based on inspection or testing of Project Site samples.

9-08.7 FIELD SAMPLES

Because of the volatility of the solvents used in the paint, the upper limit on viscosity will be waived on all paint samples taken in the field.

SECTION 9-09 TIMBER AND LUMBER

9-09.1 GENERAL REQUIREMENTS

All timber and lumber for Structures shall be Douglas Fir-Larch, unless specified otherwise in the Contract. The allowable species of timber and lumber for guardrail posts shall be Douglas Fir-Larch or Hem Fir. Timber and lumber for sign posts, mileposts, sawed fence posts, and mailbox posts, shall be Western Red Cedar, Douglas Fir-Larch, or Hem Fir.

9-09.2 GRADE REQUIREMENTS

Timber and lumber shall conform to the grades and usage as follows. Grades shall be determined by the current standards of the West Coast Lumber Inspection Bureau (WCLIB) or the Western Wood Products Association (WWPA).

Structures

Timber and lumber, unless specified otherwise in the Contract, shall conform to the following:

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 shall be Douglas Fir-Larch, grade No. 2 or better.

Guardrail Posts

Timber and lumber for guardrail posts (classified as Posts and Timbers) shall conform to the grades as follows.

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

Mileposts, sawed fence posts, and mailbox posts shall conform to the grades listed in the following table:

4x4	Construction grade (Light Framing, Section 122-b WCLIB) or (Section 40.11 WWPA)
4x6	No. 1 and better, grade (Structural Joists and Planks, Section 123-b WCLIB) or (Section 62.11 WWPA)
6x6, 6x8, 8x10	No. 1 and better, grade (Posts and Timbers, Section 131-b WCLIB) or (Section 80.11 WWPA)
6x10, 6x12	No. 1 and better, grade (Beams and Stringers, Section 130b WCLIB) or (Section 70.11 WWPA)

Sign and parking meter posts shall meet the Material requirements specified in Section 9-28.2.

9-09.2(1) SURFACING AND SEASONING

All timber and lumber shall be sized as indicated on the Drawings.

All timber and lumber to be painted shall be surfaced on all sides. All timber and lumber to be painted shall be thoroughly air or kiln dried to an equilibrium moisture content and shall be stored in such a manner as to remain in a thoroughly dry condition until placed into the Work.

9-09.2(2) RESERVED

9-09.2(3) INSPECTION

Timber and lumber shall be marked with a certified lumber grade stamp provided by one of the following agencies:

West Coast Lumber Inspection Bureau (WCLIB)
Western Wood Products Association (WWPA)
Pacific Lumber Inspection Bureau (PLIB)
Any lumber grading bureau certified by the American Lumber Standards Committee

A grading certificate shall accompany each order of timber and lumber for use in Structures as specified in Section 9-09.2. In consideration of being acceptable, the certificate shall 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 shall include the following:

1. Name of the mill performing the grading,
2. The grading rules being used,
3. Name of the person doing the grading with current certification,
4. Signature of a responsible mill official,
5. Date the lumber was graded at the mill, and
6. 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 shall 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 shall be treated in accordance with AASHTO M133. As specified by AASHTO M 133, the American Wood-Preservers' Association (AWPA) standards shall govern the specifications. These specifications include: storing and curing the timber and lumber, the wood preservatives, the preservative treatment process, documenting the results of the treatment, inspection, testing, and the identification of properly treated timber. Unless otherwise specified in the Contract, all timber and lumber shall be treated in accordance with Section C-14 of the latest addition of the AWPA standards.

All cutting, boring, chamfering, routing, surfacing, and trimming shall be done prior to treating. Any field drilling or cutoffs shall be treated by two liberal applications of compatible preservative. The applications shall be in accordance with the requirements of AWPA Standard M-4 entitled, "Standard for the Care of Pressured Treated Wood Products".

All charges shall consist of pieces of the same species that are similar in form, size, moisture content, and receptivity to treatment. The pieces in the charge shall be separated to ensure contact of treating medium with all surfaces. The method of determining the retention of the preservatives shall be by assay.

As specified in the Contract, all orders of treated timber and lumber shall be stamped "WSDOT Approved for Shipment" or accompanied by a Certificate of Treatment record. The Certificate of Treatment shall include the following information:

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, and
7. Signature of a responsible plant official.

In addition to the Certificate of Treatment, all orders of treated timber or lumber that are not stamped "WSDOT Approved for Shipment", shall be accompanied by a Grading Certificate in accordance with Section 909.2(3). Such certification or approved for shipment tag 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 prolonged storage, shipping, or upon delivery.

All timber and lumber to be used in aquatic environments, unless specified otherwise in the Contract, shall be chemically treated using Best Management Practices (BMPs). The producer of the chemically treated products shall 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 record.

SECTION 9-10 PILES

9-10.1 TIMBER PILES

9-10.1(1) GENERAL

Timber piles shall be untreated or treated with the preservatives specified on the Drawings and completely described in Section 9-09.3.

Timber piles shall have the following limiting diameters:

Length in Feet	Min. Butt Dia. 3 ft. Above Butt (inch)	Max. Butt Dia. 3 ft. Above Butt (inch)	Min. Tip Dia. (inch)
Under 40	12	20	7
40 – 54	12	20	7
55 – 74	13	20	7
Over 74	14	20	7

Timber piles shall be strapped with at least three 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 shall be provided at approximately 15-foot centers between the butt and tip. Strapping shall encircle the pile once and be tensioned as tightly as possible. Straps shall 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 shall 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 shall be strapped after treatment.

9-10.1(2) UNTREATED PILES

Except where specifically provided otherwise, untreated timber piles shall be Douglas fir, Western red cedar, or larch. Piles for foundations shall be Douglas fir. Piles shall be cut from sound, live trees and shall 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 shall be cut above the butt swell and shall have a uniform taper from butt to tip. A line drawn from the center of the tip to the center of the butt shall 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 shall have an average of at least five 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 shall 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 shall be used. All other requirements shall 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 shall consist of a pile made up of two timber sections. The lower section shall be untreated, and the upper section shall be creosote treated.

The treated and untreated sections of timber composite pile shall meet the respective requirements specified above for full length of treated and untreated timber piles.

9-10.1(5) PEELING

Untreated and creosote treated piles shall be peeled by removing all of the rough bark and at least 80 percent of the inner bark. No strip of inner bark remaining on the pile shall be over 3/4 inch wide or over 8 inches long, and there shall be at least 1 inch of clean wood surface between any two such strips. Not less than 80 percent of the surface on any circumference shall be clean wood. All knots shall be trimmed close to the body of the pile.

9-10.2 CONCRETE PILES

9-10.2(1) CONCRETE

Portland cement meeting the requirements of Section 9-01 shall be used in all precast concrete piles.

The concrete for precast-prestressed piles shall conform to the requirements of Section 9-19. The concrete for prestressed piles shall 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 shall be 3,300 psi.

The concrete for all other precast piles shall be Class 4000P. Mixing, transporting, and placing concrete shall be in accordance with the provisions of Section 6-02.3.

The Contractor shall 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 shall be molded, cured, and tested in accordance with the procedures established by the Laboratory.

In the event that 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 shall 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 shall be done under the surveillance of the Engineer.

9-10.2(2) REINFORCEMENT

Reinforcement shall meet the requirements of Section 9-07.

9-10.3 CAST-IN-PLACE CONCRETE PILES

9-10.3(1) REINFORCEMENT

Reinforcement for cast-in-place concrete piles shall conform to the requirements of AASHTO M31, Grade 60.

9-10.4 STEEL PILE TIPS AND SHOES

Steel pile tips and shoes shall be fabricated of cast steel conforming to ASTM A148, Grade 60-90 [620-415] or ASTM A27, Grade 65-35 [450-240] and be free from any obvious defects. Pile tips shall be accompanied by a mill test report stating the chemical and physical properties (tensile and yield) of the steel.

9-10.5 STEEL PILES

The Material for steel piles and pile splices shall conform to ASTM A 36, except the Material for steel pipe piles, and splices shall conform to the requirements of ASTM A252, 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 shall conform to the requirements of ASTM D 312, Type 4.

The Material used as primer shall conform to the requirements of ASTM D 41, "Primer for Use with Asphalt in Dampproofing and Waterproofing".

Acceptance shall be as provided in Section 9-02.2(1).

9-11.2 WATERPROOFING FABRIC

Waterproofing fabric shall be a saturated cotton fabric meeting the requirements 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 shall conform to the following requirements:

Portland Cement	Section 9-01
Sand	Section 9-03.1(2)C

SECTION 9-12 MANHOLES, CATCH BASINS, AND INLETS

9-12.1 REINFORCED CONCRETE

9-12.1(1) GENERAL

Reinforced concrete shall 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 placed under these Standard Specifications shall be Class 4000 (see Sections 6-02.3(1) and 6-02.3(2)). Strength determination shall be in accordance with ASTM C 39. Precast components shall conform to the strength requirements of ASTM C 478.

The use of admixtures shall require prior approval of the Engineer. Concrete with air-entraining admixture shall comply with ASTM C 175.

9-12.1(2) CEMENT

Portland cement shall conform to the requirements of Section 9-01.

9-12.1(3) STEEL REINFORCEMENT

Reinforcement shall consist of wire conforming to ASTM A82 or ASTM A496, or wire fabric conforming to ASTM A 185 or ASTM A 497, or Grade 60 steel bars conforming to ASTM A615 or Grade 80 steel bars conforming to ASTM A 306.

9-12.1(4) AGGREGATES

Aggregates for cast-in-place concrete shall conform to ASTM C 33.

9-12.2 STEPS, HANDHOLDS, AND LADDERS

9-12.2(1) GENERAL

The Material for manhole steps, ladders, and handholds shall be the same material in any individual drainage Structure. See Section 7-05.3(1)Q for submittal requirement. Sizes of components, dimensions and layout shall conform to Standard Plan no. 232.

9-12.2(2) POLYPROPYLENE ENCAPSULATED REINFORCING STEEL

Polypropylene steel reinforced steps shall be made of copolymer polypropylene plastic that encapsulates a 1/2 inch diameter grade 60 steel reinforcing steel. Steel reinforcing shall conform to the requirements of ASTM A 615, and copolymer polypropylene plastic shall conform to requirements of ASTM D4101. Steps shall have serrated tread, measure 13 inches center to center between legs of the step, and be designed to withstand pullout forces of 1500 pounds.

The Contractor may, with the Engineer's approval, use "Plastic Manhole Steps" manufactured by Lane International Corporation, or "Steps" manufactured by M.A. Industries, Inc.

9-12.3 RESERVED

9-12.4 MORTAR AND GROUT FOR SEWER AND DRAINAGE STRUCTURES

9-12.4(1) MORTAR FOR JOINTS

Mortar for jointing precast or masonry manhole, catch basin, or inlet units shall be one part Portland cement to not less than one part nor more than two parts plaster sand, mixed with the least amount of clean water necessary to provide a workable mortar. Joints between precast manhole elements shall also be rubber gasketed as noted in Section 7-05.3(1)K.

9-12.4(2) MORTAR FOR PLASTER-COATING

Mortar for plaster-coating or lining masonry unit manholes shall be proportioned according to either of the two alternates tabulated as follows:

Alternate	Parts by volume Portland cement	Parts by volume Masonry cement	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	¼	

9-12.4(3) GROUT

Grout for filling the void in Sewer and Drainage Structures where pipe connections are made shall be non-shrink cement sand grout complying with the requirements of Section 9-04.3(2).

9-12.5 CONCRETE MASONRY UNITS

Concrete masonry unit (also called concrete masonry block) shall conform to ASTM C 139, "Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes", except that nominal horizontal thickness shall be 6 inches measured radially, and blocks shall have semicircular mortar grooves approximately 1 inch radius at the ends.

9-12.6 CONCRETE BRICK

Concrete brick shall conform to the Specifications for Concrete Building Brick ASTM C 55, Grade S.

9-12.7 CLAY BRICK

Clay brick shall conform to ASTM C 32, Grade MM unless otherwise specified in the Contract.

9-12.8 METAL CASTINGS

9-12.8(1) MANHOLE RING AND COVER

Ring and cover casting dimensions shall conform to the Standard. Rings and ring extensions shall be manufactured from cast iron ASTM A 48, Class 30 or ductile iron ASTM A536, Grade 80-55-06. Covers shall be manufactured from ductile

iron ASTM A536, Grade 80-55-06. Rings and covers shall 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 shall certify that the product conforms to the requirements of these Specifications. In accordance with Section 1-06.1, where source of Material is different from manufacturer, the Contractor shall also provide the name and location of the manufacturer

Castings shall be bare metal. Artificially coated or painted castings will be cause for rejection.

Castings shall be machine finished on the horizontal seating surface and the vertical facing surface common to the ring and cover, so as 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, no matter what the source. The vertical face common to the ring and cover shall be beveled as shown on the Standard . Upon request of the Engineer, the manufacturer shall furnish at the foundry standard ring and covers for use by Inspectors in testing fit and seating.

All covers shall 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 (Sewer, Drain, etc.); and
5. Country of manufacture/origin.

Items 2. and 4. shall be on the exposed face of the cover. Items 1., 3., and 5. shall be located at the manufacturer's option. If located on the exposed face of the cover, item 1. and 3. shall be adjacent to each other and shall be set in at least 1/2 inch high recessed letters. Where lock-type castings are called for, a locking device shall permit the cover to be readily released from the ring. Movable parts shall be made of non-corrosive metals and be designed to avoid possible binding. Upon request by the Engineer, the manufacturer shall 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 manhole rings shall be labeled with the name or symbol of the manufacturer and the type of Material.

Where additional depth to a Standard Plan no. 230 frame is required, Standard Plan no. 231 ring extensions shall be securely bonded to the frame by epoxy at the manufacturer's facility. The Contractor shall provide a Manufacturer's Certificate of Compliance verifying this prior to installing the built up frame at the Project Site.

9-12.8(2) METAL FRAME AND GRATE AND METAL COVER FOR CATCH BASINS OR INLETS

The frame and grate and metal cover shall conform to the Standard .

The frame may be made of cast iron, ASTM A48, Class 30, or ductile iron, ASTM A536, Grade 80-55-06, at the manufacturer's option. The grate and cover shall be made of ductile iron only. Other applicable provisions of Section 9-12.8(1) shall apply, except item (4) for identification marking.

Catch Basins, Type 242A and 242B and Inlets, Type 250A and 250B shall be furnished with a vaned grate as indicated on Standard Plan nos. 265 and 266.

9-12.8(3) CAST METAL INLETS

The castings for cast metal inlets shall be cast steel or ductile iron as specified in Section 9-06.8 or Section 9-06.14 and as shown in WSDOT Standard Plan no. B-4. Substitutions may be accepted (see Section 1-06.1). Vaned grates shall be embossed as indicated on Standard Plan no. 264.

9-12.9 JUNCTION BOX

Junction box shall comply with Standard Plan no. 277 and rebar shall be as shown in WSDOT Standard Plan no. B-1.

9-12.10 SHOP FABRICATED CORRUGATED METAL MANHOLES

Where corrugated metal manholes are specified, they shall conform to the details as indicated in the Contract. All pipe connections to the manhole stubs shall 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.

9-12.11 MONOLITHIC CONCRETE MANHOLES

Monolithic concrete manholes shall conform to the Standard .

9-12.12 OUTLET TRAPS

Outlet traps shall be constructed in accordance with Standard Plan no. 267a.

Catch basin traps shall be constructed in accordance with Standard Plan 267b (see Section 7-05.3(2)B).

9-12.13 GRATE INLETS AND DROP INLETS

Steel in grates, angles, and anchors for grate inlets and drop inlets shall conform with AASHTO M183, except structural tube shall conform with ASTM A500, Grade B. After fabrication, the steel shall be hot-dip galvanized with a minimum coating of 2 ounces of zinc per square foot in accordance with AASHTO M111 or galvanized with a hot-sprayed (plasma flame applied) 6 mil minimum thickness zinc coating.

Steel grating shall be fabricated by weld connections. Bearing bars and cross bars shall be resistance welded at the intersecting joints. Welds, welding procedures, and welding Materials shall conform to Standard Specifications for Welding issued by the American Welding Society.

Vaned grates shall be embossed as indicated on Standard Plan no. 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, and
- 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 of Contract.

SECTION 9-13 RIPRAP, QUARRY SPALLS, AND SLOPE PROTECTION

9-13.1 GENERAL

The stone for riprap and quarry spalls shall be hard, sound and durable. It shall 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 shall meet requirements in Section 9-03.17.

9-13.2 LOOSE RIPRAP

Loose riprap shall be free of rock fines, soil, or other extraneous material.

Should the riprap contain insufficient 4" to 8" spalls, as defined in Section 9-13.7, the Contractor shall 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 ordered 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 shall meet the following requirements for grading:

	Minimum Size	Maximum Size
40% to 90%	1 ton (1/2 cubic yd.)	
70% to 90%	300 lbs. (2 cu. ft.)	
10% to 30%	3 inch	50 lbs. (spalls)

9-13.2(2) LIGHT LOOSE RIPRAP

Light loose riprap shall meet the following requirements for grading:

	Size Range	Maximum Size
20% to 90%	300 lbs. to 1 ton (2 cu. ft. to ½ cu. yd.)	
15% to 80%	50 lbs. to 1 ton (1/3 cu. ft. to ½ cu. Yd.)	
10% to 20%	3 inch	50 lbs. (spalls)

9-13.3 HAND PLACED RIPRAP

Hand placed riprap shall be as nearly rectangular as possible, 60 percent shall have a volume of not less than 1 cubic foot. No stone shall be used which is less than 6 inches thick, nor which does not extend through the wall.

9-13.4 SACK RIPRAP

Sack riprap shall 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 shall be filled with approximately 1 cubic foot of concrete having a consistency in conformance with Section 6-02.3(3)D for non-vibrated concrete.

For sack riprap exposed to fresh water, the concrete shall be unreinforced Class 2300; and for sack riprap exposed to salt water, the concrete shall be Class 3000 as specified in Section 6-02.3.

The Portland cement and fine and coarse aggregates shall conform to the requirements for Portland cement and fine and coarse aggregate of Sections 9-01 and 9-03.1, respectively.

9-13.5 RESERVED

9-13.6 CONCRETE SLOPE PROTECTION

9-13.6(1) GENERAL

Concrete slope protection shall 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.

9-13.6(2) SEMI-OPEN CONCRETE MASONRY UNITS SLOPE PROTECTION

Precast cement concrete blocks shall conform to the requirements of ASTM C 90, Type II.

9-13.6(3) POURED PORTLAND CEMENT CONCRETE SLOPE PROTECTION

Cement concrete for concrete slope protection shall be Class 3000 in conformance with Section 6-02.3.

Wire mesh reinforcement shall conform to Section 9-07.7.

9-13.6(4) PNEUMATICALLY PLACED PORTLAND CEMENT CONCRETE SLOPE PROTECTION

Cement:	This Material shall be Portland cement as specified in Section 9-01.
Aggregate:	This Material shall meet the requirements for fine aggregate as specified in Section 9-03.1. The moisture content of the fine aggregate at the time of use shall be between 3 percent and 6 percent by weight.
Reinforcement:	Wire mesh reinforcement shall conform to the provisions of Section 9-07.7.
Water:	Water shall conform to the provisions of Section 9-25.1.

9-13.7 QUARRY SPALLS

The spall shall be hard, sound, and durable. It shall be free from fracture, seams, cracks, and other discontinuities tending to adversely impact its resistance to weathering. The quarry spall shall meet the 5 test requirements listed in Section 9-03.17. Quarry spalls shall meet the following gradation requirements:

2 INCH TO 4 INCH QUARRY SPALL

Sieve Size	Percent Passing
4 inch	100
2 inch	40 max.
1-1/4 inch	5 max.

4 INCH TO 8 INCH QUARRY SPALL

Sieve Size	Percent Passing
8 inch	100
4 inch	40 max.
2 inch	5 max.

All percentages are by weight.

SECTION 9-14 EROSION CONTROL AND LANDSCAPE MATERIALS**9-14.1 SOILS****9-14.1(1) TOPSOIL TYPE A**

The topsoil shall be imported and shall be friable surface soil from the A horizon as determined by the United States Agriculture Soil Conservation Service Soil Survey. Topsoil shall be free from: Materials toxic to plant growth; noxious weed seeds, rhizomes, roots; subsoil; stones and other debris. All topsoil shall pass through a 1 inch screen. Maximum electrical conductivity shall be 2.0 milliohms and the maximum exchangeable sodium percentage shall be 10 percent.

Topsoil Type A shall consist of a sandy clay loam, sandy loam, loam, clay loam, silty clay loam, or silt loam soil. These soil textural classes shall be determined by the United States Department of Agriculture Classification System. These textural classes shall be restricted by the following maximum percentage compositions based on the Material passing the Number 10 screen:

Separates	Maximum Percentage Allowable
Sand	50%
Clay	20%

The maximum percentage retained on a 1/4 inch screen shall not exceed 20 percent by volume. Of the Material passing the 1/4 inch screen, the maximum allowable percentage of gravel retained on a Number 10 screen shall not exceed 10 percent by weight. Total organic matter shall be at least 10 percent by volume. Organic matter shall be determined by the Walkley-Black sulfuric acid dichromate digestion process. The pH shall be within the range 5.5 to 7.5.

9-14.1(2) TOPSOIL TYPE B

Topsoil Type B shall be native topsoil taken from within the Project Site, either from the area where roadway excavation is to be performed or from strippings from borrow, pit, or quarry sites, or from other designated sources. The general limits of the Material to be utilized for topsoil will be indicated in the Contract. The Engineer will make the final determination of the areas where the most suitable Material exists within these general limits. The Contractor shall reserve this Material for the specified use. The depth of excavation into existing surface soils for obtaining Topsoil Type B shall be determined in the field by the Engineer.

In the production of Topsoil Type B, all vegetative matter, except large brush and trees over 4 feet in height, shall become a part of the topsoil. Prior to removal, the Contractor shall mow or otherwise reduce the height of the native vegetation such as sagebrush, snowberry, etc., to be a height not exceeding 1 foot. Noxious weeds, as designated by authorized State and County officials, shall not be incorporated in the topsoil, but shall be removed and disposed of. The designated depth of Material shall then be taken from the designated areas and placed at locations which do not interfere with the construction of the Project as approved by the Engineer. The Contractor shall take all precautions to avoid disturbing the existing ground beyond the Project Site or slope stakes or other areas designated by the Engineer.

Topsoil Type B will not be considered as selected Material as defined in Section 2-03.3(10), and the conditions of said Section will not apply.

9-14.1(3) NATURAL DRAINAGE SYSTEM SOILS**9-14.1(3)A GENERAL**

In general, Natural Drainage System Soils shall be mixtures of component parts measured on a volume basis. These soils shall be free of branch, root, stump, vegetative material, and rock 2 inch and larger in any dimension.

9-14.1(3)B BIORETENTION SOIL TYPE 1

Bioretention Soil Type 1 shall be a 2 component mixture by volume consisting of 35% composted material meeting the requirements of Section 9-14.4(9) and 65% drainage aggregate meeting the requirements of Section 9-03.2(2). The mixture shall be well blended to produce a homogeneous mix.

9-14.1(3)C BIORETENTION SOIL TYPE 2

Bioretention Soil Type 2 shall be a 2 component mixture by volume consisting of 35% composted material meeting the requirements of Section 9-14.4(9) and 65% drainage aggregate meeting the requirements of Section 9-03.2(3). The mixture shall be well blended to produce a homogeneous mix.

9-14.1(4) PLANTING SOIL AND PLAYFIELD SOIL**9-14.1(4)A PLANTING SOIL**

Description:

Planting soil shall consist of 67% sandy loam and 33% composted organic material by volume.

A. The soil shall meet the following requirements:

1. Soil shall be sandy loam or loamy sand consisting largely of sand, but with enough silt and clay present to give it a small amount of stability. Individual sand grains can be seen and felt readily. On squeezing in the hand when dry, it shall fall apart when the pressure is released; on squeezing when moist, it shall form a cast that does not only hold its shape when the pressure is released, but shall withstand careful handling without breaking.

The mixed soil shall meet the following gradation:

Screen Size	Percent Passing
1/2 inch	100
1/4 inch	95 – 100
#10	85 – 95
#30	60 – 75
#60	50 – 60
#100	20 – 30
#200	5 – 15

- B. Shall have a pH range of 5.5 - 7.5. Soils indicated having a pH below 5.5 shall be treated with dolomitic limestone as necessary to attain this pH range. Soils having a pH greater than 7.5 shall be treated with sulfur as necessary to attain this pH range. The pH shall be determined by soil test.
- C. Organic material shall consist of composted yard debris or organic waste material composted for a minimum of 3 months. Compost shall consist of 100% recycled content.
 In addition, the organic material shall have the following physical characteristics:
 - 1. Shall pass a standard cress test for seed germination (90% germination compared to standard).
 - 2. Shall have a pH from 5.5 to 7.5.
 - 3. Shall have a maximum electrical conductivity of 3.0 ohms/cm.
 - 4. Shall have a maximum carbon to nitrogen ratio of 40:1.
 - 5. Shall be certified by the "Process to Further Reduce Pathogens" (PFRP) guideline for hot composting as established by the United States Environmental Protection Agency.
- D. Submit a certified laboratory analysis from an accredited soils testing laboratory indicating the Material source and compliance with all planting soil Specifications to the Engineer for approval before delivery to the Project Site. The analysis shall be with a sample size of no less than 2 pounds.
- E. Site specific soil testing (after placement of material) may be required for Projects requiring more than 50 cubic yards of planting soil. A Contractor provided accredited laboratory approved by the Engineer shall make recommendations for amendments required for optimum growth at no cost to the Owner. The Contractor will be allowed 4 Working Days to complete the testing from the time of written notice given by the Engineer.

Acceptable Sources:

- 1. Astec, LLC, Bellevue, WA.
- 2. Cedar Grove Compost Company, Maple Valley, WA.
- 3. Northwest Cascade, Puyallup, WA.
- 4. Pacific Topsoils, Inc., Everett, WA.
- 5. Other approved equal.

Additional sources can be found at the Clean Washington Center organization's web-site www.crc.org.

9-14.1(4)B PLAYFIELD SOIL

Description:

Playfield Soil shall consist of 2/3 sand and 1/3 composted organic material by volume.

- A. Sand shall meet the following:

Size	Sieve	Percent Passing
3/8	ASTM E-11	100
No. 20	ASTM E-11	77 – 100
No. 60	ASTM E-11	0 – 23
No. 270	ASTM E-11	0 – 10

- B. Shall have pH range of 5.0 - 6.5. Soils indicated having a pH below 5.0 shall be treated with dolomitic limestone as necessary to attain this pH range. Soils having a pH greater than 6.5 shall be treated with sulfur as necessary to attain this pH range. The pH shall be determined by soil test.
- C. Organic material shall consist of composted yard debris or organic waste material, and shall consist of 100% recycled content. In addition, the organic material shall have the following physical characteristics:
 - 1. Shall pass a 3/4 inch sieve.
 - 2. Shall pass a standard cress test for seed germination (90% germination compared to standard).
 - 3. Shall have a pH from 5.5 to 7.5.
 - 4. Shall have at least 25% organic matter by dry weight.
 - 5. Shall have a maximum electrical conductivity of 3.0 mhos/cm.
 - 6. Shall have a maximum carbon to nitrogen ration of 40:1.
 - 7. Shall be certified by the "Process to Further Reduce Pathogens" (PFRP) guideline for hot composting as established by the United States Environmental Protection Agency.

8. Composted material shall be fully mature and stable before usage (2 pound minimum size samples required).
- D. Submit (see Section 1-05.3) a certified laboratory analysis from an accredited soils testing laboratory (see Section 1-06.5) indicating the Material source and compliance with all Specifications to the Engineer for approval prior to delivery to the Project Site. Sample size shall be a minimum of 2 pounds.

Acceptable Sources:

1. ASTEC, LLC, Bellevue, WA
2. Northwest Cascade, Puyallup, WA
3. Cedar Grove Compost Company, Maple Valley, WA
4. Pacific Topsoils, Inc., Everett, WA
5. Other approved equal:

Additional sources can be found at the Clean Washington Center organization's web-site www.crc.org.

9-14.2 SEED**9-14.2(1) GENERAL**

Grasses, legumes, or cover crop seed of the type specified shall 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 shall be furnished in standard containers on which shall be shown the following information:

1. Common name of seed,
2. Lot number,
3. Net weight,
4. Percentage of purity,
5. Percentage of germination (in case of legumes percentage of germination to include hard seed), and
6. Percentage of weed seed content and inert material clearly marked for each kind of seed in accordance with applicable State and Federal law.

Upon request, the Contractor shall furnish to the Engineer duplicate copies of a statement signed by the Material Person certifying that each lot of seed has been tested by a recognized and accredited seed testing laboratory within six months before the date of delivery on the Project. Seed which has become wet, moldy, or otherwise damaged in transit or storage will not be accepted.

Approved Varieties:

- A. Turf-type Perennial Rye-grass Blend

Blend shall consist of at least two of the following varieties and mixed in equal portions by weight:

Commander	Brightstar	Palmer II	Nighthawk	Affinity
Blazer II	Prelude II	Assure	Satum	Charger
Fiesta II	SR 4200	Prizm	Birdie	Sherwood
Stallion Sel	Dimension	APM	Tara	SR 4100

- B. Creeping Red Fescue

A single variety shall be selected from the list immediately following:

Cindy	Ensylva	Flyer	Salem	Jasper
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- C. Chewings Fescue

A single variety shall be selected from the list immediately following:

Longfellow	Shadow w/Endo	Promoter	Victory	Weekend	Bridgeport
Waldorf	Bargreen	Southport	Tamara	Enjoy	-----

9-14.2(2) SEED MIX #1 (EROSION MIX)

The seed mixture and rate of application shall be as follows:

Kind and Variety of Seed in Mixture	Percent by Weight
Turf-type Perennial Rye (3 approved types)	50%
Creeping Red Fescue	20%
Chewings Fescue	20%
Hard Fescue	10%

The rate of application shall be 5 pounds per 1000 square feet. The seed mixture shall be no less than 98% pure, and shall have a minimum germination rate of 90%.

9-14.2(3) SEED MIX #2 (NON-IRRIGATED LAWN SEED MIX)

The seed mixture and rate of application shall be as follows:

Kind and Variety of Seed in Mixture	Percent by Weight
Turf-type Perennial Rye (3 approved types)	50%
Chewings Fescue	30%
Hard Fescue	20%

The rate of application shall be 6 pounds per 1000 square feet. No noxious weeds will be permitted. The seed mixture shall be no less than 98% pure, and shall have a minimum germination rate of 90%.

9-14.2(4) SEED MIX #3 (IRRIGATED LAWN OR ATHLETIC PLAYFIELD)

The seed mixture and rate of application shall be as follows:

Kind and Variety of Seed in Mixture						Percent by Weight
Turf-type Perennial Rye Grasses (choose any 3 of the following approved types)						100%
Barry	Citation	Elka	Palmer	Derby	Omega II	
Blazer	Citation II	Gator	Prelude	Omega	-----	
Manhattan II	Yorktown II	Loretta	Regal	Diplomat	-----	

The rate of application shall be 8 pounds per 1000 square feet. No noxious weeds will be permitted. The seed mixture shall be no less than 98% pure, shall have a minimum germination rate of 80%, and shall have no more than 0.5% weed seed.

All seed varieties shall be packed in separate, clean, sound containers of uniform weight. The Contractor shall deliver the seed to the Project Site in the original containers showing weight, analysis, and name of grower, and shall store in a manner that prevents all wetting and deterioration of seed, until the seed is approved, mixed and sown.

9-14.2(5) SEED MIX #4 (BIOFILTRATION SWALE MIX)

The seed mixture and rate of application shall be as follows:

Kind and Variety	Percent by Weight
Turf-type Perennial Rye ¹	40%
Turf-type Tall Fescue	20%
Meadow Foxtail	20%
Hard Fescue	10%
Big Trefoil	5%
Seaside Creeping Bentgrass ¹	5%

¹The mix indicated above shall be applied to areas associated with sea water. In areas not associated with sea water, Seaside Creeping Bentgrass shall not be included in the mix (0%) and the percentage of Turf-type Perennial Rye shall be increased from 40% to 45%. This requirement will be indicated on the Contract Drawings.

The rate of application shall be 10 pounds per 1000 square feet.

Biofiltration Swale Mix shall be applied as described in Section 9-14.4(2) for terrain steeper than 2H:1V with tackifier (see Section 9-14.4(8)). Fertilizer utilized in seeding biofiltration swales shall be as specified in Section 9-14.3(1) with 75% of nitrogen supplied as methylene urea for slow release.

9-14.2(6) WILDFLOWER MIX

The seed mixture and rate of application shall be as follows:

Wildflower Mix:

Kind and Variety	Percent by Weight
Turf Type Perennial Rye (3 types)	45%
Chewings Fescue	25%
Hard Fescue	15%
Wildflowers	15%

The Contractor shall submit, and receive approval from the Engineer at least 3 Working Days before ordering, all species included in the wildflower mix and the Material Person's written directions on how to apply the seed mix. Written directions shall include rate of application and the incorporation of specific species of grass seed components when appropriate to the achieve adequate erosion control protection while maximizing flower display and regeneration.

Wildflower seed mix shall have a minimum of 20 wildflower species and shall not contain more than 10% (by weight) of any single species. The seed mix shall be no less than 98% pure and shall have a minimum germination rate of 90%.

Noxious weeds (Chapter 16-750 WAC), and invasive species listed by the Washington State Noxious Weed Control Board, will not be allowed. The following list of invasive species will be considered as noxious weeds:

- | | |
|--|---------------------------------------|
| annual coreopsis (coreopsis tinctoria) | crimson clover (trifolium incarnatum) |
| baby blue eyes (nemophila menziesii) | dame's rocket (hesperis matronalis) |
| baby's breath (gypsophila elegans) | fireweed (chamerion angustifolium) |

bachelor's button (*centaurea cyanus*)
 black-eyed susan (*rudbeckia hirta*)
 blue flax (*linum perenne*)
 california poppy (*eschscholzia californica*)
 common yarrow (*achillea millefolium*)
 cosmos (*cosmos bipinnatus*)
 cow cockle (*vaccaria hispanica*)

forget-me-not (*mysotis sylvatica*)
 poor man's weatherglass (*anagallis arvensis*)
 redroot pigweed (*amaranthus retroflexus*)
 sweet alyssum (*lobularia maritima*)
 wild lupine (*lupinus perennis*)
 yellow toadflax (*linaria vulgaris*)

Mixes shall be applied in accordance with manufacturers written directions submitted for Engineers approval a minimum of 2 Working Days prior to application. Written directions shall include rate of application and the incorporation of specific species of grass seed components when appropriate to the achieve adequate erosion control protection while maximizing flower display and regeneration.

Wildflower seed mix shall have a minimum of 20 wildflower species and shall not contain more than 10% (by weight) of any single species. Noxious weeds will not be permitted. The seed mix shall be no less than 98% pure and shall have a minimum germination rate of 90%. Approved sources of wildflower mixes are:

1. "Bloomers"
 Turf Seed
 Hubbard, OR
 Phone (800) 247-6910
 web-site www.turf-seed.com (Information and ordering)
2. "Pacific Northwest Wildflower"
 Environmental Seeds
 Lompoc, CA
 (order by phone, by FAX, or by e-mail)
 Phone (805) 735-8888
 FAX (805) 735-8798
 E-mail esp@espseeds.com
 web-site: www.espseeds.com (Information only)
3. United Agro Products NW (dba United Horticulture)
 P.O. Box 1047
 1601 - 15th Street NW
 Auburn, WA 98071-1047
 Phone (253) 351-6432
 E-mail mike.peterson@uap.com
4. Protime
 Hobbs & Hopkins, Ltd.
 1712 Southeast Ankeny
 Portland, Oregon 97214
 (order by phone, by e-mail, or by web-site)
 Phone (503) 239-7518
 web-site www.protimelawnseed.com

9-14.3 FERTILIZER

9-14.3(1) GENERAL

Fertilizer shall be a standard commercial grade of organic or inorganic fertilizer of the kind and quality specified herein. It may be separate or in a mixture containing the percentage of total nitrogen, available phosphoric acid and water-soluble potash in the amounts specified. All fertilizers shall be furnished in standard unopened containers with weight, name of plant nutrients and manufacturer's guaranteed statement of analysis clearly marked, all in accordance with State and Federal law.

Acceptable commercial fertilizer shall be supplied in one of the following forms:

1. A dry free-flowing granular fertilizer suitable for application by agricultural fertilizer spreader,
2. A soluble fertilizer ground to a fineness that permits complete suspension of insoluble particles in water, suitable for application by power sprayer,
3. A granular or pelletized fertilizer, suitable for application by blower equipment, or
4. A non-volatile liquid fertilizer.

Fertilizer provided for hydro-seeding applications, except for seed mix #4 biofiltration swale mix, shall be 10-10-10 construction grade (50% organic) plus micronutrients, applied at a rate that provides 1 pound of nitrogen per 1000 square feet. Secondary fertilizer applications shall be 3-1-2 construction grade (50% organic) plus micronutrients, applied at a rate to provide 2 pounds of nitrogen per 1000 square feet. Fertilizer for seed mix #4 (Section 9-14.2(5)) biofiltration swale mix shall have the nitrogen component containing 75% slow release methylene urea.

Fertilizer for woody plant material shall be 15-22-15 and shall meet the following analysis:

Total Nitrogen (N) 4.6% Ammoniacal Nitrogen 3.2% Urea Nitrogen 3.3% Coated Slow Release Urea Nitrogen 2.3% Slowly Available Water Soluble Nitrogen* 1.6% Water Insoluble Nitrogen	15%
Available Phosphoric Acid (P ₂ O ₅)	22%
Soluble Potash (K ₂ O)	15%
Sulfur (S)	4%
Boron (B)	0.06%
Copper (Cu)	0.06%
Iron (Fe)	1%
Manganese (Mn)	0.15%
Zinc (Zn)	0.14%

Notes Derived from urea, sulfur-coated urea, methylene ureas, ammonium phosphate, sulfate of potash, muriate of potash, iron sulfate, calcium and sodium borate, copper oxide and sulfate, iron oxide sulfate and frit, manganese oxide and sulfate, zinc oxide and sulfate.

* Slowly available water soluble nitrogen from methylene ureas.

The Contractor shall 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

Agricultural lime shall be of standard manufacture, flour grade, meeting the requirements of ASTM C 602.

9-14.4 MULCHES AND AMENDMENTS

9-14.4(1) STRAW MULCH

All straw mulch Material shall be in an air-dried condition free of noxious weeds and other materials detrimental to plant life. Straw shall be seasoned before baling or loading and shall be suitable for spreading with mulch blower equipment.

9-14.4(2) WOOD CELLULOSE FIBER MULCH

Wood cellulose fiber mulch shall be specially processed 100 percent virgin wood fiber containing no growth or germination-inhibiting ingredients and shall be dyed a suitable color to facilitate inspection of placement of the Material. It shall 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 shall allow the absorption and percolation of moisture.

Each package of cellulose fiber shall be marked by the manufacturer to show the air dry weight content.

The hydro-seeding process shall utilize only 100% virgin wood fiber mulch in which 30% of the fibers shall be 0.15 inches long or longer and which shall have tackifier added to the mulch during the manufacturing process. Tackifier shall be added in accordance with Section 9-14.4(8). Mulch shall 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 4H:1V slope.
2. 50 pounds per 1000 square feet, or 2000 pounds per acre, for areas having between 2H:1V and 4H:1V slope.
3. 60 pounds per 1000 square feet, or 2500 pounds per acre, for areas having a slope greater than 2H:1V.

Terrain that is steeper than 2H:1V, areas that exceed 10,000 square feet, and areas having a vertical drop greater than 15 feet shall be treated with a supplemental tackifier in accordance with Section 9-14.4(8).

9-14.4(3) BARK MULCH

Bark mulch shall consist of Douglas fir, pine, or hemlock bark. It shall 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 shall not contain resin, tannin, or any other deleterious material 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.

9-14.4(4) FERTILE MULCH AMENDMENT

Description:

- A. Fertile mulch shall be a mix of 1/3 composted biosolids and 2/3 composted organic material.
- B. Fertile mulch shall be free of weed seed, sticks, roots, trash, and other foreign material.

Quality Assurance:

- A) Biosolids shall be fully composted at an approved facility. Approved biosolid composting shall meet the requirements of the United States Environmental Protection Agency, Washington State Department of Ecology, and the state and local health departments.
- B) Compost shall consist of composted yard debris or organic waste material and shall consist of 100% recycled content. In addition, the organic material shall have the following physical characteristics:
- 1) Shall be screened using a sieve with openings no smaller than 5/16 inch and no greater than 7/16 inch.
 - 2) Shall pass a standard cress test for seed germination (90% germination compared to standard).
 - 3) Shall have a pH from 5.5 to 7.5.
 - 4) Shall have a maximum electrical conductivity of 3.0 ohms/cm.
 - 5) Shall have a maximum carbon to nitrogen ration of 40:1.
 - 6) Shall be certified by the Process to Further Reduce Pathogens (PFRP) guidelines for hot composting as established by the United States Environmental Protection Agency.

Acceptable products or sources are:

1. "Steerco"
2. "Growco"
3. "Fertil-Mulch"
4. Sawdust Supply Company, Seattle, Wa.

9-14.4(5) DECOMPOSED ORGANIC MULCH AMENDMENT

Decomposed organic mulch, or composted organic Material, shall be comprised entirely of recycled organic Materials that have been sorted, ground, aerated and aged for a minimum of one year and of which 100% passes a 7/16 inch sieve. The mulch shall have a pH between 5.5 and 7.0 and shall have a carbon to nitrogen ratio between 20:1 and 40:1 with a maximum electrical conductivity of 3 ohms/cm. The product shall be tested by a Contractor provided accredited laboratory acceptable to the Engineer. The Contractor shall submit at least 2 Working Days in advance, a Manufacturer's Certificate of Compliance stating all test requirements meet the specified requirements. The product shall be certified free of all plant parasitic organisms, viable weed seeds, heavy metals or parasitic residues.

Decomposed organic mulch quantities for Projects requiring more than 35 cubic yards shall be tested before incorporation per Section 8-02.3(4) with testing procedure and correction of deficiencies as described in subitem C. of either Sections 9-14.1(4)A or 9-14.1(4)B as applicable to the plants needs.

Decomposed organic mulch for Projects requiring 35 cubic yards or less (of the mulch) shall be delivered to the Project Site with a soil fertility and micronutrient analysis from an approved independent laboratory. Amendments shall be incorporated at the Project Site per Section 8-02.3(4) to provide optimum conditions for plant establishment and early growth.

9-14.4(6) PEAT

The peat shall be derived from sphagnum and shall conform to ASTM D 2607 unless otherwise specified in the Contract. Peat shall be shredded and granulated to pass a 1/2 inch sieve and conditioned in storage piles for at least six months after excavation. The peat shall not contain substances harmful to plant life.

9-14.4(7) VERMICULITE / PERLITE / PUMICE

Vermiculite, perlite, and pumice shall be horticultural grade and free of any toxic materials.

9-14.4(8) TACKIFIER

Tackifier used to stabilize mulch shall provide a liquid soil bonding agent which gives immediate erosion protection and remains effective for a minimum of one full year on an undisturbed site.

Tackifier shall 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 condition where the addition of tackifier is required for biofiltration swale seed mix.

9-14.4(9) COMPOSTED MATERIAL

Composted material shall be derived from a Type 1 feedstock and produced by a facility in compliance with WAC 173-350-220. The compost shall meet Grade AA Compost as defined by the Washington State Department of Ecology's Interim Guidelines for Compost Quality (Publication #94-38, Revised November 1994). Com post material shall have 100 % passing a 1/2-inch screen. The carbon to nitrogen ratio (C:N) of the compost shall be in the range of 20:1 to 35:1. Organic matter of the composted Material shall be in the range 4% and 10%, and the moisture content shall be in the range of 35% to 50% as determined by ASTM D 2974. The pH of the compost shall be within the range of 5.5 to 7.0 as determined by ASTM D 2976. The maximum electrical conductivity of composted Material shall be 6 ohms/cm. Decomposed Organic Compost shall be mature as determined by US Composting Council stability test ratings referred to in the Ch 173-350 WAC.

The product shall be tested within 6 months of proposed use, and the test results shall ensure compliance with Section 9-14.4(9) requirements. The Contractor shall submit a Manufacturer's certificate of Compliance indicating the test results, a one-gallon sample, the Supplier's name and contact information, to the Engineer a minimum of 5 Working Days in advance of use.

The compost shall have a Solvita Compost Maturity Test performed at the Project Site, and shall score a number 6 or above to be accepted. Solvita Compost Maturity Test is available from Woods End Research Laboratory, phone (207) 293-2457, or 1(800)451-0337, or www.woodsend.org.

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 shall be of a uniform open plain weave of unbleached, single jute yarn treated with a fire retardant chemical. The yarn shall be of a loosely twisted construction and shall not vary in thickness by more than 1/2 of its nominal diameter. Jute matting shall be furnished in rolled strips approximately 50 yards in length. Matting width shall 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 shall be of a uniform open plain weave of unbleached 100% jute yarn. Plastic, or any geosynthetic netting shall 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.	

An approved Material and Supplier is GeoJute Plus by Belton Industries, (800) 225-4099, www.beltonindustries.com.

9-14.5(2) COIR MATTING FOR IN-STREAM APPLICATIONS

Coir matting shall be of a uniform open plain weave of unbleached 100% coir fabric from coconut husk. Plastic, or any geosynthetic netting shall not be used for stream bank construction or restoration. When coir matting is specified in the Contract, the matting shall meet and be installed in accordance with the following table:

Slope Application	Minimum Criteria	Test Method	Pre-approved products
Slope = 1:1	25 oz/sy <40% open area	ASTM D-3776 Corp of Engineers COE CW002215	"Geocoir/Dekowe 900" by Belton Industries ¹ "Koir Mat 900" by Nedia Enterprises ²
3:1 < slope < 1:1	14 oz/sy <60% open area	ASTM D-3776 Corp of Engineers COE CW002215	Geocoir/Dekowe 700 by Belton Industries Koir Mat 700 by Nedia Enterprises
4:1 < slope < 3:1	9 oz/sy <65% open area	ASTM D-3776 Corp of Engineers COE CW002215	Geocoir/Dekowe 400 by Belton Industries Koir Mat 400 by Nedia Enterprises
Slope < 4:1	No matting required unless otherwise specified in the Contract		

Notes: 1. "Geocoir/Dekowe" by Belton Industries, www.beltonindustries.com, (800) 225-4099, and
2. "Koir Mat" by Nedia Enterprises, www.nedia.com, (888) 725-6999.

9-14.5(3) EXCELSIOR MATTING

Excelsior matting shall be a machine produced mat of wood excelsior covered on one side with a biodegradable plastic netting or twisted paper composition. The Contractor shall 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 shall be accompanied by a sample at least 3 square feet in area.

The excelsior matting shall have a wood fiber minimum dry weight of 0.8 pound per square yard ± 5 %, and shall 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 shall be a minimum 36 inches, and the length of the roll shall be approximately 150 feet.

9-14.5(4) CLEAR AND BLACK PLASTIC COVERING

Plastic covering shall meet the requirements 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 for securing erosion control matting to earth surfaces shall be a minimum 12 inches in length, and shall have sufficient strength to withstand pounding the stakes into soil flush with the surface. Stake Materials may be one or more of wire staples, steel pins, steel spikes, and wooden stakes.

9-14.6 PLANT MATERIALS**9-14.6(1) DESCRIPTION**

Seedlings are plants grown from cuttings, seeds, or other approved propagation methods. Identifiable characteristics of the various species are considered to develop when they are approximately 3 years old and a minimum 24 inches in height.

Live cuttings are freshly cut stems taken from readily rooting species and selected from vigorous two to three-year-old branches. The acceptable range of lengths and diameters of the cuttings shall be as specified in the Contract. The stems shall have clean blunt cuts on the shoot end and diagonal cuts on the rooting end. Cuttings shall be taken from dormant plants and shall not be stored longer than one week except under conditions described in Section 9-14.6(7).

All measurements for plants will be per "each" (see Section 8-02.4). Height sizing typically is measured from the top of plant to where shoot meets root, typically at the soil line.

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.

Broadleaf trees are branched, over 6 feet in height and are sized typically either by caliper or by height or by both caliper and height. Caliper is measured 8 inches above the soil line separating the root from the shoot.

Coniferous trees are over 2 feet in height and are sized typically in feet by height; however, the Bid Form may occasionally size coniferous trees by spread.

Shrubs and groundcovers begin to show form characteristic to their normal habit of growth and are sized in inches either by height or by spread or by height and spread.

Container sizes may be included in the plant description and sized typically by "inch diameter pot" container and "gallon" container.

9-14.6(2) QUALITY

With the exception of cuttings, all plant Material furnished by the Contractor shall conform to the requirements of the current issue of "American Standard for Nursery Stock" and in addition, shall comply with the following provisions:

1. All plant Material shall meet State and Federal requirements with respect to plant health and absence of diseases and insect infestation. Inspection certificates required by law shall accompany each shipment of plant Material and shall be filed with the Engineer prior to planting. All plant Material specified shall 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 shall be free from disease and insect infestation, disfiguring knots, sun-scalds, abrasions of the bark, broken tops, torn roots and any other objectionable features. Large plants cut back to meet specified sizes will not be accepted. All plants shall be nursery grown stock unless otherwise indicated in the Contract. Trees shall 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. The canopy shall be full.
2. Plants shall not have cuts over 3/4 inch diameter which are not satisfactorily callusing over. Leader shall be intact on each plant.
3. Plants furnished in pots or other containers shall be acclimated to outside conditions and equal to field grown stock.
4. Collected plant Material shall conform in quality, size, and grade to standards for nursery stock and shall be listed along with source location (Sections 1-06.1 and 1-08.3(2)) for approval at least 5 Working Days in advance of digging by the Supplier or Contractor.
5. Any plant Material that is to be replaced shall be of the same species, cultivar, and of equal size to the surviving plant Material.
6. Root balls of plant Materials shall be solidly held together by a fibrous root system and shall be composed only of the soil in which the plant has been actually growing. The ball shall be securely wrapped with non-treated jute burlap or other packing Material not injurious to the plant life. Root balls shall be free of weed or foreign plant growth.
7. Trees intended for installation as street trees shall have been grown with sufficient spacing to allow for symmetrical branch development which reflects the natural characteristics of the species. Trunks shall not be noticeably imperfect in vertical alignment, and there shall be no "included bark" in the crotches between the trunk and side branches.

Container grown plants shall 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 retains 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) shall be determined by the volume of the root ball specified in the ASNS for the same size plant Material.

All bare root plant Materials shall have a heavy fibrous root system. All plants shall be dormant at the time of planting.

Average height to spread proportions and branching shall be in accordance with the applicable sections, illustrations, and accompanying notes of the American Standard for Nursery Stock.

Plants, which 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.

9-14.6(3) HANDLING AND SHIPPING

All plant material shall be dug with care. The root system of all plant Material shall not be permitted to dry out at any time.

Evergreen and deciduous plant Materials shall be furnished balled and burlapped (B&B) unless otherwise specified in the Contract. Broken or "Made" balls will not be accepted. Balled and burlapped plants shall 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. Container grown plants shall be well-developed to hold the earth intact after removal from the container without being root bound.

Balled and burlapped trees wrapped in treated or in synthetic material shall have all wrapping material removed from the tree at the time of planting. Balled and burlapped trees with wire or other material reinforcement of the burlap material shall have all wire or other reinforcement material removed at the time of planting. In all cases, the top 2/3 of the rootball as a minimum shall have all wrapping material of any kind removed before planting.

Handling and shipping shall be done in a manner that is not detrimental to the plants.

The nursery shall furnish a notice of shipment in triplicate at the time of shipment of each carload or other lot of plant Material. The original copy shall be mailed to the Engineer, the second copy to the consignee and the third copy shall accompany the shipment to be furnished to the Engineer at the Project Site. The notice shall 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, etc. 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.

To acclimate plant Materials to Northwest conditions, all plant Materials used on a Project shall be grown continuously outdoors north of the 42nd Latitude (Oregon-California Border) from not later than April 1 of the year prior to the time of planting.

All container grown plants shall be handled by the container.

Plant Material shall be packed for shipment in accordance with prevailing practice for the type of plant being shipped, and shall be protected at all times against drying, sun, wind, heat, freezing, and similar detrimental conditions both during shipment and during related handling. Where necessary, plant Material shall be temporarily heeled in. When transported in closed vehicles, plants shall receive adequate ventilation. When transported in open vehicles, plants shall be protected by tarpaulins or other suitable cover Material.

9-14.6(4) TAGGING

Plants delivered shall 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. Labels shall give the necessary detailed information as to horticultural name, size, age, caliper or other data required to identify as conforming to Specifications. When the label is attached to a bundle, box, container, etc., containing more than one plant, information on the label shall show the quantity together with the other required information. Exception: All trees, whether furnished singly or banded, shall be individually tagged with names, size or caliper, etc., 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. Plant Material with illegible or missing tags will be rejected by the Engineer. All plants that are patented or trademarked shall have an individual tag on each plant. Plant Material tagged in the field (nursery) by the Landscape Architect shall be delivered with tags in place.

9-14.6(5) INSPECTION

The Contractor shall, as soon as practical, inform the Engineer as to the source of plant Materials for the Project (See Section 1-06.1). The Contractor shall 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.

All trees will also be inspected by the Engineer at the Project Site prior to planting.

Root condition of plants furnished in containers shall be determined by removal of the plant from the container. Plants not meeting the requirements herein specified shall be immediately removed from the Project and replaced by the Contractor at the Contractor's sole expense.

Plant Material delivered, inspected and approved for planting shall be planted immediately. Plants not immediately planted by the Contractor may be temporarily stored after receiving approval from the Engineer (see Section 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 of the Contract. If substitution is permitted, it can be made only with written approval by the Engineer in accordance with Section 1-05.3(5). The nearest variety, size, and grade as approved by the Engineer shall then be furnished.

9-14.6(7) TEMPORARY STORAGE

Plants stored under temporary conditions shall be the responsibility of the Contractor.

Plants stored in any location for use on the Project shall 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.

Plant Material delivered and accepted shall be planted immediately. Plants that cannot be planted within 1 Day after arrival shall be "heeled-in" in accordance with accepted horticultural practice, as follows:

1. Bare root plants shall 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 shall have the bundle broken and the plants placed in the trenches separately.
2. Balled and burlapped plants shall have the root ball protected by earth, sawdust, or other material acceptable to the Engineer and the material shall be kept continuously moist.
3. Live cuttings may be stored for up to seven Days, provided they are protected against loss of moisture by a minimum six 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 shall 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.

9-14.6(8) SOD

Description:

Sod shall be composed of the following:

Turf-type perennial rye grass	50%
Kentucky bluegrass	30% - 40%
Fine fescue	10% - 20%

Approved Varieties:

A. TURF-TYPE PERENNIAL RYE GRASS

Turf-type perennial rye grass shall consist of two or more of the following varieties:

Brightstar	Palmer II	Nighthawk	Prelude II	Saturn
SR 4200	Prizm	Affinity	Assure	SR 4100
Dimension	APM	Charger	Sherwood	Fiesta II
Blazer II	Stallion Sel	Tara	Commander	Birdie II

B. KENTUCKY BLUEGRASS

Kentucky bluegrass shall consist of two or more of the following varieties:

A-34	Cheri	Merit	Touchdown	Majestic
Adelphi	Columbia	Parade	Bristol	Sydsport
Baron	Fylking	Shasta	Bonnie Blue	-----

C. FINE FESCUE

Fine fescue shall consist of one or more of the following varieties:

Cindy	Janser	Salem	Flyer	Barskol
Shadow d/Endo	Southport	Ensylva	Barcrown	Promormer
Marker	Longfellow	Weekend	Tamara	-----

All sod shall comply with State and Federal law, including guaranty, with respect to inspection, plant diseases and insect infestation. Sod shipments shall have a certificate of origin and certification of approved treatment when shipment originates in known infected areas.

Sod shall be mature, densely rooted grass composed of equal amounts of two or more approved varieties of turf-type perennial rye grass and fine leafed fescues. Kentucky bluegrass may be included to provide stability for non-netted sod. Sod

shall be free of weeds and reasonably free of objectionable grasses. Plastic mesh is not allowed. Sod shall be cut to a 1 inch mowing height prior to lifting from the field.

9-14.7 TREE STAKES, GUYS, AND WRAPPING

Stakes shall 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 no. 100a). The Contractor shall be prepared to provide No. 5 deformed steel reinforcing bar as a substitute stake for compatibility with tree grates. The stakes shall be installed as shown in the Standard Plans unless the Contract indicates otherwise.

Guys shall be pre-manufactured adjustable ties made of plastic Material such as No. 2 Chainlock or approved equal.

Tree wrap shall be as indicated in the Contract.

9-14.8 SHEAR BOARDS

Shear boards shall be 2 inch x 8 inch x 8 foot non-treated, rough finished lumber. When conditions require a length less than 8 feet, the Contractor shall 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 shall be exposed aggregate concrete of the size indicated on the Drawings. Pavers shall be made from the following mix:

Material	Quantity per cubic yard
gray cement	564 pounds
5/8 inch minus gravel	2,400 pounds
building sand	1,030 pounds

A sample of exposed aggregate showing the desired amount of exposure is available at the Seattle Public Utilities' Materials Laboratory at 707 South Plummer Street.

The Contractor shall submit two sample paver blocks, which are representative of those to be used in the Project, for the Engineer's approval.

Exposed aggregate surface of all concrete paver units shall be sealed with a heavy-duty concrete enamel containing a 10% methylacrylate solution or approved equal. On request by the Engineer, the Contractor shall provide a 1 pint sample of sealant for testing. Sealant Material shall be approved by the Engineer prior to application.

9-14.9(2) INTERLOCKING CONCRETE PAVERS

Interlocking paver blocks shall be "Unistone" regular paver blocks manufactured by Westcon Construction Products Ltd., Olympia, Washington, or an approved equal.

The manufactured product shall meet the following Specifications in color, materials, physical properties configuration, and tolerances:

The color of the unit concrete paver shall be natural conforming to samples available from the Engineer. The nominal dimensions shall be:

length	9 inches
width	4-1/2 inches
thickness	2-3/8 inches

The length sides of the paver shall have two projections and two recessions per side. The projection on one side shall correspond to a recession on the opposite side. The projections and recessions shall be 3/8 inch when measured from the extension of the nominal width lines for the length of the paver.

The width sides of the paver shall have one projection and one recession per side. The projection on one side shall correspond to a recession on the other side. The projections and recessions shall be 3/8 inch when measured from the extension of the nominal length lines for the width of the paver.

The top and bottom surfaces shall be flat and parallel. The top side edge shall be chamfered 1/4 inch. The sides shall be perpendicular to the top and bottom surfaces. Full size edging pavers shall have one width side flat. Half size edging pavers shall be 1/2 the nominal length with one width side flat.

9-14.9(3) CEMENTITIOUS MATERIALS

Materials shall conform to the following:

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 shall conform to the following, except that grading requirements may not necessarily apply:

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, finely ground silica, etc., shall be previously established as suitable by the Engineer for use in concrete, and shall conform to ASTM Standards where applicable, or shall be shown by test or experience 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 shall not be less than 8000 psi with no individual paver unit less than 7200 psi.

The average absorption shall not be greater than 5%, with no individual unit greater than 7%.

The manufacturer shall 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 shall have been exposed to the same general type of environment, temperature, range, and traffic volume.

When tested in accordance with Section 8 of ASTM C 67, specimens shall not have breakage or, greater than 1.0% loss on dry weight of any individual paver unit when subjected to 50 cycles of freezing and thawing. This test shall be conducted not more than 12 months prior to delivery of units. When tested in accordance with ASTM C 418. "Abrasion Resistance of Concrete By Sandblasting" specimens shall not have volume loss greater than 0.915 cubic inch per 7.75 square inch. The average thickness loss shall not exceed 1/8 inch.

9-14.9(6) PERMISSIBLE TOLERANCE IN DIMENSIONS

Length or width of paver unit shall not differ by more than 0.059 inches and heights shall not differ by more than 0.11 inches from the specified dimensions.

9-14.9(7) VISUAL INSPECTION

All paver units shall be sounded and free of defects that would interfere with the proper placing of 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 shall be replaced.

9-14.9(8) SAMPLING AND TESTING

The Contractor shall submit three (3) samples of the paver unit to the SPU Material Laboratory for approval.

Sample units will be tested in accordance with ASTM C 140.

9-14.9(9) BASE COURSE

The base course shall be 6 inches in depth, shall conform to the requirements of Section 9-03.9(3) Crushed Surfacing, and shall consist of Mineral Aggregate Type 2, 1-1/4 inch minus crushed rock, as describe in Section 9-03. 20% "ISOLITE" CG2 shall be incorporated into the base course in paver areas extending the width of the sidewalk adjacent to tree pits (a 8' x 7" surface area per pit).

9-14.9(10) TOP COURSE OR KEYSTONE

The Top Course shall be 2 inch in depth and shall conform to the requirements of Section 9-03.9(3) Crushed Surfacing and shall consist of Mineral Aggregate Type 1, 5/8" inch minus crushed rock, as describe in Section 9-03. 20% "ISOLITE" CG2 shall 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).

9-14.9(11) LEVELING COURSE

The Leveling Course shall conform to the requirements of Section 9-03.11 Crushed Gravel, as modified herein.

The Material shall be 3/8 inch minus chip rock with the following gradation:

Sieve Size	% Passing
3/8 inch	98
1/4 inch	50 – 90
No. 4	25 – 55
No. 6	0 – 20
No. 10	0 – 10
No. 40	0 – 5
No. 200	0 – 3

No. 200 sieve size passing shall be brought to the job bagged and dry.

9-14.9(12) BEDDING SAND

The Bedding Sand shall conform to the requirements of Section 9-03.12(6) Washed Sand and Gravel and shall consist of Mineral Aggregate Type 6, washed sand, as described in Section 9-03.

9-14.9(13) JOINT FILLING SAND

The joint filling sand shall have the following grading:

Sieve Size	% 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 shall be 100%. This Material is crushed sand, available from:

Manufacturers Mineral Company
1215 Monster Road Southwest
Renton, Washington 98055
425-228-2120

9-14.9(14) EDGING

Pre manufactured edging shall be Pave Edge, or Bric-edge manufactured by Oly`Ola Sales (1-800-EDGINGS) or approved equal.

9-14.10 TURF REINFORCEMENT

Turf reinforcement shall be "Grasspave²" by Invisible Structures, Inc or approved equal.

9-14.11 CEDAR EDGING

Material for edging shall be 2 inch x 4 inch cedar, construction grade or better with tight knots.

9-14.12 BOLLARDS**9-14.12(1) WOOD BOLLARDS**

Bollards shall be nominal 8 inch x 8 inch, 90 Day stack dry, select Douglas Fir. Bollards shall be pressure-treated (by closed cylinder method) with Pentachlorophenol after cutting and predrilling. Tops and four sides of bollards shall 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 (bolts, nuts, washers, etc.) shall be hot-dipped galvanized.

9-14.12(2) CONCRETE BOLLARDS

Concrete bollards shall be made of Class 5 (3/4) concrete (see Section 5-05), reinforced with four No. 4 deformed steel bars placed one inch clear below the concrete surface and held in place with No. 8 gauge wire ties. After forms are removed, concrete shall show a smooth dense face. Any surface irregularities showing above grade shall be scraped or stoned off; the surface shall then be washed and a 1:1 mortar shall be brushed on. After the initial set but before the final set, the excess mortar shall be rubbed off using burlap sacking or pieces of carpeting. The bollards shall then be cured by being kept damp with water for not less than 2 Days.

9-14.12(3) RESERVED**9-14.12(4) PADLOCKS FOR REMOVABLE BOLLARDS**

The padlock shall 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 shall be of the type indicated in the Contract.

9-14.14 TREE GRATES

Tree grates shall be manufactured in 2 equal sized sections made of gray iron conforming to ASTM A536, GR80-56-06. Grates shall have a 3/4 inch nominal thickness and cover an area not less than 24 square feet. To accommodate tree growth, the grates shall have 3 or 4 centrally located concentric break-out rings allowing a 12 inch minimum to 30 inch maximum opening either in diameter. Break out rings shall have no more than 6 points of attachment per grate section and shall be scored to allow ease of expansion for tree growth. Grates shall be designed to not fail under a wheel load of up to 4000 pounds except at the break-out rings.

9-14.15 IN-STREAM LOGS

In-stream logs shall consist of tree shoot with or without limb, and tree root and rootwad. In-stream log may include the use of on-site tree identified for removal.

In-stream log shall be cedar, douglas fir, or other species tree as specified in the Contract. Logs shall be of sound quality, shall not be split or cracked, and shall be clean and free of insects, rot, decay, soil, rock, and other deleterious material.

The shoot portion of the tree shall not contain any root and may have any alignment unless the Contract specifies otherwise. The logs shall not be limbed; however, may require trimming of limbs to dimensions as specified in the Contract.

The Contract will specify log length(s) and diameter(s), and may specify a range of butt and tip diameters. Unless the Contract specifies otherwise, tree diameter will be measured as specified in Section 2-02.3(3)l. The root section dimension will contain a minimum and/or maximum diameter and may require trimming approximating a plane.

9-14.16 WATTLES

Wattles shall act as a screen or filter and shall consist of biodegradable plant material such as any combination of twigs, wicker, bamboo, other withes, straw, coir, and wood shavings in the shape of cylinders typically ranging from 10 inch to 16 inch diameter and of any length. The wattle shall be encased within biodegradable netting.

SECTION 9-15 IRRIGATION SYSTEM**9-15.1 PIPE AND FITTINGS****9-15.1(1) GENERAL**

Pipe shall be galvanized iron, PVC, or polyethylene, as specified in the Contract.

9-15.1(2) GALVANIZED PIPE AND FITTINGS

Pipe shall be standard weight, hot-dipped galvanized iron or steel pipe, threaded and coupled. Pipe shall meet the requirements of ASTM A 120.

9-15.1(3) POLYVINYL CHLORIDE PIPE AND FITTINGS

PVC pipe upstream of the control valves shall be schedule 40 and conform to all requirements of ASTM D 1785.

PVC pipe downstream of the control valves shall be pressure rated for 200 psi and conform to all requirements of ASTM D 2241, SDR 21.

Fittings shall be of the solvent weld type except where risers, valves, etc., require threaded transition fittings. Fittings shall conform to the requirements of ASTM D 2466.

PVC pipe and fittings shall be non-toxic, free from taste and odor, and self-extinguishing.

Pipe shall be homogenous throughout and free of defects cracks, holes, foreign Materials, wrinkles, dents and blisters.

PVC pipe shall 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 shall be Class 80, SDR 15, medium density polyethylene pipe, meet the requirements of 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 shall be copper refrigerator tubing meeting the current requirements of ASTM B 280 in the size specified on the Drawings. Tubing and fittings shall be capable of withstanding a 300 psi operating pressure, and shall be of the size indicated on the Drawings.

9-15.3 SLEEVE

Pipe sleeves shall be PVC schedule 40. Sizes and installation shall be in accordance with the Drawings and Standard Plan no. 128.

Conduit shall meet the requirements of Section 9-34.

9-15.4 IRRIGATION AUTOMATIC CONTROLLERS

Automatic controllers shall be installed in electrical controller cabinets on a concrete base as shown on Standard Plan no. 129. The dimensions and details of the controller cabinet shall be as shown on Standard Plan no. 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 shall 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 shall be enclosed in a weatherproof metal enclosure. The Contractor shall submit a Shop Drawing of the padlock secured enclosure sized adequately to hold all specified equipment. The enclosure shall include a modified free-standing shelf measuring 12 inches x 12 inches x 15 inches 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 shall be behind a dead front panel. The controller

shall be solid state and capable of operating the irrigation system as designed and constructed and shall include the following operating features:

1. Each controller station shall be adjustable for setting to remain open for any desired period of time - from five minutes or less to at least one hour.
2. Adjustments shall 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 shall continue automatically within a 14 Day cycle until the operator desires to make new adjustments.
3. Controls shall allow any position to be operated manually both on or off whenever desired.
4. Controls shall provide for resetting the start of the irrigation cycle at any time and advancing from one position to another.
5. Controllers shall contain an on-off switch and fuse assembly.
6. Controller adjustments shall be such that the open cycle may be doubled or repeated not less than 3 times during the complete watering cycle.
7. Controller shall have a power failure cutout.
8. Controller shall be UL approved and marked accordingly.

Contractor shall provide an outdoor rated padlock by Best Manufacturing Company with a removable blue core.

9-15.5 SPRINKLER HEADS

Sprinkler heads shall 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 shall be designed so that spray adjustments can be made by either an adjustment screw or interchangeable nozzles. Watering cores shall be easily removed without removing the housing from the pipe.

All turn heads shall 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 shall 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 (see Sections 1-02.4(1) and 1-05.3(5)). The Contractor shall design the layout of such systems incorporating efficient and adequate coverage without overspray.

9-15.6 ELECTRICAL WIRE

Wire from controller to valves shall be #14 UF direct burial (UL approved), red or black for the hot side, white for neutral (solid copper). The auxiliary wires, where required, shall be any third color (except green). UF and UL designations shall be clearly marked on the insulation jacket of all wires.

9-15.7 IRRIGATION VALVES

9-15.7(1) GATE VALVES

Gate valves, when called for on the Drawings, shall be heavy duty bronze conforming to the requirements of ASTM B 62. Valves shall be of the same size as the pipes on which they are placed and shall have union or flange connections. Service rating (for non-shock cold water) shall be 300 psi. Valves shall be of the double disk, taper seat type, with rising stem, union bonnet and handwheel. Manufacturer's name, type of valve and size shall be cast on the valve.

9-15.7(2) CONTROL VALVES

9-15.7(2)A MANUAL CONTROL VALVES

Manual valves shall be bronze or brass, angle type with hex brass union. Service rating shall be not less than 150 psi nonshock cold water. Valves shall be designed for underground installation with suitable cross wheel for operation with a standard key. The Contractor shall furnish three suitable operating keys per Contract. Valves shall have removable bonnet and stem assembly with adjustable packing gland and shall house long acme threaded stem to ensure full opening and closing. Valve discs shall be full floating with replaceable seat washers.

9-15.7(2)B AUTOMATIC CONTROL VALVES

Automatic remote control valves shall be globe pattern with flanged or screwed connections as required. The valve shall be constructed so as to allow all internal parts to be removable from the top of the valve without disturbing the valve installation. Screwed valves shall be provided with union connections.

Valves shall be of a "normally closed" design and shall be electric solenoid operated, having maximum rating of 6.5 watts utilizing 24 volts AC power. Solenoids shall be directly attached to the valve bonnets or body with all control parts and ports completely internal. Valves shall be of 150 psi brass or bronze, or iron body bronze-mounted combination. The time interval for valve closing operation shall 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 shall 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 shall 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 shall 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 shall be similar to the automatic control valve and shall also reduce the inlet pressure to a constant lower pressure regardless of supply fluctuations. The regulator shall be fully adjustable.

9-15.7(3) QUICK COUPLER VALVES

Quick coupler valves shall have a service rating not less than 125 psi for nonshock cold water. The body of the valves shall be of cast leaded semi-red brass alloy No. C84400 conforming to ASTM B 584. The base of the valve shall have standard female pipe threads. The design of the valve shall 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 shall be designed with double worm slots to allow smooth action in opening and closing of the valve with a minimum of effort. Slots shall be notched at the base to hold the coupler firmly in the open position. Couplers shall be of the same material as the valve body with stainless steel double guide lugs to fit the worm slots. Couplers shall be of one piece construction with steel reinforced side handles attached. All couplers shall have standard male pipe threads at the top. Couplers shall be furnished with all quick coupler valves unless otherwise specified in Contract. See Standard Plan no. 121.

9-15.7(4) DRAIN VALVES

The Contractor shall install a 3/4 inch male automatic ball check drain valve at the low point in the system. The drain valve shall be drained to a pocket containing a minimum of 1/2 cubic yard of Mineral Aggregate Type 4. See Standard Plan no. 122.

9-15.7(5) CHECK VALVES

Check valves shall be heavy duty bronze or steel. The valves shall function by means of a hinged disc suspended from the body and able to close of its own weight. Valves shall be of the size as the pipes on which they are placed, unless otherwise specified in the Contract, and shall have union or flanged connections. Service rating (for non-shock cold water) shall be 300 psi. Manufacturer's name, type of valve and size shall be cast on the valve.

9-15.7(6) PRESSURE REDUCING VALVES

Pressure reducing valves shall have a minimum of 150 psi working pressure with an adjustable outlet range of 20 to 70 psi. The valves shall be factory set as shown on the Drawings.

Pressure reducing valves shall be rated for safe operation at 175 psi non-shock cold water.

9-15.7(7) THREE WAY VALVES

Three way valves shall be tight closing, three port, ball or plug type, constructed to permit straight through and 90 degree flow only. The valve shall be of bronze or approved corrosion resistant body Materials and shall have a minimum of 150 psi working pressure. The head of the valve, or handle when applicable, shall be permanently marked to indicate port position. Whenever handles are included as an integral part of the valve, the Contractor shall remove the handles and give them to the Engineer for ultimate distribution to the Maintenance Division.

9-15.7(8) FLOW CONTROL VALVES

Valve body materials shall be plastic or metal. Internal parts shall be stainless steel. Valves shall be factory set to design flows. Valves shall have no external adjustment and be tamper proof when installed. One-quarter inch and smaller flow control valves shall have a minimum pressure absorption range of 2 to 32 psi. One and one half inch and larger flow control valves shall have a minimum pressure absorption range of 3 to 50 psi.

Flow shall be controlled to 5 percent of design volumes.

9-15.7(9) AIR RELIEF VALVE

The air relief valve shall automatically relieve air and break a vacuum in the serviced pipe. Body Materials shall be installed exactly at all high points.

9-15.8 VALVE BOXES

All automatic control valves, flow control valves, and pressure reducing valves shall be provided with valve boxes. Valve boxes shall be sized as appropriate to allow efficient access to components and shall be approved by the Engineer prior to installation. Valve boxes shall be extendable to obtain the depth required. Where 1 inch diameter Schedule 80 PVC braces are required for quick coupler valves as indicated on Standard Plan no. 121, the box shall have holes adequately sized to securely snug fit the brace. All manual drain valves and manual control valves shall be equipped with a protective sleeve and cap as shown in the Standard Plans.

9-15.9 BACKFLOW PREVENTION ASSEMBLIES

Backflow prevention assemblies shall be as specified in Section 9-30.16.

9-15.10 HOSE BIBS

Hose bibs shall be constructed of bronze or brass, angle type threaded to accommodate a 3/4 inch hose connection, and shall be key operated. Design shall be such as to prevent operation by wrench or pliers.

9-15.11 DETECTABLE MARKING TAPE

Detectable marking tape shall 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 shall be color coded and shall be imprinted continuously over its entire length in permanent black ink. The message shall convey the type of line buried below and shall also have the word "Caution" prominently shown. Color coding of the tape shall be as follows:

Utility	Tape Color
Water	Blue
Sewer	Green
Electrical	Red
Gas-Oil	Yellow
Telephone-CATV	Orange

The width of the tape shall 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 shall be new. Iron or steel Material shall 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 shall conform to the requirements of ASTM F 1083. The base Material for the manufacture of steel H columns shall meet the requirements of ASTM A 663 or ASTM A 675.

Roll-formed posts, braces, and rails shall be made from sheet steel and shall conform with the details as shown on the Drawings or Standard Plan no. 450b. The Material for end, corner, and pull posts shall have a minimum yield strength of 35,000 psi. The minimum yield strength for Alternate A roll-formed line posts shall 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 shall conform to the minimum yield strength as required for either post respectively.

All posts, braces, top rails, and gate frames shall be hot-dip galvanized. They shall 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 shall be galvanized in accordance with the requirements of ASTM F626. Other Materials shall be galvanized in accordance with the requirements of ASTM A153.

9-16.1(2) POSTS

All posts for chain link fence shall be of the shape, size, and weight per foot shown on Standard Plan no. 450b. Roll-formed end, corner, and pull posts shall be made from 0.1345 inch minimum thickness sheet steel and shall have integral fastening loops to connect to the fabric for the full length of each post. Roll-formed line posts shall be made from 0.110 inch minimum thickness sheet steel for Type 3 and Type 4 fences and shall 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 shall be applied on an individual post basis and shall be plus or minus 5 percent for tubular and H-section posts and plus or minus 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 shall be of the type and size shown on Standard Plan no. 450b. Tension truss rods shall be 3/8 inch round galvanized rods with drop forged turnbuckles, or other approved type of adjustment. Couplings for tubular sections shall be outside sleeve type and at least 6 inches long. Roll-formed top and brace rails shall be made from 0.0747 inch thick sheet steel and shall be an open rectangular section with internal flanges. The acceptable thickness tolerance for sheet steel members shall be ± 0.006 inch.

9-16.1(4) TENSION WIRE AND ATTACHMENTS

Top and bottom wire shall be 7 gage coil spring steel wire of good commercial quality and shall have a zinc coating averaging 0.8 ounce per square foot of surface area. All tension wire attachments shall be hot-dip galvanized steel. Eye bolts shall be 3/8 inch diameter and of sufficient length to fasten to the type of posts used.

9-16.1(5) RESERVED**9-16.1(6) FITTINGS**

All fittings and miscellaneous hardware shall be malleable cast iron or pressed steel. Fittings shall be galvanized in accordance with ASTM F 626. Galvanizing of miscellaneous hardware not covered by ASTM F626 shall be in conformance with ASTM A 153. Fittings for any particular fence shall be those furnished by the manufacturer of the fence.

9-16.1(7) CHAIN LINK FENCE FABRIC

Chain link fabric shall 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 shall be selected for use in any one Contract:

1. Galvanized steel wire conforming to ASTM A 392.
2. Galvanizing shall be Class I performed by the hot-dip process.
3. Aluminum coated steel wire conforming to ASTM A491.
4. Class II aluminum wire conforming to 6061-T94 alloy.

The wire shall be woven into approximately 2 inch diamond mesh. The width and top and bottom finish of the fabric shall be as shown in Standard Plan nos. 450a and 450c.

9-16.1(8) FABRIC BANDS AND STRETCHER BARS

Fabric bands shall be 1/8 inch by 1 inch nominal and stretcher bars 3/16 inch by 3/4 inch nominal. Nominal shall be construed to be the area of the cross-section of the shape obtained by multiplying the specified width by thickness. A variation of plus or minus 5 percent from this theoretical area shall be construed as "nominal" size. Both shall be hot-dip galvanized to meet the requirements of ASTM F 626.

9-16.1(9) TIE WIRE

Tie wire shall be 9 gage aluminum wire complying with the ASTM B 211 or 9 gage galvanized wire meeting the requirements of AASHTO M279. Galvanizing shall be Class 1. Hog rings shall meet the requirements of AASHTO M279. Galvanizing shall be Class 1.

9-16.1(10) CHAIN LINK GATES

Gate frames shall 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 shall be fastened together and reinforced with a malleable iron or pressed steel fitting designed for the purpose, or they may be welded. Welding shall conform to the requirements of Section 6-03.3(25). All welds shall be ground smooth and painted with a high zinc dust content paint meeting the requirements of MIL-P-21035. The paint shall be applied in one or more coats to provide a dry film thickness of 3.5 mils minimum.

Cross trussing shall be 3/8 inch galvanized steel adjustable rods.

Chain link gate fence fabric Material shall be the same as used for the chain link fence (see Section 9-16.1(7)).

Each gate shall 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 shall have positive type latching devices with provisions for padlocking.

Gate frames constructed of steel sections, other than 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(11) MISCELLANEOUS

All concrete shall 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 shall be new. All iron or steel material shall be galvanized. Imperfectly galvanized material or material upon which serious abrasions of galvanizing occur shall not be used.

9-16.2(2) STEEL FENCE POSTS AND BRACES

All posts for chain link fence shall be of the shape, size, and weight per foot shown in Standard Plan no. 450b. Roll-formed end, corner, and pull posts shall be made from 0.1345 inch minimum thickness sheet steel and shall have integral fastening loops to connect to the fabric for the full length of each post. Roll-formed line posts shall be made from 0.110 inch minimum thickness sheet steel for Type 3 and Type 4 fences and shall 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 shall be used throughout the Project. Line posts shall 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 shall have a minimum weight of 1.33 pounds per linear foot and shall 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 \pm 2 square inches.

End, corner, gate, and pull posts shall meet the requirements specified for line posts, except that the posts shall have a minimum weight of 3.1 pounds per linear foot and anchor plates and special studs, slots, or adapters for the attachment of wires will not be required.

Braces shall have a minimum weight of 3.1 pounds per linear foot.

All posts, braces, anchor plates, and hardware not covered by ASTM F 626 shall be galvanized in accordance with the requirements of 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 shall be used in the construction of wood fence posts and braces. The material shall be of good quality and approved by the Engineer before use. Peeler cores shall not be used for round posts. Wood fencing materials shall have sufficient sapwood in the outer periphery to obtain the specified penetration of preservative. Fencing materials shall be cut to the correct length before pressure treatment.

Line posts shall be 3 inch minimum diameter round posts or nominal 3 inch by 3 inch square sawed posts. If the posts are to be pointed for driving, they shall be pointed before treatment. Line posts shall be at least 7 feet in length.

Pull posts and brace posts shall be 6 inch diameter round posts or nominal 6 inch by 6 inch Material not less than 7 feet in length.

End, gate, and corner posts, and posts at an intersecting fence shall be 6 inch diameter round posts or nominal 6 inch by 6 inch material not less than 7 feet 10 inches in length.

All sawed posts and timbers shall meet the requirements of Section 9-09.2.

The preservatives used to pressure-treat wood fencing materials shall meet the requirements of Section 9-09.3.

The retention and penetration of the preservative shall be as follows:

Minimum Retention in Pounds Per Cubic Foot		
Preservative	Sawed Posts	Round Posts
Creosote	10.00	8.00
Pentachlorophenol	0.50	0.40
ACA	0.40	0.40
ACZA	0.40	0.40
ACQ	0.40	0.40

Minimum Penetration	
for material less than 5 inch	0.40 inches penetration and 90% of sapwood
for material 5 inch or greater	0.50 inches penetration and 90% of sapwood

9-16.2(4) BRACE WIRE

Brace wire shall be 9 gage galvanized wire meeting the requirements 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 shall be galvanized 9 gage, 1-1/2 inches long meeting the requirements of AASHTO M 279, galvanizing Class 1.

The wire clamps used to attach the wire fencing to steel posts shall be galvanized 11 gage wire meeting the requirements of AASHTO M 279, galvanizing Class 1.

9-16.2(6) BARBED WIRE

Barbed wire shall conform to the requirements of AASHTO M280, and shall consist of two strands of 12-1/2 gage wire, twisted with four point 14 gage barbs with the barbs spaced an average of 5 inches apart. Galvanizing shall be Class 3.

9-16.2(7) WIRE MESH

Wire mesh shall conform to the requirements of AASHTO M279, and shall consist of seven horizontal wires with vertical stays spaced 6 inches apart. The top and bottom wires shall be 10 gage, and the intermediate wires and vertical stays shall be 12-1/2 gage. The mesh shall have a total width of 26 inches (Design No. 726-6-12-1/2). Galvanizing shall be Class 3. The zinc-coated wire as represented by the test specimens shall 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.

9-16.2(8) VERTICAL CINCH STAYS

Vertical cinch stays shall be 9-1/2 gage galvanized wire meeting the requirements of AASHTO M279, except that the minimum weight of zinc coating shall be 0.3 ounce per square foot of uncoated wire surface.

9-16.2(9) WIRE GATES

Gate frames shall be constructed of galvanized standard weight pipe with a nominal diameter of not less than 1 inch. The pipe shall conform to the requirements of ASTM A53. Wire gates shall be not less than 48 inches in height and shall be designed to fit openings of the widths called for in the Contract. Each gate shall be provided with two upright braces of the same material as the frame, spaced at 1/3 points in the gate. All gates shall be provided with adjustable 3/8 inch diameter diagonal truss rods from corner to corner.

The gate frame shall be provided with wire mesh conforming to the requirements specified in Section 9-16.2(7), except that it shall consist of 10 horizontal wires and have a total width of 47 inches (Design No. 1047-6-12-1/2).

Each gate shall be furnished complete with necessary hinges and latch designed for use with the type of gate posts used on the Project. The hinges shall be so designed as to be securely attached to the gate post and to enable the gate to be swung back against the fence.

Double gates shall be hinged in the same manner as single gates and shall 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 shall be galvanized in accordance with AASHTO M 232.

All concrete shall be Class 3000 in accordance with 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 shall conform to "A Guide to Standardized Highway Barrier Hardware" published by AASHTO, AGC, and ARTBA. All rail elements shall be formed from 12-gage steel except for thrie beam used for bridge rail retrofit and Design F end sections, that shall be formed from 10 gage steel.

The rail splices shall have a minimum total ultimate strength of 80,000 pounds at each joint.

The 6 inch channel rails and splice plates shall conform to ASTM A36. All fabrication shall be complete before galvanizing.

The holes in the plate shall be slotted to facilitate erection and to permit expansion and contraction. The edges of the rail shall be rolled or rounded so they present no sharp edges. Where the rail is on a curve, the plates at the splice shall make contact throughout the area of splice. When the radius of curvature is less than 150 feet, the rail shall be shaped in the shop.

9-16.3(2) POSTS AND BLOCKS

Posts and blocks may be of creosote treated timber, pentachlorophenol treated timber, waterborne ammoniacal copper arsenate (ACA), 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 meet NCHRP Report 350 criteria may be used in accordance with the manufacturer's recommendations. Except for terminal or anchor assemblies, all posts for any one Project shall be of the same type (wood or steel). Posts and blocks shall be of the size and length shown in WSDOT Standard Plan nos. C-1 and C-1a and meet the requirements of these Specifications. Post and block may be S4S or rough sawn.

Timber posts and blocks shall 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 shall be fabricated as specified in the WSDOT Standard Plans before being treated. Timber posts and blocks shall be treated by the empty cell process to provide a minimum retention, depending on the treatment used, according to the following:

Creosote oil	12 lbs. pcf. of lumber
Pentachlorophenol	0.60 lbs. pcf. of lumber
ACA	0.50 lbs. pcf. of lumber
ACZA	0.50 lbs. pcf. of lumber
ACQ	0.50 lbs. pcf. of lumber

Treatment shall be in accordance with Section 9-09.3.

Steel posts, blocks, and base plates, where used, shall conform to ASTM A 36, and shall be galvanized in accordance with AASHTO M111. Welding shall conform to Section 6-03.3(25). All fabrication shall be completed prior to galvanizing.

9-16.3(3) GALVANIZING

Beam rail elements and terminal sections shall be galvanized in accordance with AASHTO M 180, Class A, Type 2, except that the rail shall 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 shall be 2 ounces per square foot of surface (not sheet), the average to be determined on the basis of three 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 shall not exceed 0.01 percent. Channel rails, splice plates, WF steel posts, and base plates shall be galvanized in accordance with ASTM A 123. Anchor cables shall be galvanized in accordance with Federal Specification RR-W-410, Table II,

galvanized at finished size. Bolts, nuts, washers, plates, rods, and other hardware shall be galvanized in accordance with ASTM A 153.

9-16.3(4) **HARDWARE**

Bolts, unless otherwise specified in other Standard Specifications or in the Standard Plans, shall comply with ASTM A 307, Grade A specifications. High strength bolts shall conform to the requirements of AASHTO M 164. Nuts shall comply with ASTM A 563, Grade A specifications. Washers, unless otherwise specified in other Standard Specifications or in the Standard Plans, shall meet ASTM F 844 specifications. The Contractor shall 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 shall conform to Section 6-03.3(25).

All welding shall be at least equal in strength to the parent metal.

All fabrication shall 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 shall be fabricated from steel conforming to the requirements of ASTM A 500, Grade B, or ASTM A 501.

The anchor plate assembly shall develop a minimum tensile strength of 40,000 pounds.

The anchor plate, W200 x 27 and metal plates shall be fabricated of steel conforming to the specifications of ASTM A 36.

Anchor cable shall be ¾-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 shall be furnished to the Engineer.

Swaged cable fittings shall develop 100 percent of the specified breaking strength of the cable. One swaged fitting attached to 3 feet of cable shall be furnished to the Engineer for testing.

The swaged fitting and stud assembly shall be of steel conforming to the requirements of American Iron and Steel Institute C-1035 and shall be annealed and galvanized suitable for cold swaging.

Welded wire fabric for Type 1 anchor shall 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 shall be hot-dip galvanized in accordance with Section 9-16.3(3).

Cement concrete, of the class specified, shall conform to the applicable requirements of Section 6-02.3.

Cement grout shall consist of one part Portland cement and two parts sand.

9-16.3(6) **INSPECTION AND ACCEPTANCE**

The Contractor shall give 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 shall arrange for all facilities necessary for the inspection of material and workmanship at the point of fabrication of the rail element, and Inspectors shall be allowed free access to necessary parts of the premises.

The Inspector shall have the authority to reject materials or workmanship which do not fulfill the requirements of 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 meets the requirements of 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 meets the Specification requirements. 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 shall 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 shall consist of No. 9 gage (0.148 inch diameter) commercial quality zinc coated steel wire, 3-1/2 inches x 5-1/2 inches diamond mesh chain link conforming to the requirements of AASHTO M181. Galvanizing shall conform to the requirements of ASTM A392 except the weight of zinc coating shall be 0.80 ounce per square foot minimum, of uncoated wire surface. Galvanizing shall be done before weaving.

The wire mesh fabric shall have knuckled selvages.

Alternate wire mesh for slope protection shall be double twisted mesh. The mesh shall 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 inch after galvanization. The wire shall be galvanized prior to weaving into the mesh and shall conform to ASTM A 641, Class 3, Finish 5, Soft temper. The minimum tensile strength shall be 60,000 psi when tested in accordance with ASTM A 370. Openings shall be hexagonal in shape and uniform in size measuring not more than 3-1/4 inches by 4 ½ inches, approximately 9 square

inches. Lacing wire shall be the same specifications as the wire used in the wire mesh except that its diameter shall be 0.0866 inch after galvanization.

Edges shall be mechanically selvaged in such a manner as to prevent unraveling, and shall develop the full strength of the mesh. The wire used for the selvage shall have a nominal diameter of 0.1535 inch.

9-16.4(3) WIRE ROPE

Wire rope shall be 5/8 inch diameter zinc coated steel structural wire rope conforming to the requirements of ASTM A 603, Class A.

9-16.4(4) HARDWARE

All rings shall be drop-forged steel, heat treated after forging. Lightweight wire rope thimbles weighing approximately 13.8 pounds per hundred shall 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 shall be galvanized in accordance with AASHTO M232, Class C, except castings shall be Class A, and forgings shall be Class B.

9-16.4(5) HOG RINGS AND TIE WIRE

Hog ring fasteners and tie wire shall be manufactured of 9 gauge steel wire meeting 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 shall consist of one part Portland cement and three parts of clean sand. The Portland cement shall conform to the requirements of Section 9-01.2(1).

9-16.4(7) ANCHOR RODS

Anchor rods shall be of good quality steel. The eye may be drop forged or formed with a full penetration weld and shall develop 100 percent of the rod strength. The anchor rod shall be galvanized in accordance with ASTM A 153.

9-16.5 RESERVED

9-16.6 GLARE SCREEN

9-16.6(1) GENERAL

All material used in the construction of the fence shall be new. Iron or steel material shall be galvanized or aluminum coated as specified. Imperfectly galvanized or aluminum coated material, or material upon which serious abrasions of galvanizing or aluminum coating occur, will not be acceptable.

9-16.6(2) GLARE SCREEN FABRIC

Glare screen fabric shall consist of diamond woven wire mesh. The fabric wire may be 0.148 inch diameter aluminum alloy complying with the Aluminum Association requirements for alloy 6061T94, or it may be 0.148 inch diameter (9 gage) iron or steel wire which shall meet all of the requirements of ASTM A392 galvanized or A 491 for aluminum coated, except that galvanizing of Type 2 glare screen fabric shall be not less than 0.8 ounce per square foot and shall be done before weaving. Aluminum coating shall be Class II.

Type 1 glare screen mesh size shall be approximately a 1 inch diamond. Type 2 glare screen mesh size shall be a maximum of 3-1/2 inch vertical and 5-1/2 inch horizontal. The design shall permit the slats to be installed in a vertical position as shown in WSDOT Standard Plans without distortion of the slats.

9-16.6(3) POSTS

Line posts for Type 1 glare screen shall be 1.5 inches by 1.875 inches hot-dip galvanized steel H column with a minimum weight of 2.8 pounds per linear foot. Line posts for Type 2 glare screen shall be 1.95 inches by 2.25 inches hot-dip galvanized steel H column with a minimum weight of 4.0 pounds per linear foot, or 2 inch inside diameter hot-dip galvanized steel pipe with a nominal weight of 3.65 pounds per linear foot provided only one type shall be used on any one Project.

End, corner, brace, and pull posts shall be 2 inch inside diameter hot-dip galvanized steel pipe with nominal weight of 3.65 pounds per linear foot. Intermediate pull posts (braced line posts) shall be H column as specified for line posts. Brace post sleeves shall be 2-1/2 inch inside diameter hot-dip galvanized steel pipe with nominal weight of 5.79 pounds per linear foot.

The base material for the manufacture of steel pipes used for posts shall conform to the requirements of ASTM A 53, except the weight tolerance on tubular posts shall be applied as follows. The base material for the manufacture of steel H columns shall meet the requirements of ASTM A675.

Posts provided for glare screen will have an acceptance tolerance on the weight per linear foot, as specified, equal to plus or minus 5 percent for tubular and H-section posts. This tolerance applies to each individual post.

All posts, braces, and top rails shall be hot-dip galvanized. They shall 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 of weight of coating is defined as a 12 inch piece cut from each end of the galvanized member.

9-16.6(4) TENSION WIRE

Top and bottom tension wire shall be 7 gage coil spring steel wire of good commercial quality and shall have a zinc coating averaging 0.8 ounces per square foot of surface area.

9-16.6(5) CABLE

The tension cable shall be 1/4 inch diameter aluminum coated or hot-dip galvanized, 7 wire strand steel cable conforming to the requirements of ASTM A474 for aluminum coated or ASTM A475 for galvanized, High-Strength Grade. Galvanizing shall be Class A.

9-16.6(6) CABLE AND TENSION WIRE ATTACHMENTS

All tension wire and cable attachments shall be hot-dip galvanized steel conforming to the requirements of AASHTO M232 unless otherwise specified in the Contract. Eye bolts shall have either a shoulder or a back-up nut on the eye end and be provided with an eye nut where needed or standard hex nut and lock washer and be 5/8 inch diameter for tension cable and 3/8 inch diameter for tension wire and of sufficient length to fasten to the type of posts used. Where the eye bolt is to be installed through a pipe section, two lead washers and one steel washer shall also be provided. Turnbuckles shall be of the shackle end type, 1/2 inch diameter, with standard takeup of 6 inches and provided with 3/8 inch diameter pins. Thimbles shall be light weight wire rope thimbles for use with 1/4 inch diameter cable. Wire rope clips shall have a U-bolt diameter of 5/16 inch for use with 1/4 inch diameter cable. Anchor shackles shall be 3/8 inch diameter with a minimum distance between eyes of 1-1/16 inch and a pin diameter of 7/16 inch. Seizing shall be 0.032 inch diameter galvanized annealed iron wire.

9-16.6(7) SLATS**9-16.6(7)A WOOD SLATS**

Wood slats shall be 3/8 inch by 2-3/8 inch by the height designation of the fence. Material shall be finished and treated cedar or redwood and shall be free from loose knots, cracks, and other imperfections. A dimensional tolerance of $\pm 1/16$ inch in width or thickness is allowed provided that the maximum space between slats does not exceed 3/4 inch.

9-16.6(7)B PLASTIC SLATS

Plastic slats shall be 3/8 inch by 2-3/8 inch by the height designation of the fence. They shall be manufactured from tubular polyethylene color pigmented material consisting of high density virgin polyethylene and color pigments, designed to retard ultraviolet penetration. The material shall have a minimum wall thickness of 0.0030 inch \pm 0.0003 inch and shall remain flexible without distortion and without becoming brittle through a temperature range of -70°F to +250°F. Tensile strength shall be at least 3600 psi and the melt index shall not exceed 0.25.

Plastic slats shall be retained in place by means of U-shaped retainer members at the bottom and top of the fence. Retainer members shall be of the same material as the slats.

The color for plastic slats will be approved by the Engineer from samples submitted by the Contractor.

9-16.6(8) FITTINGS

Fittings shall be malleable cast iron or pressed steel and galvanized in accordance with the requirements of AASHTO M232.

Fittings for any particular fence shall be those furnished by the manufacturer of the fence.

9-16.6(9) FABRIC BANDS AND STRETCHER BARS

Fabric bands shall be 1/8 inch by 1 inch nominal and stretcher bars 3/16 inch by 3/4 inch nominal. Nominal shall be construed to be the area of the cross-section of the shape obtained by multiplying the specified width by thickness. A variation of minus 5 percent from this theoretical area shall be construed as "nominal" size. Both shall be hot-dip galvanized to meet the requirements of ASTM F 626.

9-16.6(10) TIE WIRE

Tie wire shall be 9 gage aluminum wire complying with the ASTM B 211 for alloy 1100 H14 or 9 gage galvanized wire meeting the requirements of AASHTO M279. Galvanizing shall be Class 1.

9-16.7 RESERVED**9-16.8 WEATHERING STEEL BEAM GUARDRAIL****9-16.8(1) RAIL AND HARDWARE**

Steel for rail elements and terminal sections shall conform to ASTM A 606 or ASTM A607. Bolts, nuts, and washers for installation of the weathering steel shall be manufactured from steel conforming to ASTM A242M and shall not be galvanized. If required, 6 inch channels and fittings shall conform to ASTM A242. In addition, all steel for the guardrail components shall 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 to 0.50	0.07 to 0.15	0.05 Max.	0.25 to 0.75	0.25 to 0.55	0.30 to 1.25	0.65 Max.	-----
No. 2	0.12 Max.	0.50 to 1.00	0.12 Max.	0.05 Max.	0.20 to 0.90	0.50 Max.	0.40 to 1.00	1.00 Max.	0.10 Max.

Blast cleaning or pickling to remove mill scale will not be required. All fabricated steel parts shall be handled with care to avoid gouges, scratches, and dents. The steel shall 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 shall be positioned to allow free drainage and air circulation.

9-16.8(2) ANCHORS

Guardrail anchors may either be furnished as provided in Section 9-16.3(5) or they may be nongalvanized and fabricated from steel conforming to ASTM A242 with the exception that all Type 1 anchors shall have galvanized cable and fittings as specified in Section 9-16.3(5).

9-16.8(3) POSTS AND BLOCKS

Posts and blocks for weathering steel beam guardrail shall comply with the requirements of Section 9-16.3(2).

SECTION 9-17 FLEXIBLE GUIDE POSTS**9-17.1 GENERAL**

See Section 8-10 for flexible delineator posts.

Flexible guide posts shall be made of a flexible, nonwarping, nonmetallic, durable plastic material; shall be resistant to damage due to impact, ultraviolet light, ozone, hydrocarbons, and other effects of atmospheric weathering; shall resist stiffening with age; and shall be designed for a minimum life equaling 60 months of outdoor service.

The post system shall be designed for permanent installation to resist overturning, twisting, and displacement from wind and impact forces.

Each flexible guide post shall be permanently identified with the manufacturer's name, the month and year of fabrication and a mark indicating the recommended burial depth. The letters shall 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 shall be white or brown as indicated on the Drawings. Guide post length shall be in accordance with Section 8-10.3.

The reflective panel on a flat or elliptical guide post shall have a minimum width of 3 inches facing traffic. The reflective sheeting shall have a minimum area of 24 square inches (3 inches by 8 inches). The reflective panel on a round guide post shall have a 9 inch minimum band of reflective sheeting visible for 360 degrees.

9-17.2 LABORATORY TESTS

Ten guide posts of each model shall be conditioned in an oven for two hours at 120°F ± 3F°. After conditioning, the guide post shall be bent backwards at 90 degrees from the vertical to simulate a field impact. The guide post shall, without cracking, recover to within 10 degrees of its original position within five minutes. Color shall 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 ten guide posts tested for heat resistance shall be tested for cold resistance. The guide posts shall be conditioned for 24 hours at -20°F, ± 3F°, then subjected to the same testing as for heat resistance. The guide posts shall 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.

Three guide posts of each model shall be subjected to deflection testing. The guide posts shall be fixed near the base in such a way that 4 feet of the post is cantilevered. The guide posts shall 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 shall be calculated as follows:

$$P = K(Q/b)$$

Where:

- P is the equivalent stress in pounds per square foot.
- Q is the load at collapse in pounds.
- b is the post width (diameter of major axis) in inches.
- K is constant equal to 6 inches per square foot.

The value of P shall 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 three guide posts subjected to deflection testing shall be subjected to cyclic loading with an amplitude of 2 inches at the tip, with a cycle testing machine. Each guide post shall be cycled 30,000 times at 60 cycles per minute. When the

cyclic tests are completed, the three guide posts shall again be subjected to deflection testing. The average load of the posts after cyclic loading shall 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.

Three guide posts of each model shall be subjected to a 5.5-pound deflection test. The guide posts shall be fixed near the base in such a way that 4 feet of the post is cantilevered. The guide post shall 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 unreflectorized portion of each of three guide posts shall be prepared. The specimens shall be cycled at 1000 hours in a weatherometer in accordance with ASTM G 53 (3 hr. 60C UV, 3 hr. 50C CON). The specimens shall show no signs of delamination, distress, or discoloration. Physical properties of tensile strength and rigidity shall be maintained within 80 percent of the unconditioned values.

9-17.3 FIELD TESTS

Ten guide posts of each model, supplied in accordance with Section 9-17.4, shall be installed by the manufacturer's representative at the SPU Materials Laboratory designated test site. Anchoring Materials shall be driven such that the anchor is flush with, or below, the ground level. The test temperature shall be at or below 50°F.

The ten guide posts shall be struck seven 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 shall be inspected for the following criteria:

1. A minimum of 50 percent of the reflective sheeting shall be retained 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, other than 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 shall submit a Manufacturer's Certificate of Compliance stating all materials meet or exceed Contract requirements. See Section 1-05.3.

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 shall meet the following requirements and be submitted to the SPU Materials Laboratory for approval:

1. Aggregates shall conform to the requirements of Section 9-03 except that they shall be uniformly graded up to a maximum size of 3/8 inch and shall contain sufficient fine fractions to permit securing the type of surface finish specified herein. The aggregate shall be approved by the SPU Materials Laboratory before it is used.
2. Reinforcing steel shall conform to the requirements of Section 9-07.
3. The cement concrete mix shall 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 shall be kept in good repair and shall 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 shall 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 shall be added to any batch after completion of the mixing period. Each batch of concrete shall be completely emptied from the mixer before placing more Materials in it. A batch which has not been placed within 30 minutes from the time water was first added shall not be used.

The amount of water in the concrete shall 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 shall 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 shall be tight fitting so that there is no leakage of mortar between the bulkhead and form.

The Materials and methods used for lubricating the forms shall be such that they do not result in discoloration of the curb at any time. A minimum quantity of lubricant shall be used and all excess lubricant shall be removed.

9-18.1(4) PLACING CONCRETE

The concrete shall 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 shall be placed and maintained in its proper position as shown in the Standard Plans.

Curb or buttons shall not be manufactured in an atmospheric temperature of less than 50°F.

9-18.1(5) REMOVAL OF FORMS

The curb shall be removed from the molds or forms with instructions, or by some other identified method, acceptable to the Engineer.

The loosening of the curb from the molds shall 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 shall be deferred until such time as the curb 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 shall 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°F, nor more than 100°F. Each unit shall 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 shall 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 shall 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, two coats of a water-repellent compound, meeting the requirements of Section 9-18.4, shall be brush applied. When the first coat has dried, the second coat of water-repellent compound shall be applied.

9-18.1(9) DIMENSIONS AND SHAPE

The curb shall 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 413C curb shall be made in sections 3'-0" maximum length sections. Circular curbing shall be made only for such radii as called for in the details on the Drawings.

Each 413C curb section shall have two (2) one (1) inch diameter holes as shown in Standard Plan no. 413a.

9-18.1(11) DEFECTIVE CURB

Not more than 2 percent of the top area in any one piece of curb shall 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 shall be broken or rounded. There shall 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 in accordance with 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 shall 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 shall 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 shall not exceed 50 percent of the length of the curb, and the maximum length of any single line of discoloration shall not exceed 18 inches. 75 percent of the curb laid shall 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 shall be subject to the approval of the Engineer.

The repairing of molds which are chipped or broken shall 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 checking develops during the first five 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 in accordance with 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 shall be neatly repaired immediately after removal from the molds in a manner subject to the approval of the Engineer. However, no patching or other repairs shall be made

without the permission of the Engineer. Patches shall 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 shall 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 shall be marked in black paint on the back or end of each piece of curb.

Rejected curb shall 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 shall be shipped from the manufacturing plant 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 shall submit, for the approval of the Engineer, an advance sample of curb which shall 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 shall be done on the advance sample. Upon approval, the advance sample shall be stored at the plant or site of manufacture in a location readily accessible to the Inspector where there is adequate daylight for examination. The advance sample shall be protected from damage and discoloration and shall be used as a standard of comparison for color, surface texture, and bottom finish for all curb manufactured. All curb furnished shall be equivalent in the foregoing respects.

The inspection at the plant 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 checking and hidden air holes if it is impractical to examine for these defects at the final inspection.

9-18.2 RESERVED

9-18.3 BLOCK TRAFFIC CURB

Block traffic curb shall be as shown on Standard Plan no. 413b.

The curb units shall be made from Portland cement and high quality sand and gravel, the proportions of which shall 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 shall 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 shall be free from chips, air holes, honeycomb, or other imperfections, and cracks shall 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 shall have approximately the same color and surface characteristics.

9-18.4 WATER-REPELLENT COMPOUND

The water-repellent compound shall be a clear, penetrating type, silicone resin base compound containing no filler or other Material which leaves a film on the surface of the masonry after it is applied, and bonds securely to the masonry. It shall 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 three test specimens treated with the water-repellent compound, when tested in accordance with the methods used in the Laboratory shall not exceed 2 percent after being partially immersed in water for 72 hours immediately after curing.

The average moisture vapor transpiration (breathing) of three test specimens, when tested in accordance with the methods used in the Laboratory, shall be not less than 50 percent at seven Days.

The water-repellent compound shall be approved by the Laboratory before it is used.

9-18.5 SODIUM METASILICATE

Sodium metasilicate shall comply with ASTM D 537.

SECTION 9-19 PRESTRESSED CONCRETE GIRDERS

9-19.1 CONCRETE AGGREGATES AND PROPORTIONING

The concrete for prestressed girders shall have the minimum compressive strengths as specified on the Drawings. Aggregates used in the mix shall conform to the following:

1. Coarse aggregate shall be in accordance with Section 9-03.1(3).
2. Fine aggregate shall be in accordance with Section 9-03.1(2), Class I or Class II.
3. The manufacturer may revise the grading of the coarse aggregate provided that the concrete mix design is qualified with the modified gradation.

The Contractor shall submit for review a proposed mix design for each design strength. Included shall be evidence acceptable to the Engineer that the proposed mix design meets design requirements. The mix design review will not preclude any requirements for the concrete placed in the girders.

The concrete mix shall be prepared and placed in accordance with the appropriate sections of Section 6-02.

Water used in mixing the concrete shall conform to the requirements of Section 9-25.1.

Portland cement shall conform to the requirements of Section 9-01.

Chemical admixtures shall conform to the provisions of Section 9-23.7.

The total chloride ion (C1-) content shall be as specified in Section 6-02.3(2)A.

9-19.2 REINFORCEMENT

Reinforcement shall meet the requirements of Section 9-07 and shall be placed in accordance with the requirements of Section 6-02.3(24).

SECTION 9-20 RESERVED

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 shall be composed of thermosetting resins, pigments and inert ingredients and shall be of uniform composition throughout. The color shall 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 shall 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 shall be such that coarse aggregate particles on the curved surface are covered by not less than 1/16 inch of pigmented Material.

The and lane marker Type 1 shall meet the following requirements (see Standard Plan no. 700):

Lane Marker/Traffic Button (Description)	Lane Marker Type 1
Diameter	3-7/8 inch to 4-1/8 inch
Weight (pounds)	0.275 min.
State Reflectance	80% min.
Impact Resistance (Inch-pounds)	15 min.
Planeness of Base:	
Concavity (Inches)	0.02 max.
Convexity (Inches)	0.05 max.
Titanium Dioxide (% by weight)	21 min.
Resin Content (% by weight)	20 min.

9-21.1(3) TEST METHODS

Test methods shall be as follows:

- Reflectance:** Reflectance will be measured with a photovolt Reflectance Meter or its equivalent by comparing the buttons to a 75 percent brightness standard.
- 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.
- Titanium Dioxide Content:** The titanium dioxide content will be determined by ashing representative portions of the lane marker, treating the ash with a boiling $(\text{NH}_4)_2\text{SO}_4 \cdot \text{H}_2\text{SO}_4$ solution, filtering, and measuring the absorbance of the filtrate at about 410 millimicrons. Calibration shall be with known samples using ASTM D 921.
- 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 Seattle Public Utilities' Materials Laboratory.

9-21.2 LANE MARKERS TYPE 2A AND TYPE 2B

The markers shall consist of an acrylic plastic shell filled with a tightly adhering potting compound. The shell shall contain prismatic reflective faces as shown in Standard Plan no. 700 to reflect incident light from opposite directions.

9-21.2(1) PHYSICAL PROPERTIES

The shell shall be molded of methyl methacrylate or acrylonitrile butadiene styrene (ABS).

Filler shall be a potting compound selected for strength, resilience, and adhesion adequate to pass physical requirements as outlined herein.

The outer surface of the shell shall be smooth except for purposes of identification and shall 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 shall be substantially free from gloss or substances that may reduce its bond to adhesive. This shall be done by embedding sand or inert granules on the surface of the potting compound prior to its curing.

The markers shall be fabricated as follows:

Lane Marker (Description)	Lane Marker Type 2A	Lane Marker Type 2B
Dimensions of Plastic Shells	4 inch x 4 inch x 0.65 inch or octagonal w/4 inch across flats	4.7 inch x 2.3 inch x 0.52 inch
Slope of Reflecting Face	20 deg. to 30 deg.	20 deg. to 30 deg.
Area of Each Reflecting Surface	3.0 to 3.25 square inches	1.87 square inches

9-21.2(2) OPTICAL REQUIREMENTS

- Definitions:**
Horizontal entrance angle shall mean the angle in the horizontal plane between the direction of incident light and the normal to the leading edge of the marker.
Observation angle shall mean the angle at the reflector between observer's line of sight and direction of the light incident on the reflector.
Specific intensity (S.I.) shall mean 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 specific intensity of each crystal reflecting surface at 0.2 degrees observation angle shall be not less than the following when the incident light is parallel to the base of the marker:

Hor. Ent. Angle	S.I.
0°	3.0
20°	1.2

Yellow reflectors shall be not less than 60 percent and red reflectors not less than 25 percent of the above values.

- Optical Testing Procedure:** A random lot of markers will be tested. The markers to be tested shall 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 shall be 0.05 inch. It shall be shielded to eliminate stray light. The distance from light source center to the photocell center shall be 0.21 inch. If a test distance of other than 5 feet is used, the source and receiver dimensions and the distance between source and receiver shall be modified in the same proportion as the test distance.
 Failure of more than 4 percent of the samples shall be cause for rejection of the lot.

9-21.2(3) STRENGTH REQUIREMENTS

Markers shall support a load of 2,000 pounds as applied in the following manner:

- A marker shall be centered over the open end of a vertically positioned hollow metal cylinder. The cylinder shall be 1 inch high with an internal diameter of 3 inches and wall thickness of 1/4 inch. The load shall 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.
- 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 shall conform to the requirements of ASTM A 48, Class 30 and shall 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 shall certify that the product conforms to the requirements of these Specifications.

Monument castings shall be machine finished or ground on seating surfaces to assure non-rocking fit in any position, and interchangeability. The foundry shall 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 shall meet the requirements of AASHTO M171, Sheet Materials for Curing Concrete, except that only white reflective type shall be used.

9-23.2 LIQUID MEMBRANE-FORMING CONCRETE CURING COMPOUNDS

Liquid membrane-forming compounds for curing concrete shall conform to the requirements of AASHTO M 148 (ASTM C 309) Type 1D or Type 2, Class A or Class B, except that the moisture loss when tested in accordance with WSDOT Test Method 814 shall be 2.50 grams maximum for all applications.

Each lot of liquid membrane-forming curing compound shall be sampled at the Project Site and tested for acceptance. Liquid membrane-forming curing compound shall not be used in the absence of acceptable test results.

9-23.3 RESERVED**9-23.4 RESERVED****9-23.5 BURLAP CLOTH**

Burlap cloth shall meet the requirements of AASHTO M 182, Class 4.

9-23.6 AIR-ENTRAINING AND CHEMICAL ADMIXTURES

Admixtures for use in concrete shall meet the following specifications:

Admixture	Specification	
Air entraining	AASHTO M154	ASTM C 260
Water Reducing	AASHTO M194 Type A	ASTM C 494 Type A
Set Retarding	AASHTO M194 Type B	ASTM C 494 Type B
Water Reducing/Set Retarding	AASHTO M194 Type D	ASTM C 494 Type D
High Range Water Reducing	AASHTO M194 Type F and G	ASTM C 494 Type F and G

In addition to the above Specifications, admixtures proposed for use shall contain less than one percent chloride ion (Cl-) by weight of admixture.

Acceptance of admixtures will be based on Manufacturer's Certificate of Compliance. If required by the Engineer, admixtures shall be sampled and tested before they are used.

The use of calcium chloride will not be allowed.

9-23.7 AIR-ENTRAINING AND CHEMICAL ADMIXTURES FOR PRECAST PRESTRESSED CONCRETE

Air-entraining admixture shall meet the requirements of AASHTO M 154.

If required by the Engineer, the air-entraining admixture shall be sampled and tested by the SPU Materials Laboratory before use.

Chemical admixtures shall conform to the requirements of AASHTO M194, Type A, Type B, Type D, or Type F. Approval of specific admixture products shall be required as a part of the annual approval of prestressed fabricators. Chloride ion content of chemical admixtures shall not exceed one percent by weight.

Acceptance will be on the basis of a Manufacturer's Certificate of Compliance.

9-23.8 INCORPORATING ADMIXTURES INTO CONCRETE

Concrete admixtures shall be added to the concrete mix at the time of batching the concrete or in accordance with the Supplier's written procedure and as approved by the Engineer. A copy of the Supplier's written procedure shall be submitted to the Engineer prior to use of any admixture. Any deviations from the Supplier's written procedures shall be submitted to the Engineer for approval. Admixtures proposed to be added to the concrete by any method other than the furnished manufacturer's written procedure shall not be added to the concrete until the Engineer has provided written notice approving such.

When the Contractor is proposing to use admixtures from different admixture Supplier's, each and every Supplier shall provide Manufacturer's Certificate of Compliance to the Engineer stating that the admixture will be compatible with other Supplier's admixture(s) and shall not adversely effect the air void system of the hardened concrete. Test results complying with ASTM C 457 shall be provided as the evidence to satisfy this requirement. Admixture combinations which have been previously tested and which are in compliance with ASTM C 457 are listed in the Washington State Department of Transportation's (WSDOT's) Qualified Products List (QPL). See www.wsdot.wa.gov/Biz/mats/QPL/QPL.cfm. Proposed combinations not found in the QPL shall meet this requirement.

Accelerators shall not be used. Should the Contractor determine that an accelerator is needed, the Contractor shall submit such a request to the Engineer for approval before use and shall provide:

- 1) a Manufacturer's Certificate of Compliance stating that any chloride ion content meets the requirement of Section 9-23.6 and that the admixture does not contain calcium chloride, and
- 2) the reasons for needing an accelerator as it relates to the specific application.

Air entrained Portland cement shall not be used to air entrain concrete.

9-23.9 CONCRETE MIXES INCORPORATING POZZOLAN

Concrete mixes incorporating pozzolan(s) (see Section 9-01.6) may be utilized for all classes of concrete, unless otherwise specified in the Contract. Mix proportions for each application will be subject to approval by the Engineer and shall be in compliance with the following conditions:

1. Roadway Structure Applications (See Section 6-02.1A for definition of "roadway Structures"):

A. General.

- 1) Fly ash without other pozzolans may be used to replace up to 25 percent of Portland cement at the rate of 1-1/4 pounds fly ash for each pound of Portland cement replaced. In concrete mix designs where a specific cement content is not specified, the fly ash content shall not exceed 15 percent of the total cementitious Material.

An exception to Section 9-01.6(1) is fly ash shall conform to the requirements of ASTM C 618, Class F with optional chemical and physical requirements as set forth in Tables 1A and 2A and with a further limitation that the loss of ignition be a maximum of 1.5 percent.

- 2) Ground granulated blast furnace slag without other pozzolans may be used to replace up to 25 percent of Portland cement at the rate of one (1) pound slag for each pound of Portland cement replaced. In concrete mix designs where a specific cement content is not specified, the slag content shall not exceed 15 percent of the total cementitious Material.
- 3) Both slag and fly ash without other pozzolans may be combined in any ratio, and the combination used to replace up to a 25 percent of Portland cement at the component replacement rates as specified in items 1) and 2) immediately above.

In concrete mix designs where a specific cement content is not specified, the combined fly ash and slag content shall not exceed 15 percent of the total cementitious Material.

The ratio of the components fly ash to slag in the combined pozzolan, is at the discretion of the Contractor.

- B. Cement replacement or substitution in concrete mixes specifying a Portland cement content shall be subject to strength confirmation testing and approval of the proposed mix design by the Engineer.

- C. The Contractor shall design the concrete mix to meet an average 28 day compressive strength of 1.34 times the minimum ultimate compressive strength for the class of concrete specified in the Contract for concrete plants with a coefficient of variation (CV) of 20%.

- D. (1) For concrete plants with a coefficient of variation of less than 20 percent, the required average strength shall be:

$$f'_{CR} = (1/(1 - 1.28 V)) \times f'_C$$

where:

f'_{CR} = required average 28 Day compressive strength.

f'_C = minimum ultimate compressive strength at 28 Days.

V = coefficient of variation (CV) expressed as a decimal i.e. CV=20%, V=0.20.

- (2) The required average 28-Day compressive strength will be determined from five 6 inch by 12 inch cylinders tested in accordance with WSDOT test methods 801 and 811.
- (3) A CV of 20% will be assumed unless the concrete Supplier can justify a lower value.
- (4) For a concrete plant to establish a CV of less than 20% for that concrete plant, a minimum of 30 sets of two cylinder compression test breaks will be required. The cylinders shall be 6 inch by 12 inch test specimens and shall be made, handled, and stored in accordance with WSDOT Test Method 809 (Method 1) and tested in accordance with WSDOT Test Methods 801 and 811. Each set of two cylinders shall be produced from separate batches of production concrete. The equipment used for the production concrete shall be the same as that used for determining the CV value.
- (5) The concrete mix design will require approval by the Engineer and require verification by submission of ingredients and testing of specimens made in accordance with this mix design prior to the use on the Project.

- E. All concrete of the same class within a Structure shall contain the same proportion of cementitious material.

- F. Acceptance of concrete containing any combination of pozzolans will be on the same basis as for comparable class of concrete and designation of concrete without pozzolans.

- G. As an alternative to the substituting pozzolan(s) for Portland cement, a blended hydraulic cement may be used. Concrete made with blended hydraulic cement shall comply with ASTM C-595-83, Type 1P(MS). In addition, the origin and amount of each pozzolan as part of the total cementitious material shall be certified on the cement mill test certificate.

2. **Portland cement concrete pavement, sidewalk, curb, and curb and gutter applications.**
- (A) Fly ash without other pozzolan may be used to replace up to 25 percent by weight of the Portland cement content on a 1 - 1/4 pounds fly ash for one pound Portland cement basis. An exception to Section 9-01.6(1) is fly ash shall be limited to ASTM C 618, Class F with a maximum CaO content of 15 percent by weight.
 - (B) Ground granulated blast furnace slag without other pozzolan may be used to replace up to 25 percent by weight of the Portland cement content on a one pound slag for one pound Portland cement basis.
 - (C) Blended hydraulic cement that meets the requirements of Section 9 01.2(4) may be substituted for Portland cement on a one pound blended cement for one pound Portland cement basis.
 - (D) Both ground granulated blast furnace slag and fly ash without other pozzolan may be used to replace up to 25 percent by weight of the total Portland cement content in a mix design.

9-23.10 COLORING AGENT

The coloring agent for matching the color of new concrete to the color of adjacent existing concrete shall be dry lamp black, added to the concrete during mixing in an amount not to exceed 1-1/2 pounds per cubic yard of concrete.

Use of liquid concrete coloring agent will be permitted when approved by the Engineer.

SECTION 9-24 PLASTIC WATERSTOP

9-24.1 MATERIAL

Waterstops shall be fabricated from a plastic compound, the basic resin of which shall be polyvinyl chloride. The compound shall contain such additional resins, plasticizers, inhibitors, or other material that when the Material is compounded, it shall meet the performance requirements given in this Specification.

Single-pass reworked Material of the same composition generated from the fabricator's waterstop production may be used. No reclaimed polyvinyl chloride shall be used.

All waterstops shall be molded or extruded in such a manner that any cross section is dense, homogeneous, and free from porosity and other imperfections.

Waterstops shall be symmetrical in shape, nominally 4 inches in width by 3/16 inch thick, and have a minimum of four ribs on each side of the bulb. The bulb thickness and diameter shall be as noted on the Drawings.

9-24.1(1) TESTS OF MATERIAL

The waterstops shall 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 shall be not less than 160 pounds per inch. The Contractor shall furnish such 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 mortar or concrete shall be clear and apparently clean. 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 C 94M Section 5.1.3, Tables 2 and 3.

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 shall not be used in bridge roadway deck slabs, flat slab bridge superstructures, modified concrete overlays, or prestressed concrete,
2. Specific gravity shall not exceed 1.07,
3. Alkalies, expressed as $[\text{Na}_2\text{O} + 0.658 \text{K}_2\text{O}]$ shall not exceed 600 ppm,
4. Shall be free of coloring agents,
5. If the wash water contains admixtures from different manufacturers, the Contractor shall 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, shall be conducted on the following schedule:
 - a. The physical requirements shall be tested on weekly intervals for four weeks and thereafter on monthly intervals,
 - b. The chemical requirements shall be conducted on monthly intervals, and
 - c. The specific gravity shall be determined daily in accordance with ASTM D 1429, Test Method D.

The Contractor shall use the services of a laboratory that has equipment calibration/verification system, and a technician training and evaluation process per AASHTO R-18 to conduct all tests. The laboratory shall use testing equipment that has been calibrated / verified at least once within the past 12 months to meet the requirements of each test procedure in accordance with the appropriate section of AASHTO R-18. Documentation of tester qualifications and equipment verification records shall be maintained and be available for review by the Engineer upon written notice. The Engineer's review of the

laboratory facility, testing equipment personnel, and all qualification, calibration, and verification records will be conducted at the Engineer's discretion.

9-25.2 WATER FOR IRRIGATION

Water for irrigation shall not contain dissolved or suspended matter which is harmful to the plant Material on which it is to be used.

SECTION 9-26 EPOXY RESINS

9-26.1 GENERAL

These Specifications cover 2-component epoxy resin systems for bonding plastic concrete or mortar to metal or hardened concrete, or for bonding hardened concrete or other materials to hardened concrete.

Epoxy resins used for patching external concrete shall have a concrete-gray color.

The epoxy resin systems shall be furnished in the type, grade, and class as specified according to current ASTM C 881.

9-26.1(1) RESERVED

9-26.1(2) AGGREGATE

Aggregate for epoxy mortar or concrete shall be clean, surface dry and inert (defined as not affecting cure rate or physical properties of the epoxy resin system), and shall be of a quality and gradation suitable for Portland cement mortar or concrete. Sand meeting the requirements of Section 9-03.1(2) will be acceptable.

9-26.1(3) SAMPLING

A representative sample of each component (one pint of each) shall be taken either from a well-blended bulk lot prior to packaging or by withdrawing thief samples from no less than 5 percent of the containers comprising the lot or shipment. Instead of the foregoing, packaged materials may be sampled by a random selection of containers of each component from each lot. Samples shall be submitted to the SPU Materials Laboratory.

9-26.1(4) REJECTION

Except as noted otherwise in Section 9-26, the entire lot of both epoxy components may be rejected if samples submitted for test fail to meet any requirement of Section 9-26.

9-26.1(5) PACKAGING AND MARKING

9-26.1(5)A PACKAGING

The two components of the epoxy resin system furnished under these Specifications shall be supplied in separate containers which are nonreactive with the materials contained. The contents of each container shall be such that the recommended proportions of the final mixture can be obtained by combining one container of one component with one container of the other component.

9-26.1(5)B MARKING

Containers shall be identified as "Component A - contains Epoxy Resin" and "Component B - contains Curing Agent" and shall show the type, grade, class, and mixing directions as defined by these Specifications. Each container shall be marked with the name of the manufacturer, the lot or batch number, the date of packaging, and the quantity contained in pounds and gallons.

Potential hazards shall be so stated on the package in accordance with the Federal Hazardous Products Labeling Act and State of Washington, Department of Labor and Industries Regulations for Shipment of Hazardous Products.

9-26.1(6) CERTIFICATION

If requested by the Engineer, the manufacturer of the epoxy resin system shall provide a Manufacturer's Certificate of Compliance that components A and B meet the requirements of this Specification before a sample will be accepted for testing by the Owner. Such certification shall consist of either a copy of the manufacturer's test report or a statement of the manufacturer, accompanied by a copy of the test results, that components A and B have been sampled and tested. Such certifications shall indicate the date of testing and shall be signed by an authorized agent of the formulator or manufacturer.

9-26.1(7) ACCEPTANCE

Acceptance of a batch lot or shipment of the Material for use on the Project will be on the basis of Laboratory tests of samples, as specified in Section 9-26.1(3) representing the particular batch or shipment of Materials supplied. These tests will be performed at the Laboratory. A period of 10 Days should be allowed for testing, following receipt of samples by the Laboratory.

9-26.2 ADHESIVE FOR LANE MARKERS

9-26.2(1) DESCRIPTION

The adhesive shall be furnished as two components, each packaged separately. The components shall have the following composition:

Package A	Parts by Weight
Epoxy Resin	100.0
Titanium Dioxide	4.55
Oleophillic Fumed Silica	2.28
Talc	37.97
Package B	
N-Aminoethyl Piperazine	22.53
Nonylphenol	50.88
Carbon Black	0.14
Silica	25.32
Talc	50.63
Oleophillic Fumed Silica	2.28

At the time of use, the contents of packages A and B shall be thoroughly dispersed by mixing. One volume or weight of Package A shall be mixed with one volume or weight of Package B until a uniform gray color is achieved. The maximum acceptable variation in mix ratio shall be five from the 50/50 ratio (45A to 55B or 55A to 45B). The mix ratio shall be determined by analysis for nitrogen percentage in the mixed and cured adhesive.

9-26.2(2) RAW MATERIALS

Raw Materials for the adhesive shall meet the following specifications:

- Epoxy Resin**--Viscosity, 70-100 poise at 25°C; epoxide equivalent 175-200; color (Gardner), 5 maximum; manufactured from epichlorohydrin and bisphenol A. The reactive diluent shall be either butane diol diglycerol ether or para tertiary butyl phenyl/glycidal ether.
- High purity fumed silica**--surface treated with a silicone oil, with the following properties: appearance, fluffy white powder; surface area, N2 B.E.T. method; $100 \pm 20 \text{ M}^2/\text{g}$; weight percent carbon, 4.5 minimum; ignition loss (dry basis) 2 hours at 1,000°C, 7 maximum; specific gravity, 1.8. Moisture, weight percent, 0.5 maximum.
- Talc**--Percent passing 325 mesh screen, 100 percent; oil absorption in grams/100 g. talc, 28-34; Hegman grind in oil, 3 minimum; purity, 98 percent, talc minimum.
- N-Aminoethyl Piperazine** - COLOR (APHA) 50 maximum; amine value, 1250-1350 based on titration which reacts with 3 nitrogens in the molecule; appearance, clear and substantially free of suspended matter.
- Nonylphenol** - Color (APHA) 50 maximum; hydroxyl number, 245-255; distillation range, degrees C at 760 mm, first drop 295 minimum, 5 percent 298 minimum, 95 percent 325 maximum; water, percent (K.F.) 0.05 maximum.
- Carbon Black** - TT-P-343, Form I, Class B.
- Silica**--percent passing through 325 mesh screen, 98 percent minimum. Average particle size, 7 to 10 microns; oil absorption in grams per 100 g. silica, 25 to 31. Hegman grind, 3 minimum. Purity, 98 percent silica (SiO₂) minimum.

9-26.2(3) PHYSICAL REQUIREMENTS OF MIXED ADHESIVE

Mixed adhesive shall be a blend of 1 part of component A and 1 part of component B, as specified in Section 9-26.2(1), and shall meet the following properties:

Gel time (150 g./Batch)	5-10 minutes
Tensile strength 1/16" film between steel blocks cured 24 hours at 70°F. Tested at 70°F	1,000 psi (Min.)
Shore D Hardness	(Cured 24 hrs. at 70°F)
Tested at 70°F	70 – 80
Tested at 120°F	Min. 30
Deformation Temp.	Min. 120°F
Viscosity of Mixed Adhesive ¹	1,000 – 2,000 poise

NOTE ¹ Brookfield to Helipath spindle at 77°F.

9-26.2(4) ACCEPTANCE

Adhesive for lane markers may be accepted by the Engineer based on submitting the Manufacturer's Certificate of Compliance. The manufacturer shall certify that each batch of adhesive conforms to these Specification.

The lot or batch number shall appear on the certificates, on all samples, and on all lots of adhesives delivered. A one pint sample of the A and B components shall be submitted to the SPU Materials Laboratory by the Supplier not less than 10 Working Days before using (see Section 1-05.3(3)).

SECTION 9-27 CRIBBING**9-27.1 RESERVED****9-27.2 RESERVED****9-27.3 GABION CRIBBING****9-27.3(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 shall be used throughout a structure.

Baskets shall be furnished in the required dimensions with a dimensional tolerance of $\pm 5\%$.

Wire for construction of gabions shall 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 shall have a minimum tensile strength of 60,000 psi when tested in accordance with ASTM A 370.

9-27.3(2) GABION BASKETS

Gabion baskets 1 foot or greater in the vertical dimension shall have mesh openings with nominal dimensions not to exceed 4-1/2 inches and the maximum area of any mesh opening shall not exceed 10 square inches.

1. Hexagon Twisted Wire Mesh

- a. Wire for galvanized or aluminized hexagonal twisted wire mesh shall be nominal sized 0.120 inch galvanized steel wire or aluminized steel wire.
- b. Hexagonal wire mesh 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 shall be tied to a selvage wire of the same composition as the body mesh and have a minimum diameter of 0.150 inch so that the selvage is at least the same strength as the body of the mesh.

2. Welded Wire Mesh

- a. Welded wire mesh shall be fabricated from galvanized steel wire having a diameter of 0.106 inch. Wire shall be galvanized prior to fabrication.
- b. Welded wire mesh shall be formed in a uniform square pattern with openings 3 inches by 3 inches with a resistance weld at each connection in accordance with ASTM A 185.
- c. If required, a PVC coating shall be fusion bonded onto the welded wire mesh to provide a nominal coating thickness of 0.0216 inch per side with a minimum of 0.0150 inch.

3. PVC Coating (for welded wire mesh only).

Acceptance of PVC coating material shall be by certified test reports of an independent laboratory. The initial properties of PVC coating material shall 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 testing 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 shall 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 shall show no effect after 3,000 hours of salt spray exposure according to ASTM B 117. The PVC shall 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 shall 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 shall not change more than 6, 25, 25, and 10 percent respectively from their initial values.

9-27.3(3) GABION MATTRESSES

Gabion baskets less than 1 foot in the vertical dimension shall have mesh openings with nominal dimensions not to exceed 3.3 inches, and the maximum area of any mesh opening shall not exceed 6 square inches.

1. Hexagonal Twisted Wire Mesh:

- a. Wire for galvanized or aluminized hexagonal twisted wire mesh shall be nominal sized 0.086 inch galvanized steel wire or aluminized steel wire.
- b. Hexagonal wire mesh shall be formed from galvanized or aluminized wire in a uniform hexagonal pattern with nonraveling double twisted. The perimeter edges of the mesh for each panel shall be tied to a selvage wire of the same composition as the body mesh and have a minimum diameter of 0.1062 inch so that the selvage is at least the same strength as the body of the mesh.

2. Welded Wire Mesh:

- a. Welded wire mesh shall be fabricated from galvanized steel wire having a diameter of 0.080 inch. Wire shall be galvanized prior to fabrication.
- b. Welded wire mesh shall be formed in a uniform rectangular pattern with openings 1-1/2 inches by 3 inches with a resistance weld at each connection in accordance with ASTM A 185.

- c. If required, a PVC coating shall be fusion bonded onto the welded wire mesh to provide a nominal coating thickness of 0.0216 inch per side with a minimum of 0.0150 inch. The PVC coating shall be in conformance with Section 9-27.3(2).

9-27.3(4) FASTENERS FOR BASKET ASSEMBLY

The lacing wire shall be a nominal sized 0.0866 inch galvanized steel wire or aluminized steel wire. Lacing wire shall have the same coating as the basket mesh.

Spiral binders, if used for joining welded wire panels shall 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 shall 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 shall be submitted for approval.

Internal connecting wires shall be the same as required for lacing wire. Alternate stiffeners acceptable to the gabion manufacturer may be used if found acceptable to the Engineer.

9-27.3(5) NONRAVELING CONSTRUCTION

The wire mesh shall be fabricated in a manner 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.

9-27.3(6) STONE

Stone for filling gabions shall have a Degradation Factor of at least 30. The stone shall be dense enough to pass the unit-weight test described in Section 6-09.3(6)F. Stone shall meet the following requirements for gradation:

Sieve Size	Percent Passing
8" square	100
6" square	75-90
4" square	0-10
% Fracture	75 min.

All percentages are by weight.

SECTION 9-28 SIGNING MATERIALS AND FABRICATION

9-28.1 SIGNS

9-28.1(1) GENERAL

Signs to be mounted on wood utility poles (other than Seattle City Light poles) and signs installed overhead shall be High Density Overlay plywood. Other signs shall be either High Density Overlay plywood or sheet aluminum.

Parking and pedestrian control signs shall be nonreflectorized. All other traffic signs shall be reflectorized.

STOP and YIELD sign backs and edges shall be painted with one coat of red enamel to match the red on the sign face.

Regulatory and warning signs shall have rounded corners with the exception of STOP signs. All other signs shall have square cut corners. Borders for signs having square cut corners shall 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 shall be concentric with the rounded corners.

9-28.1(2) PLYWOOD

Plywood signs shall be constructed of High Density Overlay plywood, meeting 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 shall be free of contaminants which would adversely affect the application or life of the sheeting to be applied. Face veneers shall be Grade B or better.

Core and crossband veneers shall be solid. Core veneers shall be jointed, and core gaps shall not exceed 1/8 inch in width. The entire area of each contacting veneer surface shall be bonded with a waterproof adhesive that meets the requirements of the U.S. Department of Commerce for exterior type plywood.

The overlay shall be of the high density type. It shall have a minimum weight of 60 pounds per thousand square feet of surface and shall be at least 0.012 inches thick before pressing. The overlay shall 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:

Up to 18 inches inclusive in width	3/8 inch
Over 18 inches to 36 inches inclusive in width	5/8 inch
Over 36 inches in width	¾ inch
Overhead signs	¾ inch

Street designation signs and signs mounted on span wires or mast arms shall 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 shall have only the edges primed with 1 coat of white exterior enamel undercoat and finished with 1 coat of white exterior enamel. The primer shall be as recommended by the Supplier of the finish coat. The finish enamel shall meet the requirements of Federal Specification TT-E-489.

9-28.1(3) SHEET ALUMINUM

Sheet aluminum signs shall 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 sheeting has been fabricated, it shall be degreased and etched by immersion for a minimum of 5 minutes in a 6 ounce per gallon caustic etch solution at 120°F, followed, in order, by a water rinse, de-oxidation, water rinse, hot water rinse, and drying. The etching process shall produce a dull aluminum finish on both sides of the panel which lasts the life of the sign. The treated panel surface shall be compatible with the sign face sheeting to be applied. The Contractor may use an Alodine 1200 application for single panel signs in lieu of the above treatment. Reflectorized aluminum signs shall be comprised of panels 4 feet or less in width. The Contractor shall use the widest panels possible. Parts necessary for assembly shall be constructed of aluminum. Sheet aluminum thickness shall be 0.080 inch.

Metal shall be protected by handling with a suitable device or with clean canvas gloves between cleaning and etching operations and the application of sign face sheeting.

Sheet aluminum edges shall be filed smooth to eliminate sharp edges and burrs.

9-28.1(4) REFLECTIVE SIGN FACE SHEETING

Reflective sheeting shall consist of spherical lens elements embedded within a transparent plastic or adhered to a synthetic resin and encapsulated by a transparent plastic. The sheeting shall have a flat, smooth outer surface, be weather resistant, and have a pre-coated adhesive backing with a protective liner.

The sheeting shall have the following minimum brightness values expressed as average candle power per foot candle per square foot of Material. Measurements shall be conducted in accordance with standard testing procedures for reflex-reflectors in Federal Specification L-S-300.

The brightness of the reflective sheeting, totally wet by rain, shall be not less than 90 percent of the above values. Wet performance measurements shall be conducted in conformance with the Standard Rainfall Test specified in Federal Specification L-S-300C.

The diffuse day color of the reflective sheeting shall be visually evaluated by comparison with the applicable Highway Color Tolerance Chart. Color comparisons shall be made under north daylight or a scientific daylight having a color temperature of from 6500 degrees to 7500 degrees Kelvin. Color shall be illuminated at 45 degrees and viewed at 90 degrees.

The sheeting surface shall 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 shall 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 shall permit cutting and color processing at temperatures of 60°F to 100°F and 20 to 80 percent relative humidity.

The sheeting surface shall 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 inch x 2 inch x 8 inch aluminum, conditioned 24 hours, and tested at 72°F and 50 percent relative humidity, shall 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 shall be 5 to 20 pounds per inch width when tested in accordance with ASTM D 828. Following liner removal, the sheeting shall 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, shall 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 shall be easily removable by peeling without soaking in water or other solvents.

The pre-coated adhesive backing shall be a tack free heat activated type or a pressure sensitive type, either of which shall adhere to the sheeting without the necessity of additional coats of adhesive.

The adhesive shall 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 shall be sufficient to render the applied sheeting vandal-resistant and prevent its shocking off when jabbed with a spatula at 10°F. The sheeting shall 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.		
	0.2deg	0.5deg	1.50	0.2.	0.5deg	1.5deg	0.2deg	0.50	1.5deg
Inc. Ang.	Silver-White #1			Silver-White #2			Yellow		
-4deg	70.0	30.0	4.0	80.0	41.0	4.0	50.0	25.0	5.0
40deg	14.5	8.5	1.5	16.5	9.5	2.0	11.5	7.0	1.5
Inc. Ang.	Red			Blue			Green		
-4deg	14.5	7.5	1.0	4.0	2.0	0.6	9.0	4.5	1.0
40deg	3.0	1.5	0.3	0.9	0.4	0.08	1.8	1.5	0.2
Inc. Ang.	Orange			Brown			-----		
-4deg	25.0	13.5	1.5	1.0	0.35	0.1			
40deg	1.0	0.8	0.1	0.2	0.1	0.01			

With Encapsulated Lens Elements:						
	Div. Ang.			Div. Ang.		
	0.2deg	0.5deg	1.5deg	0.2deg	0.5deg	1.5deg
Inc. Ang.	Silver White			Yellow		
-4deg	250.0	95.0	4.0	170.0	62.0	3.0
40deg	120.0	54.0	2.0	80.0	35.0	1.5
Inc. Ang.	Orange			Green		
-4deg	70.0	25.0	1.1	30.0	12.0	0.5
40deg	33.0	14.0	0.5	14.0	6.8	0.2
Inc. Ang.	Red			-----		
-4deg	35.0	13.0	0.7			
40deg	16.0	7.4	0.3			

9-28.1(5) NON-REFLECTIVE SIGN FACE SHEETING

The non-reflective sheeting shall consist of a white plastic film having a smooth, flat outer surface. The sheeting shall be weather-resistant and have a protected pre-coated adhesive backing.

9-28.1(6) SHEETING APPLICATION

Plywood sign faces shall be cleaned with lacquer thinner, heptane, benzene, or solvent recommended by the sheeting manufacturer. The surface shall be sanded with light sandpaper or steel wool and wiped dry and clean with clean cloth. Aluminum sign faces shall be cleaned with a solvent recommended by the sheeting manufacturer.

Sign face sheeting shall be applied by a vacuum applicator recommended by the sheeting manufacturer, or by a continuous roll applicator.

Heat-activated adhesive backed sheeting shall be applied by the vacuum method. The adhesive on the back of the sheeting shall be activated by a minimum temperature of 185°F and with a minimum vacuum pressure of 25 inches of mercury. This operation shall 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 shall form a bond equal to or greater than the strength of the sheeting.

Pressure sensitive adhesive backed sheeting shall be applied by a continuous roll applicator. The process shall be in conformance with the recommendation of the sheeting manufacturer.

Edges and splices of sign face sheeting shall be coated with an edge sealer recommended by the sheeting manufacturer.

9-28.1(7) LETTERS, ARROWS, AND SYMBOLS

Letters, arrows, and symbols shall 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 shall 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 shall be of the same Material for each attachment. All parts necessary for assembly shall be constructed of the following Materials:

Hardware	Specification
Bolts	ASTM B 209, 2024-T4 Aluminum
	ASTM A307 Steel
	ASTM F 593 Stainless Steel
Washers	ASTM B 209, 2024-T4 Aluminum
	ASTM A 36 Steel
	ASTM A240 Stainless Steel
Nuts	ASTM B 209, 6061-T6 Aluminum
	ASTM A307 Steel
	ASTM F 594 Stainless Steel
Locknuts	ASTM B 211, 2017-T4 Aluminum
	ASTM A307 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 A276 Stainless Steel

All steel parts shall be galvanized per ASTM A 123. Steel bolts and related connecting hardware shall be galvanized per ASTM A 153.

9-28.2 POSTS

9-28.2(1) RESERVED

9-28.2(2) PARKING METER POST

9-28.2(2)A GENERAL

Parking meter post mounted with a parking meter and with no sign attached to the post shall have a 2-1/2 inch nominal ASTM A 53, Schedule 40 galvanized standard steel pipe sleeve fitted loosely over the exposed meter post full length. On the bottom, the sleeve shall make contact with the canopy for surface mounted posts or with the finished grade for direct burial posts. On the top, the sleeve shall make contact with the parking meter base. Standard Plan no. 629 shows the sleeve on a direct burial post. Direct burial and surface-mounted meter posts not used for a parking meter and used only for parking sign or other type sign, shall have a 2-3/8 inch galvanized steel cap securely fitted over the top of the post as specified in Section 8-21.3(2)B and as shown on Standard Plan nos. 627 and 628.

9-28.2(2)B DIRECT BURIAL PARKING METER POST

See Standard Plan no. 629. Direct burial parking meter post shall be fabricated from 2 inch nominal diameter standard ASTM A53, schedule 40 galvanized pipe, 46 inches in length, and with the bottom 3 inches flattened. Two 1/4 inch weep holes are required. The buried post base shall be backfilled, and mounded for drainage, with very quick setting and very strong cement grout, such as "jet-set cement", having the following properties:

Compressive Strength	ASTM C 109	8,000 psi. min. in 28 days
Bond Strength	ASTM C 1042	500 psi. min. in 1 day
Shrinkage	ASTM C 596	Less than 0.10%
Set-time	ASTM C 191	Initial set in 8 to 10 minutes Final set in 15 to 20 minutes

Cement grout meeting these requirements is "jet-set cement" and can be obtained from Jet Set Northwest Inc., Seattle, Wa., or approved equal.

9-28.2(2)C SURFACE MOUNTED PARKING METER POSTS

Bolted-down parking meter and parking sign posts shall be fabricated from 2 inch nominal diameter standard ASTM A 53, schedule 40 galvanized steel pipe, 40 inches in length, with 5/16 x 5 x 5 inch ASTM A36 steel base plate. The meter post base "canopy", also known as "collar", shall be made of 0.062 inch 2-5-0 aluminum as shown on Standard Plan no. 627.

9-28.2(3) QWIK PUNCH TELES PAR POST

As indicated on Standard Plan nos. 621a, 621b, and 625, Qwik Punch Telespar sign posts and anchors with die-cut knockouts shall be galvanized cold formed steel. An approved local Supplier is Zumar Industries, 1-800-426-7967 (1-253-536-7740), 12015 Steele Street, Tacoma, WA. 98445, (mailing address P.O. Box 44549, Tacoma, WA. 98444), e-mail "Mgiese@zumar.com".

9-28.2(4) STREET NAME SIGN POST

Street name sign post shall be 2-1/2 inch inside diameter x 10 feet 6 inches standard weight galvanized steel pipe, with the bottom 6 inch end section flattened to form a wedge. For details, see Standard Plan no. 622.

9-28.3 RESERVED**SECTION 9-29 PAVEMENT MARKING****9-29.1 GENERAL**

Materials for pavement markings shall be paint or plastic Material as specified in the Contract.

9-29.2 PAINT**9-29.2(1) GENERAL**

Paint shall comply with Specifications for no heat, instant dry pavement marking. White sharp sand shall comply with the Specifications for E-16 sand.

9-29.2(2) PHYSICAL PROPERTIES OF THE COATING

1. Viscosity (in Krebs Units).
 - a. At 70°F - 70-75 KU
 - b. At 50°F - 86 KU max.
 - c. At 122°F - 66 KU min.
2. Weight per gallon at 70°F.
 - a. White 12.00 pounds min.
 - b. Yellow 12.10 pounds min.
3. Contrast ratio at spread rate of 320 sq. ft. per gallon.
 - a. White .92 min.
 - b. Yellow .92 min.
4. Daylight reflectance (at 10 mils wet film thickness).
 - a. White 86 min.
 - b. Yellow 64 min.
5. Non-volatile content (total at 212°F.) - 65% to 68%.
6. Pigment content of total weight - 53% max.
7. Dispersion, Hegman standard gauge - 2 min.
8. Flexibility - Pass 1/2-inch mandrel bend.
9. Dry to no-pick-up (beaded) – 15 to 35 sec.
10. Bleeding over asphalt - 90% min.
11. The Material shall not show evidence of heavy caking or settling which requires mechanical means to return the product to usable condition for a period of one year from the date of manufacture or date first shipped to the Owner.
12. Color - The paint shall match a standard color sample which may be obtained upon application to the SPU Materials Laboratory.

9-29.2(3) TEST METHODS

The properties enumerated in these Specifications shall be determined in accordance with the following methods of test:

1. Viscosity - Federal test method standard 141A, Method #4281.
2. Weight per gallon - Federal test method standard 141A, Method #4184.1.
3. Contrast ratio - Federal test method standard 141A, Method #4121 procedure "B", method "B".
4. Daylight reflectance - Federal test method standard 141A, Method #6121 using standards as prescribed in Par. 1.3.2.
5. Non-volatile content - Federal test method standard 141A, Method #4021.1.
6. Pigment content - Federal test method standard 141A, Method #4021.1.
7. Dispersion - Federal test method standard 141A, Method #4411.1.
8. Flexibility - The paint shall show no cracking, flaking, or loss of adhesion when tested in the following manner:
9. Apply a wet film thickness of .005 inches with a film applicator to a 3 x 5 tin panel weighing 0.39 to 0.51 lbs. per square foot previously cleaned with benzene and lightly buffed with steel wool. Dry the paint film at 70°F to 80°F in a horizontal position for 18 hours, then bake in an oven 3 hours at 212°F ± 4F°. Cool to room temperature for at least 1/2 hour and bend over a 1/2 inch diameter rod and examine.
10. Dry to no-pick-up - The reflectorized line, when applied at a rate of 10 mils wet film thickness and 4 pounds of glass spheres per gallon of paint, shall dry to no-pick-up in 15 to 35 seconds. For test purposes, the line

shall be applied using a striper with accurate thickness control capable of maintaining a uniform thickness with 4 pounds of glass spheres per gallon either dropped or blown onto the stripe. The line shall be dry to no-pick-up within specified time range when the pavement temperature is 55°F or more and the relative humidity is 50 percent or less, providing that the pavement is dry. Dry to no-pick-up tests will be performed by having a standard size sedan or equivalent test vehicle, coast across the paint stripe (no turning or accelerating). A successful no-pick-up test will be considered one in which at least 3 out of 4 samples show no visible paint from the stripe being tracked onto the adjacent pavement when viewed standing 50 feet from the point where the test vehicle crosses the stripe. All paint samples shall have successfully completed all laboratory tests prior to the no-pick-up test being performed. All field testing shall be performed blind in that the persons conducting the field test shall have no knowledge of which sample is from which manufacturer. All testing shall be performed without the manufacturer's representatives present. Each manufacturer will be provided test results for their sample(s) upon request.

11. Bleeding over asphalt - ASTM D 969 using substrate as in Par. 3.2 except reflectance measurement over asphalt paper area is compared to reflectance measurement over taped area.
12. Reflectance over asphalt paper area X 100 = % Bleeding Reflectance over taped area or asphalt.

9-29.2(4) COMPOSITIONAL REQUIREMENTS

1. **Pigment Composition:** Pigments shall be first quality point grade pigments. Medium chrome yellow for the yellow traffic paint shall meet the requirements of ASTM D 211-67, Type III. The Titanium Dioxide for the white traffic paint shall meet the requirements of ASTM D 476-73 Type II, III or IV. The inert or filler pigments shall be of a type and quality generally recognized as first quality paint grade products and shall not contribute to settling of the paint in storage or be so hard as to cause excessive wear of the spray application equipment.
2. **Vehicle or Resinous Binder Composition:** The vehicle may be any combination of natural or synthetic resinous Materials. Chlorinated rubber combined with other natural and/or synthetic resins and plasticizers is the preferred system. All resins used shall be permanently capable of re-dissolving in the solvent combination used in the paint. Therefore, resins which dry by the process of oxidation and/or polymerization such as alkyd resins are specifically excluded as suitable resinous binders in this Specification. The purpose of the above requirement is to minimize build-up of the paint on the sides of tanks, paint lines, and clogging of spray equipment from undissolvable skins.

9-29.3 THERMOPLASTIC

One of the following types of thermoplastic pavement marking Material Types "A" or "B" shall be used at the Contractor's option and in compliance with the manufacturer's recommendations:

Type "A": Hot-laid, liquid thermoplastic Material, containing reflective glass bead (with additional glass beads applied separately), 120 mil (3.0 millimeters) or greater thickness. The approved thermoplastic Material Suppliers are as follows:

1. Lafrentz brand, 125 mil thickness, hot extruded thermoplastic manufactured by Lafrentz Road Services Ltd., Edmonton, Alberta, Canada T6E4N7, or
2. Catatherm ABITOL formulation, 125-mil thickness, hot extruded thermoplastic manufactured by Ferro Corporation, Cataphote Division, P.O. Box 2369, Jackson, Mississippi 39205, or
3. M.L.E. Code #R200/80 formulation, 125-mil thickness, hot extruded thermoplastic manufactured by M.L.E. Industries Ltd., Calgary, Alberta, Canada T2C1N6, or
4. Pave-Mark SD formulation, 125-mil thickness, hot extruded thermoplastic manufactured by Pave-Mark Corporation, Smyrna, Georgia 30081.

Type "B": Cold-laid, prefabricated glass bead reflective thermoplastic ribbon, 60 mil (1.5 millimeters) or greater thickness.

The approved thermoplastic Material Suppliers are as follows:

1. Prismo brand thermoplastic pavement marking Material, 60 mil thickness (HT60), coated with pressure sensitive adhesive, manufactured by Prismo Universal Corporation, 300 Lanidex Plaza, Parsippany, N.J. 07054, or
2. Prismo brand thermoplastic pavement marking Material, 90 mil thickness (HT90), coated with pressure sensitive adhesive, manufactured by Prismo Universal Corporation, 300 Lanidex Plaza, Parsippany, N.J. 07054, or
3. 3M, Stamark brand pliant polymer pavement marking film, 60-mil thickness, coated with pressure-sensitive adhesive, manufactured by 3M Company, 3M Center, St. Paul, Minnesota 55101.

The glass beads shall comply with Specifications for Type II waterproof overlay glass spheres.

The skid resistance of the Material when installed on the roadway shall be not less than 40 BPN when tested with a British Portable Tester in accordance with ASTM E 303.

Primer, if required, shall be as recommended by the thermoplastic Material manufacturer.

9-29.4 PRESSURE-SENSITIVE TAPE

Pressure-sensitive tape shall be a 4 inch wide, pressure-sensitive, reflective-type tape of the form suitable for marking asphalt and concrete pavement surfaces. Biodegradable tape with paper backing is unacceptable.

The following pressure-sensitive tape has been approved as a temporary pavement marking tape:

3-M Scotch name brand pavement marking tape, coated with pressure-sensitive adhesive, manufactured by 3-M Company, 3-M Center, St. Paul, Minnesota 55101.

Surface preparation and application shall be in conformance with all the manufacturer's specifications.

SECTION 9-30 WATER DISTRIBUTION AND TRANSMISSION MATERIALS

9-30.0 GENERAL

All Materials for water distribution and transmission shall be new. Materials used for temporary Water Main and for temporary service connection purposes may be either new or previously used materials and shall be subject to Seattle Public Utilities' Water Operation's inspection and approval prior to installation.

Prior to ordering any pipe to be used in a potable water supply, the Contractor shall submit the Material source as required by Section 1-06.1 and shall obtain the Engineer's approval.

All direct and indirect drinking water system components which come in contact with potable water shall have National Sanitation Foundation certification.

9-30.1 PIPE

All pipe and fittings shall be clearly marked with the manufacturer's name, type, class, and thickness as applicable and shall be marked on the component at the place of manufacture. Marking shall be legible and permanent under normal conditions of handling and storage.

9-30.1(1) DUCTILE IRON PIPE

1. Ductile iron pipe shall be centrifugally cast in 18-foot nominal lengths shall be marked conforming to AWWA C151. Ductile iron pipe shall have a cement-mortar lining conforming to AWWA C104. Ductile iron pipe to be joined using restrained joints shall be Standard Thickness Class 52.
2. Non-restrained joints shall be rubber gasket, push-on type, or mechanical joint conforming to AWWA C111.
3. Restrained joints shall be as specified in Section 9-30.2(6).
4. Coatings, other than those required in item 1 above, shall comply with Section 9-30.1(6).
5. Pipe with threaded flanges shall not be used.

9-30.1(2) RESERVED

9-30.1(3) RESERVED

9-30.1(4) STEEL PIPE

9-30.1(4)A STEEL PIPE LESS THAN 4 INCHES DIAMETER

Steel pipe less than 4 inches in diameter shall conform to ASTM A 53, schedule 40 and shall be hot dip galvanized inside and out, including the couplings. The pipe sections shall be coupled by malleable iron screw coupling in accordance with ANSI Specification B16.3.

9-30.1(4)B STEEL PIPE 4 INCH DIAMETER AND LARGER

Steel pipe 4 inches in diameter and larger shall 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(5) PLASTIC PIPE AND ASBESTOS CEMENT PIPE

Polyvinyl chloride (PVC), polyethylene, polybutylene, and asbestos cement material pipe shall not be used as Water Main to convey potable water.

9-30.1(6) PIPE COATINGS

9-30.1(6)A SPECIAL PIPE COATINGS

Special pipe coatings shall be in accordance with the Contract.

9-30.1(6)B MULTI-LAYERED POLYETHYLENE TAPE COATING (MULTI-LAYERED POLYETHYLENE ENCASEMENT)

See Section 9-30.1(6)D for polyethylene (film wrap) encasement.

Acceptable Suppliers of multi-layered polyethylene tape coating shall be Polyken YGIII as manufactured by Kendall Company, or Tapecoat CT 10/40 W as manufactured by Tapecoat Company, or approved equal. The multi-layered polyethylene tape coating shall conforming to AWWA C214, and shall meet the following requirements:

1. The multi-layered polyethylene tape coating system shall 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 shall be fast drying and shall form an instantaneous, firm bond when the adhesive on the tape coating comes in contact with the primed pipe surface. Coating primer shall be compatible with the adhesive and shall be from the same manufacturer.
3. The inner wrap coating shall consist of polyethylene backing with a butyl-based adhesive laminated to one side of the backing. The polyethylene backing and adhesive shall be made by the calendaring process in

order to ensure the maximum bonding of the adhesive to the backing. The adhesive shall be formulated so that it forms a firm bond upon contact with the primed pipe surface.

4. The pressure sensitive adhesive outer wrap shall consist of a polyethylene backing with a butyl-adhesive laminated to one side of the backing. The pressure sensitive adhesive on the outer wrap shall form a firm continuous bond to the backing of the tape coating.
5. Cutbacks on the spigot end shall be 6 inches or less and shall be made with a cutting device that is guided from the end of the pipe to ensure a straight, uniform cutback. No cutback shall be made on the bell end of the pipe.
6. Following the application of the outer wrap, the coating shall be electrically tested for holidays with a pulse tape holiday detector. The detector voltage range for this coating is 7000-9800 volts. The testing shall conform to NACE RP-02-74.
All defects electrically detected shall 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 shall be YG III as manufactured by Kendall Co., or approved equal. The accessory tape shall conform to AWWA C209, and shall meet the following requirements:
 - a. One layer of pipeline coating primer and 50 mil inner wrap.
 - b. One layer of 35 mil outer wrap.

The primer shall be fast drying and shall 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 shall consist of a polyethylene backing with a butyl-adhesive laminated to one side of the backing. The pressure sensitive adhesive on the outer wrap shall form a firm continuous bond to the backing of the tape coating.

9-30.1(6)C THERMOPLASTIC POWDER COATING

9-30.1(6)C1 GENERAL

The powdered thermoplastic Material shall consist of acid modified polyolefin elastomer to which any stabilizers, pigments, or other additives necessary to meet the performance requirements of this Specification have been added by extrusion compounding. The thermoplastic powder shall 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 in accordance with the guidelines agreed by the manufacturers and approved applicators, the powder shall form a coating which meets or exceeds all requirements of this Specification.

9-30.1(6)C2 QUALITY OF DUCTILE IRON PIPE

Surface preparation, application and curing of powder coating, and testing and touch-up of coating shall be performed by an "experienced applicator". "Experienced applicator" shall be defined as having working knowledge of and experience with:

1. Surface preparation/blasting of 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(6)C3 SURFACE PREPARATION

The pipe and fittings shall be prepared for coating by blasting the pipe surface to remove impurities and imperfections. The existing pipe surface profile shall not change by more than 2 to 3 mils. Preparation shall 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 shall 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 shall not be visible. The prepared Material shall be maintained clean for the coating.

9-30.1(6)C4 APPLICATION OF POWDER COATING

Powder Coating

PPA 571 thermoplastic powder coating, as manufactured by Plascoat Systems Limited or an approved equal.

Masking and Plugging

All masking, where required, shall be done using a high powder coating masking tape. The ends of pipe and fittings shall 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 shall 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 shall be used for determining coating temperature.

Preheating shall 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 shall be applied to a dry film thickness of 20 to 25 mil and be totally free of holidays/pinholes.

It is then necessary to convey the part to the oven which shall be set between 285°F and 385°F in order to complete flowing out of powder.

The coating shall 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 mil.

The part shall be conveyed to the oven for a complete flowing of the powder.

The coating shall be smooth, even, and free of runs, sags, streaks and overspray.

9-30.1(6)C5 TESTING**Holidays**

After completing the coating process, the part shall be cooled to ambient temperature and then electrically tested for holidays with a Tinker & Rasor AP/S1 holiday detector or equivalent. The voltage should not exceed 6kv for a 25 mil coating. The testing shall conform to NACE RP-02-74. All defects electrically detected shall be repaired by the following method. Clean the area around the holiday/pinhole using mineral sprits, acetone or alcohol. Immediately after cleaning, heat should be applied to the coating surrounding the pinhole to re-melt and flow the coating over the holiday/pinhole repair.

Thickness

Each coated part shall be tested for coating thickness using an electronic coating thickness gauge such as Qua Nix 1500 or equivalent and the test results in accordance with Section 1-06.5 shall be submitted to the Engineer within 3 Working Days of the testing.

9-30.1(6)C6 FIELD REPAIR AND TOUCH-UP

Damaged coating or repair of cutback areas may be repaired after proper substrate preparation. Exposed substrate should be thoroughly cleaned of corrosion products and contamination to expose bare metal. Abrasive techniques (wire brush, sandpaper, sandblast, etc.) followed by cleaning with mineral sprits, acetone or alcohol are recommended. Immediately after cleaning heat should be applied 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 shall remove and replace the damaged item.

9-30.1(6)C7 MATERIAL REQUIREMENTS**Test Conditions**

Unless otherwise specified in the Contract, the testing conditions shall be in accordance with ASTM D3924 at standard Conditions: 73.5°F ±3.5°F, 50% ±5% relative humidity.

Specific Gravity

Specific gravity of the powder thermoplastic coating Material shall be between 0.90 and 0.97. Specific gravity shall be determined in accordance with method B specified in ASTM D 729.

Color

Color of the thermoplastic powder coating shall be specified by the purchaser and evaluated for conformance in accordance with ASTM D 1729.

Flexibility

The thermoplastic powder coating shall exhibit no cracking, peeling, or loss of adhesion when bent (coated side in tension) 180 degrees over a conical mandrel in accordance with ASTM D 522, Test Method B. Panels shall be examined immediately after bending.

Adhesion

The thermoplastic powder coating shall exhibit a minimum of 1000 psi adhesion to the aluminum and steel substrates in accordance with ASTM D 4541.

Thermal Shock Resistance

The applied thermoplastic powder coating shall withstand 10 temperature cycles without cracking, checking, or disbonding. Cycles should be from +104 °F to -40 °F.

Impact Resistance

The applied thermoplastic powder coating shall resist minimum direct and reverse impacts of 36 inch-pounds without cracking, disbonding or holiday formation as determined by visual inspection. Test panels shall be impacted in accordance with ASTM D 2794 using a 2 pound weight with a 0.5" diameter indenter dropped from a height of 18".

Abrasion Resistance

Weight loss from the applied thermoplastic powder shall not exceed 90 milligrams. Test panels shall be tested for 1000 cycles using a Taber Abrader apparatus with CS-17 wheels and 1000 gram weights in accordance with ASTM D 4060. Weight loss shall be determined immediately after test to three significant figures.

Salt Spray Resistance

Unscribed: There shall be no blisters, wrinkles or loss of adhesion nor any general surface corrosion or pitting after 1000 hours of salt spray exposure.

Scribed: There shall be no blisters, wrinkles nor any general surface corrosion or pitting after 1000 hours of salt spray exposure. There shall 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 shall exhibit no objectionable alteration to the surface such as discoloration, change in gloss, blistering, softening, loss of adhesion, formation of holidays or special phenomena after immersion for 7 Days in accordance with 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 shall exhibit no objectionable alteration to the surface such as discoloration, change in gloss, blistering, softening, loss of adhesion, formation of holidays or special phenomena after immersion for 7 Days in accordance with ASTM D 1308 in the following chemical solutions:

1. 3M aqueous CaCl₂.
2. 3M aqueous NaOH.
3. Saturated aqueous Ca(OH)₂.
4. Aqueous solution of H₂SO₄ (specific gravity = 1.29 ±0.02).

Dielectric Strength

The applied thermoplastic coating shall have a dielectric strength of 900 ±100 v/mil at 15 mil in accordance with ASTM D 149.

Weathering Properties

The applied thermoplastic coating shall exhibit the following resistance to weathering:

1. **Accelerated weathering.** The applied thermoplastic powder coating shall show no cracking, significant color change (fade), chalking, Blistering, wrinkling or loss of adhesion, nor shall there be any evidence of substrate corrosion after 2000 hours exposure to accelerated weathering in accordance with ASTM G 53 using UVB-313 fluorescent lamps. The coating, shall exhibit no more than 30% loss in 60 degree specular gloss after exposure.
2. **Humidity resistance.** Test panels shall be exposed to a 120°F ±2°F, 100% relative humidity environment in accordance with ASTM D 2247 for 30 Days. The coating shall show no blistering, wrinkling or loss of adhesion nor shall there be any evidence of substrate corrosion after humidity exposure.
3. **Holidays.** The applied thermoplastic powder coating shall be free of holidays at an application thickness of 20-25 mil. holiday detection shall be performed with a low voltage (75-100 volts) direct current detector.
4. **Shelf life.** Powder coating Materials shall meet the requirements of the Owner, with a minimum of 2 years from the date of manufacture when stored below 85°F, 50% relative in the unopened original container.

Material Safety Data Sheets (MSDS)

Material Safety Data Sheets shall be provided to the Engineer.

9-30.1(6)D POLYETHYLENE ENCASEMENT (FILM WRAP)

Plastic film wrap for polyethylene encasement shall be 8 mil polyethylene conforming to AWWA C105.

See Section 9-30.1(6)B for multi-layered polyethylene encasement.

9-30.1(6)E HEAT SHRINK JOINT SLEEVE

The sleeve shall be Aqua Shield, or approved equal. The sleeve shall be a wrap around type with a joint closure and shall contain a thermal indicator.

9-30.1(6)F WAX TAPE COATINGS

Petrolatum-impregnated wax tape coating shall 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 7-12.3(8) for field application construction requirements.

9-30.2 FITTINGS**9-30.2(1) DUCTILE IRON PIPE**

Fittings for ductile iron pipe shall be ductile iron conforming to AWWA C110, and AWWA C111 or AWWA C153 and shall be cement-mortar lined conforming to AWWA C104.

Except where restrained joint systems are required, fitting joints shall be mechanical joint.

Where restrained joint pipe is required, threaded flanges by restrained joint adapters shall not be longer than three pipe diameters. Threaded flanges and pipe shall conform to AWWA C115. The exterior flange lip overlapping the pipe barrel shall be sealed with a bituminous mastic.

Sleeves less than 12 inches in diameter shall be 12 inches minimum length and shall be mechanical joint.

Sleeves greater than 12 inches in diameter shall be of the long body type and shall be 15 inches minimum length and shall 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 shall 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 shall 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 shall be joined with a transition mechanical joint sleeve having a single-piece body.

Hub-by-flange fitting length shall conform to AWWA C110 or AWWA C153. The body of hub-by-flange fittings shall be a single-piece casting. Threaded pipe and flange combinations shall not be used.

9-30.2(2) RESERVED**9-30.2(3) RESERVED****9-30.2(4) STEEL PIPE**

Fittings for steel pipe 3-1/2 inches in diameter and smaller shall be malleable iron threaded type with a pressure rating of 150 psi. Dimensions shall conform to ANSI B16.3. Threading shall conform to ANSI B2.1 Material shall conform to ASTM A47, Grade 32510. All fittings shall be banded and hot-dip galvanized inside and out.

Unions shall be malleable iron with a pressure rating of at least 150 psi. Material shall conform to ASTM A 47, Grade 32510. Unions shall be ground joint, bronze to iron type.

Steel fittings for pipe 4 inches in diameter and larger shall be in accordance with AWWA C208. The class of the fittings shall be at least the same as that of the pipe. Coatings for the fittings shall be the same as specified for the pipe. Field couplings shall be compression type. When flanges are required, they shall conform to AWWA C207. All couplings shall have the same coating as the pipe coating.

9-30.2(5) RESERVED**9-30.2(6) RESTRAINED JOINTS**

Restrained joints, where required on the Drawings, shall be a boltless design which is flexible after assembly and can be disassembled without special tools, such as TR Flex Restrained Joint Pipe as manufactured by U.S. Pipe Co., or approved equal, and shall meet the following criteria:

1. The restrained joint shall have a positive metal to metal contact locking system without the use of gripping teeth, and
2. The joint restraint system for the pipe shall be the same as the joint restraint system for pipe fittings.

9-30.2(7) TRANSITION REDUCING, AND INSULATING FLEXIBLE COUPLINGS

Transition couplings, reducing couplings, transition reducing couplings, sleeves, and flexible insulating couplings for Water Main shall be compression type, (Romac or Ford or approved equal, constructed of ductile iron sleeves, and ductile or malleable iron followers. Bolts and nuts shall be corrosion resistant per AWWA C111. Stainless steel bolts require anti-seize compound. Couplings shall be stainless steel. The long body pattern with a minimum length of 10 inches for pipe up to 12 inches diameter and 15 inches minimum length for pipe greater than 12 inches diameter. Factory finish shall be fusion bonded epoxy or Plascoat PPA 571 thermoplastic coating.

9-30.2(7)A INSULATING COUPLINGS

Insulating couplings and flange kits shall be required at any point of connection of two dissimilar metallic Material pipes (i.e., ductile iron to cast iron). The insulating coupling body and end rings shall be ductile iron; 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 shall 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(6)C; insulating boot shall cover the pipe end to prevent metal contact between pipe sections being joined. The insulating boots and rubber gaskets shall be virgin synthetic butyl rubber compatible for potable water service. The nuts and bolts shall be stainless steel ASTM F 593, Type 316. The insulating coupling shall be manufactured by Romac Industries, Inc., or approved equal.

9-30.2(7)B INSULATING FLANGE KITS

Insulating flange kits shall 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 Pipeline Seal and Insulator (PSI) Inc., Houston, Tx.; Central Plastics Co., Shawnee, OK.; or approved equal.

9-30.2(8) RESTRAINED FLEXIBLE COUPLINGS AND SLEEVES

Restrained flexible couplings or sleeves shall be as indicated on the Drawings.

9-30.2(9) SPECIAL FITTINGS

Special fittings shall be as indicated on the Drawings.

9-30.2(10) TWO-INCH BLOWOFF ASSEMBLY

Two inch blowoff assembly shall be as indicated on Standard Plan nos. 340a and 340b at the locations shown on the Drawings.

Two inch service tube shall be Type K copper. Two inch gate valve shall be of iron-body construction, having bronze seat rings and stem, an o-ring stem seal system, shall be fitted with a 2 inch square operating nut, F.I.P.T. inlet and outlet threading conforming to ANSI B2.1, and shall be minimum 150 pounds working water pressure rated. Plastic foam Material shall conform to Section 9-30.2(11). Frame and cover shall conform to Section 9-30.3(12)H. Meter Box shall conform with Section 9-30.6(8).

9-30.2(11) PLASTIC FOAM (ETHAFOAM)

Plastic foam shall be in accordance with Section 9-05.10.

9-30.2(12) PORTLAND CEMENT CONCRETE

Portland Cement Concrete for pipe support saddles and cradles and for thrust blocking shall be Class 5 (1-1/2) (see Section 5-05.3).

9-30.2(13) RESERVED**9-30.2(14) STEEL CASING PIPE**

Steel casing pipe shall have a diameter and wall thickness as specified on the Drawings. Pipe shall be smooth and bare.

9-30.2(15) SEALS AND SPACERS FOR STEEL CASING PIPE**9-30.2(15)A SEALS**

Casing end seals shall be used to completely seal the annular space between the casing and the Water Main at each end of the casing. Casing end seals shall provide a moisture-proof seal that is resistant to heat, cold, vibration, impact, abrasion, disbonding, expansion and contraction, and shall 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(15)B SPACERS

Casing spacers shall be bands at least 12 inch in width, and shall be either stainless steel or heavy duty fusion bonded epoxy coated steel. Runners shall be 2" wide glass reinforced plastic securely bonded to the spacer, and shall be aligned on the spacer along the axis of insertion of Water Main into casing pipe. Runner length shall approximate the width of the spacer. Securing the spacer to the Water Main shall be in accordance with 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.

9-30.3 VALVES**9-30.3(1) GENERAL - MANUFACTURE AND MARKING**

The valves shall be a standard pattern of a manufacturer whose products are approved by the Engineer and shall 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 shall be NSF approved and valve bodies shall be ductile iron. All valves shall 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 shall 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 shall conform to AWWA C500, be equipped with non-rising stems and "O" ring stuffing box, and with double disc gates having a bronze wedging device.

All gate valves shall have a ductile iron body.

Valves shall open counterclockwise when viewed from above, and shall be equipped with a standard AWWA 2 inch square operating nut. Valves shall be double disc-bronze seated valves if they have iron bodies.

Three (3) Manufacturer's Certificates of Compliance demonstrating performance tests comply with AWWA C500 shall be submitted to the Engineer.

Valve ends shall be mechanical joint. Where restrained joints are called out, valve ends shall be flanged with appropriate flange by restrained joint adapters per Section 9-30.2(1).

The valves shall be as manufactured by Clow, M & H, American Flow Control (ACIPCo), Pratt/Mueller, M&H/Kennedy, or approved equal in sizes 12 inches or less.

Gate valves 2-1/2 inch and smaller shall 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 shall be minimum 150 pounds water working pressure.

The 2 inch and smaller valves shall 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 shall conform to AWWA C509 and Section 9-30.3(1).

9-30.3(3) RESERVED**9-30.3(4) BUTTERFLY VALVES**

In addition to the requirements of section 9-30.3(1), Water Main butterfly valves shall conform to AWWA C504 and shall be Class 150B. The valve shall be short-body type and shall have flanged ends. Flanged ends shall be sized and drilled in conformance with ANSI B16.1 Class 125. Valve shall be suitable for direct burial installation; however butterfly valves 12 inch and larger shall be installed within an access vault sized to permit removal and replacement of the valve.

All butterfly valve bodies and discs shall be ductile iron.

Butterfly valves other than AWWA C504 Class 150 and butterfly valves installed on water transmission pipeline shall be as indicated in the Contract.

Where butterfly valves are installed on restrained joint Water Mains, the valve ends shall be flanged with flanged by restrained joint adapters per Section 9-30.2(1).

Valves shall be mounted on the Water Main or pipeline such that the operating nut is accessible and operable from above.

Operator shall be manual, fully enclosed, and suitable for buried service. It shall open left (counterclockwise when viewed from above), and shall be equipped with a standard AWWA 2 inch square operating nut.

Operators for 16 inch and larger valves shall be equipped with external indicators, visible from above, which show the position of the valve disc.

Unless otherwise indicated in the Contract, the minimum number of turns from fully open to fully closed on Class 150 butterfly valves shall be as follows:

Diameter	Turns, min.
4 inch to 8 inch	16 turns
10 inch to 12 inch	28 turns
14 inch to 18 inch	30 turns
20 inch	60 turns
24 inch	100 turns
30 inch	150 turns
36 inch and larger	200 turns

A Manufacturer's Certificate of Compliance stating that the valves to be furnished fully comply with AWWA C504 and the modifications contained herein shall be submitted to the Engineer before incorporation of the valve into the Work.

Unless the Contract specifies otherwise, bolting and torquing for the valve connection to the Water Main shall be as recommended by the manufacturer including any connection coating requirement when buried in soil. Wearing surfaces shall be bronze or other approved noncorrosive Material and there shall be no moving bearing or contact surface of iron in contact with iron. Rubber seat shall be retained in the body and shall mate against a stainless steel surface mounted on the disc. Contact surfaces shall be machined and finished in the best workmanlike manner, and all wearing surfaces shall be easily renewable.

The butterfly valves shall be manufactured by Henry Pratt Company, Mueller, DeZurick, Mosser Valve Division of Olsen Technologies, or approved equal.

The valve manufacturer shall provide a non-corrosive durable metal tag, measuring 4 inches by 6 inches, 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, shall 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(5) VALVE BOXES

Valve boxes shall be installed on all buried valves. The box and lid shall be cast iron, 2-piece slip type with cast iron extension as necessary, conforming to requirements and dimensions of the current Seattle Public Utilities - Water Utility Standards.

The cover shall have the word "WATER" or the letter "W" cast in it.

Valve boxes, lids and extensions of the following manufacture and pattern are approved for use:

045 Valve Box (Olympic Foundry Inc.) Standard Base and Extension

Lid Section # 13-5010

Top Section # 13-5020

Base Section # 13-5021

Each top and lid section shall be tested for accuracy of fit and shall be marked in sets for delivery.

Valve box extension pieces shall be provided for valves with ground cover in excess of the depth of the standard valve box (see Standard Plan nos. 315a and 315b).

9-30.3(6) RESERVED

9-30.3(7) COMBINATION AIR RELEASE / AIR VACUUM VALVES

Combination air release/air vacuum valves shall comply with the requirements of ANSI / AWWA C512.

9-30.3(8) END CONNECTIONS

The dimensions of hub or bell end connections shall conform to the dimensions of AWWA C100. The dimensions for the mechanical joint connections shall conform to the ANSI A21.11.

The end flanges of flanged valves shall conform in dimensions and drilling to the standard ANSI B16.1 for cast iron flanges and flanged fittings, Class 125, unless specifically provided otherwise in the Contract. The bolt holes shall straddle the vertical center line.

9-30.3(9) RESERVED

9-30.3(10) OPERATING NUT EXTENSIONS

An operating nut extension conforming to Standard Plan no. 315b shall 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(11) PLASTIC FOAM RINGS

Valve boxes shall 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 no. 315b installed between the base and the valve casting. The plastic foam shall conform to the requirements of Section 9-05.10.

9-30.3(12) VALVE CHAMBERS

9-30.3(12)A PRECAST VALVE CHAMBER

Size, shape, and Materials shall be as indicated on the Drawings.

The chambers shall be furnished in precast concrete sections with sufficient strength to withstand HS 20 traffic loading together with ladder and access frames and covers to provide the minimum clearance dimensions shown on the Drawings.

The chambers shall be watertight after assembly. Gasket Material shall be installed in the groove of the keyway of each chamber section as it is installed. There shall be no evidence of moisture seeping into the chambers through the walls, floor, or joints.

9-30.3(12)B CONCRETE BLOCKS FOR VALVE CHAMBERS

Portland cement concrete blocks shall be solid, and shall conform to the requirements of ASTM C 139. Overall thickness of block shall be 6 inches with optional lengths and widths. Curved manhole blocks shall be used for round valve chambers.

9-30.3(12)C CONCRETE BRICK FOR VALVE CHAMBERS

Concrete brick shall be solid and conform to ASTM C 55, Grade A.

9-30.3(12)D CLAY BRICK FOR VALVE CHAMBERS

Clay brick shall conform to ASTM C 62, Grade SW.

9-30.3(12)E MORTAR

Portland cement mortar shall 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(12)F PORTLAND CEMENT CONCRETE

Concrete for chamber foundation shall be Class 2300 (see Section 6-02.3).

9-30.3(12)G CAST-IN-PLACE CONCRETE VALVE CHAMBER

The design, size, shape, and Materials for cast-in-place concrete valve chambers shall be in accordance with the Drawings. The Contractor shall submit Shop Drawings of the chamber indicating all features to the Engineer per Section 1-05.3.

9-30.3(12)H FRAME AND COVER AND VALVE BOX CASTINGS

Castings for cast iron frame and cover and for cast iron parts of valve boxes shall conform to the requirements of ASTM A 48, Class 30 and shall conform to the Standard Plans unless specified otherwise in the Contract.

The word "WATER" shall be cast in the cover in 3 inch letters as indicated on the Standard Plans.

Each ring and cover section shall be tested for accuracy of fit and shall be marked in sets for delivery.

An acceptable Supplier is Olympic Foundry Type SM29 standard box and lid or approved equal.

See Section 930.3(4) 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(12)I MORTAR FOR PLASTER-COATING

Mortar for plaster-coating masonry unit manholes shall be proportioned according to either of the two following tabulated alternates:

	Parts by volume Portland cement	Parts by volume masonry cement	Parts by volume hydrated lime or lime putty
alternate 1	1	1 (Type II)	0
alternate 2	1	0	1/4

Plaster sand for either alternate 1 or alternate 2 above shall be measured in a damp, loose condition, and shall be not less than 2-1/4 and not more than 3 times the sum of volumes of cement and lime.

A bituminous coating shall be applied to all surfaces after plastering.

9-30.3(12)J LADDERS

Ladder shall be made of steel, and shall be galvanized after fabrication. They shall be made of 1 inch deformed steel bar conforming to ASTM A615, intermediate or standard grade, hot bent at least 1600°F. Galvanization shall conform to ASTM A123.

9-30.3(13) PAINTING AT FACTORY

After the factory test and inspection, all ferrous parts of the valves except finished or bearing surfaces shall be painted inside and out with two coats of asphalt varnish, Federal Specification TT-V-51A or approved equal.

9-30.3(14) WATER PRESSURE REGULATING VALVES**1. Water Pressure Regulating Valves, 3 inch through 12 inch Sizes:**

Valve shall be flanged at both ends, Class 150 ASA drilling, with ductile iron body. Valve shall be a diaphragm operated, single seat, globe valve with stainless steel trim. It shall be spring loaded and hydraulically operated. Seat ring shall be replaceable. The diaphragm shall be fully guided top and bottom. All necessary repairs shall be possible without removing the valve from the line. Packing glands are not permitted. Disc shall be synthetic rubber and have a rectangular cross section. The stem shall be guided by a bearing in the valve cover and an integral bearing in the valve seat. There shall be no piston operating the main valve.

Valves shall 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 shall be CLA Valve No. 90 or approved equal.

2. **Water Pressure Regulating Valves, 2 inch Size:**

Valves shall be Mueller No. H-9310 2 inch Water Pressure Reducing Valves or approved equal.

9-30.3(15) COATINGS FOR VALVES

Special coatings, thermoplastic powder coating, and polyethylene encasement shall be per Section 9-30.1(6).

9-30.4 RESERVED

9-30.5 HYDRANTS

9-30.5(1) GENERAL

Fire hydrants shall conform to AWWA C502 and shall 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 shall be plainly cast in raised letters on the hydrant barrel to be visible after the hydrant is installed.

Hydrants of the following manufacture and pattern have been approved for use by the City of Seattle:

1. Pacific States
2. Clow Model 5110 (Iowa)
3. Mueller "Centurion" Model A-423
4. American-Darling Model B-62B
5. Kennedy K81D "Guardian"

9-30.5(2) END CONNECTIONS

The end connection shall be 6 inches, standard flange, Class 125 drilling conforming to ANSI B16.1.

9-30.5(3) HYDRANT DIMENSIONS

The dimensions and details of hydrant and nozzles shall 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 shall 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.
10. Drain Valve: Drain valve shall be automatic with outlet tapped with 1/4 to 3/4 inch female iron pipe threads. The threads on the drain valve outlet holes shall 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 shall be fitted with cast iron threaded caps with operating nut of the same design and proportions as the hydrant stem nut. Caps shall be threaded to fit the corresponding nozzles and shall be fitted with suitable neoprene gaskets for positive water tightness under test pressures.

9-30.5(4) OPERATING NUTS

The operating nuts on hydrant stem and nozzle caps shall be as follows:

Pattern of nut	Tapered pentagonal
Height	1-1/6 inch
Size of pentagon	1.35 inch at bottom of nut
	1.23 inch at top of nut (measured from point to flat)

The direction of opening shall be clearly marked on the operating nut or hydrant and shall be counterclockwise.

9-30.5(5) HYDRANT RESTRAINT

9-30.5(5)A RESTRAINT SYSTEM FOR SHACKLE RODS

Rewrite to allow under special circumstance as directed by Engineer. Otherwise, megafollowers only. Shackling rods shall be 3/4 inch diameter with threaded ends, and shall meet ASTM A36. "All-thread" rod is not acceptable. If a tie bolt restraint system is used, it shall 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 shall conform dimensionally as shown on the hydrant detail, and shall be ductile iron conforming to ASTM A536 Class 80-55-06. Coating for shackling rods shall be in accordance with Section 9-30.15.

9-30.5(5)B RESTRAINT SYSTEM FOR WEDGE RESTRAINT GLANDS

If a wedge restraint system is used in lieu of shackle rods, mechanical joint (MJ) pipe shall be used rather than slip joint (SJ) pipe. The wedge restraint system shall conform to AWWA C111, ASTM A 536-80 Grade 65-45-12. All bolts and wedges shall be ductile iron. Wedges shall be heat-treated to a minimum 370 BHN. The wedge restraint system shall be rated for 350 psi for pipe 12 inch in diameter and smaller. Wedge restraint systems shall be tape wrapped and joint bonded if installed on coated Water Main.

9-30.5(6) BREAKAWAY FLANGE CONSTRUCTION

Hydrants shall 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 shall 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 shall be equipped with O-ring stem seals.

9-30.5(7) HYDRANT PAINTING**9-30.5(7)A HYDRANT SHOP PAINTING**

All iron parts of the hydrant shall be thoroughly cleaned and painted at the factory. All inside surfaces and the outside surfaces below the ground line shall be coated with asphalt varnish, Federal Specification TT-V-51a or J.A.N.P-450, unless otherwise specified in the Contract. They shall be covered with two coats, the first having dried thoroughly before the second is applied.

9-30.5(7)B HYDRANT FIELD TOUCH-UP PAINTING

All iron parts of the hydrant shall be thoroughly cleaned and painted at the factory. All inside surfaces and the outside surfaces below the breakaway flanges shall be coated with asphalt varnish, Federal Specification TT-V-51a or J.A.N.P-450, unless otherwise specified in the Contract. They shall 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, shall 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 shall be painted with two coats of oil based gloss enamel paint (Kelly-Moore Luxlite or approve equal) with the final coat being Red.

9-30.5(8) HYDRANT FACTORY HYDROSTATIC TEST

All hydrants shall be tested by the manufacturer, as required in AWWA C502. The Contractors shall furnish to the Owner an affidavit of compliance from the manufacturer for all tests.

9-30.5(9) HYDRANT CONNECTION PIPE

Pipe connections from the hydrant to the Water Main shall be 6 inch Ductile Iron Pipe, Class 52, in accordance with Section 9-30.1(1).

9-30.5(10) HYDRANT VERTICAL EXTENSIONS

Hydrant barrel extensions shall have a 7 inch minimum inside diameter and shall be gray cast iron or Ductile Iron and shall conform to the AWWA Standards for such castings. The drillings of the connecting flanges on the extensions shall match the drillings of the flanges on the hydrant.

Hydrant vertical extensions shall also include the necessary hydrant operating stem extension, complete with safety stem couplings.

Extensions with threaded flanges shall be ductile iron and shall conform to AWWA C115. The exterior flange lip overlapping the barrel pipe shall be sealed with a bituminous mastic.

Vertical extensions shorter than 18 inches shall be installed at the bottom of the factory supplied barrel pipe.

9-30.5(11) HYDRANT BLEEDER

The hydrant bleeder assembly, as shown on the hydrant detail, shall be constructed of 3/4 inch copper tubing Type K, conforming to Section 9-30.6(4).

9-30.5(12) POLYETHYLENE ENCASEMENT AND SPECIAL TAPE COATING FOR HYDRANTS AND CONNECTIONS

Refer to Section 9-30.1(6).

9-30.6 SERVICE CONNECTIONS AND SERVICE PIPE OR TUBING**9-30.6(1) GENERAL**

Service piping standards shall be used, and modified when indicated on the Drawings, for 2 inch blowoff assembly and hydrant bleeder assembly.

9-30.6(2) SADDLES

Saddles shall be ductile iron, or bronze, double straps with thread standard outlet tapping. Saddles shall be of a size designed by the manufacturer to fit the pipe called for on the Drawings.

9-30.6(3) CORPORATION STOPS

Corporation stops for use with saddle shall 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 shall be bronze alloy with AWWA tapered inlet Outlets on 3/4 inch and 1 inch direct tap corporation stops shall 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 shall be male iron pipe or tubing to be connected.

9-30.6(4) SERVICE PIPE**9-30.6(4)A COPPER TUBING**

Copper tubing shall conform to the requirements of ASTM B 88, Type K, annealed. The tubing shall be coupled using compression fittings having a positive external gripping feature to prevent tubing pull-out, conforming to the requirements of AWWA C800, minimum 150 psi working pressure.

9-30.6(5) COMPRESSION COUPLINGS

Compression couplings for use in connecting plain end water service pipes shall be applicable for the type of pipe being coupled. Compression couplings shall have armored gaskets when similar metal pipes are being joined.

9-30.6(6) RESERVED**9-30.6(7) METER STOPS AND SETTERS**

Meter stops and setters shall be in accordance with the SPU Water Operation Standards.

9-30.6(8) METER BOX AND LID

Meter Box and Lid shall be in accordance with the current SPU Water Operation Standards. The Meter Box casting shall conform to ASTM A 48, Class 30 for gray cast iron. The Lid casting shall conform to ASTM A536, Grade 80-55-06 for ductile iron. Castings shall be brushed or dipped with a bituminous coating. Meter Box and Lid shall be Olympic Foundry (1984) Inc. SM-29, or approved equal.

9-30.6(9) VALVES

Valves shall conform to Section 9-30.3.

9-30.7 BEDDING, FOUNDATION MATERIAL AND GRAVEL

When the Mineral Aggregate is specified by a "Type" designation, it shall conform to the requirements in Section 9-03. See Section 7-10.3(9) for bedding requirements.

9-30.8 RESERVED**9-30.9 RESERVED****9-30.10 JOINT BOND CABLE**

General joint bond cable shall be single-conductor No. 2 AWG stranded copper wire with 600-volt, 7/64" 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 under THERMITE WELD MATERIALS, this Section.

9-30.11 THERMITE WELD MATERIALS**9-30.11(1) GENERAL**

Thermite weld Materials shall 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 shall be the product of a single manufacturer. Interchanging Materials of different manufacturers will not be acceptable.

Molds shall be made of graphite. Ceramic "one-shot" molds will not be acceptable.

Steel thermite weld cartridges shall be used for steel pipe and fittings. Cast iron thermite weld cartridges shall be used for all cast and ductile iron pipe and fittings. Maximum cartridge sizes for steel thermite welds shall 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 shall 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.

9-30.11(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 shall be attached with the appropriate size and type of hammer die provided by the thermite weld manufacturer.

9-30.11(3) THERMITE WELD CAPS AND PRIMER

Thermite Weld caps shall 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.

9-30.11(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, shall be 100% solid epoxy that cures in submerged or buried conditions. Repair of thermoplastic powder coating shall be as specified in Section 9-30.1(6)C6.

9-30.12 ELECTROLYSIS TEST STATION**9-30.12(1) GENERAL - NON-TRAFFIC AREA**

An electrolysis test station shall consist of a standard meter box and lid as specified in Section 9-30(6)8 providing a housing for a test box as specified in Section 9-30.12(2).

9-30.12(2) TEST BOX

Test box requirements shall be as follows:

The 4" (10 cm) deep test box shall provide a single piece enclosure 8" by 6" (20 cm by 15 cm) with a removable, hinged lid. The test box shall be Hoffman No. 864CHQRFQ or approved equal.

The lid shall be manufactured from molded fiberglass reinforced Material, and fitted with a one-piece oil resistant "O" ring gasket. The lid shall be attached to the test box with a monel hinge pin and secured by quick release latches.

The test box shall comply with NEMA 4X standards, to supply protection against corrosion, windblown dust, rain, splashing water, and hose direct water.

A watertight connector consisting of a heat-shrinkable cable entry system, shall be used for passage of test wires into the enclosure. The entry system shall be a three 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 shall be type CES-2 or CES-3, with SFTS-1 or SFES-3 tape sealant as manufactured by Sigmaform Corporation; or approved equal.

9-30.12(3) TEST STATION WIRES

Test station wires shall be single conductor, No. 10 AWG and No. 6 AWG stranded copper with 600 volt XHHW insulation. Color of insulation per Drawings.

9-30.12(4) WIRE CONNECTORS INSIDE TEST BOX

Wire connectors inside the test box shall be one-piece, tin-plated crimp-on lug connector as manufactured by Burndy Co., Thomas and Betts, or equal.

9-30.12(5) ZINC REFERENCE ELECTRODES

The electrode shall be packaged in a thoroughly mixed backfill material consisting of 75% gypsum, 20% bentonite clay and 5% sodium sulfate. The package shall be water permeable and of sufficient size to ensure complete envelopment of the reference electrode.

9-30.12(6) ELECTRICAL CONDUIT AND FITTINGS

PVC electrical conduit and fittings shall be schedule 40 and UL listed for direct burial. Conduit and fittings shall meet the requirements of NEMA TC and TC3, federal specification W-C-1094, UL and NEC.

9-30.13 TURBINE METERS (METER, COLD WATER, MAGNETIC DRIVE TURBINE TYPE, SIZES 2" - 12")**9-30.13(1) GENERAL**

These requirements apply to Magnetic Drive Turbine Type Cold Water Meters 2 inch through 12 inch in size, manufactured for use on customer water services. Turbine Meters shall consist of a cast bronze case containing the measuring mechanism with a strainer housing attached.

Meters shall meet the requirements of AWWA C701, current edition, Class II type, except as modified herein.

9-30.13(2) REGISTER AND REGISTER BOX

Registration shall be in cubic feet.

9-30.13(3) RESERVED**9-30.13(4) MEASURING MECHANISM**

The measuring mechanism shall be the inline type, and so designed that it can be readily removed from the main case as a complete unit. The measuring mechanism shall be capable of operating within the accuracy limits specified under "Normal Flow Limits" in Section 9-30.13(7) without recalibration when transferred from one turbine meter case to another.

9-30.13(5) INTERMEDIATE GEAR TRAIN

If an intermediate gear train is utilized, it shall operate in a dry, hermetically sealed compartment, separated from the water passage by a bronze wall.

9-30.13(6) CAPACITY AND ACCURACY

The turbine meter shall register all rates of flow through it with an accuracy of 100% ± 2% at rates of flow within the limits specified under "Normal Flow Limits" in Section 9-30.13(7).

9-30.13(7) NORMAL FLOW LIMITS

Size	Normal Flow Limit
2-Inch	5 - 160 GPM
3-Inch	10 - 350 GPM
4-Inch	15 - 800 GPM
6-Inch	30 - 1800 GPM
8-Inch	50 - 3500 GPM
10-Inch	55 - 5500 GPM
12-Inch	70 - 7000 GPM

NOTE: Above flow limit shall be for continuous flows, all turbine meters shall have a 25% overspeed capacity for intermittent flows.

9-30.13(8) HEAD LOSS

Maximum loss of head shall not exceed 7 psi at the flow rates listed under "Normal Flow Limits" in Section 9-30.13(7).

9-30.13(9) CONNECTIONS

All main case connections shall be flanged. The flanges for 2 inch meters shall be of the two bolt oval type. Meters shall be furnished without companion flanges.

9-30.13(10) INTERCHANGEABLE PARTS

All parts of turbine meters of the same size, make and model shall be interchangeable.

9-30.13(11) STRAINER

Turbine meters shall be supplied with a strainer attached. Strainers shall 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.

9-30.13(12) REMOTE READING

Turbine meters shall be compatible with existing SPU Automated Meter Reading and Demand Recording Hardware and/or switches. Manufacturer, type, and style of switch shall be submitted for approval by the Engineer before ordering.

9-30.13(13) MANUFACTURE AND APPROVAL

Only meters manufactured by a well established firm will be considered. Only those meters of a specific model and manufacturer, samples of which have been submitted to SPU Water Meter Shop for inspection and approval, and carrying a minimum 1 year guarantee will be acceptable.

9-30.13(14) 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.

9-30.13(15) GUARANTEE

All turbine meters shall be guaranteed for a period of 1 year after installation. This guarantee shall be against defects in Materials, workmanship, and construction.

9-30.13(16) TEST REPORT

All turbine meters purchased under this Specification shall be accompanied by a notarized test report of the factory accuracy test.

9-30.14 LOCATING WIRE

Locating wire shall be 14 gauge solid copper with neoprene coating. Connections and splices shall be made with Penn Wilson split Bolt Wire Connectors, catalog No. 5-8-5, or approved equal.

9-30.15 COATING FOR ALL BOLTS AND SHACKLE RODS

All bolts and shackle rods shall be coated with 2 coats of asphaltic varnish Royston Roskote 612 XM, or approved equal.

On corrosion protected Water Mains, all shackle rods, concrete blocking anchor rods, and shackle clamps shall have a factory applied protective coating with fusion bonded epoxy in accordance with ASTM A 755. After threading and assembly, the threaded ends, nuts, and washers shall be coated with a wrapping of Trenton wax tape #1 or approved equal.

9-30.16 BACKFLOW PREVENTION ASSEMBLIES (BPAs)**9-30.16(1) GENERAL**

All backflow prevention assemblies (formerly called backflow prevention devices or BPDs) shall be on the Washington State Department of Health current list of approved backflow prevention assemblies, and both temporary and

permanent installations of such assemblies shall be verified acceptable by the Engineer. The list of Washington State Approved assemblies is available at 1-503-246-5845.

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 7D 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, shall be inspected by Seattle King County Health Department Plumbing Inspection.

9-30.16(2) ATMOSPHERIC VACUUM BREAKERS (AVBs)

Atmospheric vacuum breakers shall 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 shall 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 shall be installed above ground.

An atmospheric vacuum breaker shall be attached to each hose bib. An AVB shall not be operated for more than 12 hours in any 24 hour period. AVBs shall not be used on systems with chemical additions.

9-30.16(3) PRESSURE VACUUM BREAKER ASSEMBLIES (PVBAs)

Pressure vacuum breakers shall 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 shall 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 shall be inspected and tested annually during the life of the Contract by backflow device testers certified by the Washington State Department of Health. PVBAs shall not be installed below ground. PVBAs shall not be used for systems with chemical additions.

9-30.16(4) DOUBLE CHECK VALVE ASSEMBLIES (DCVAs)

Double check valve assemblies shall be of a type included in the Washington State Department of Health current listing of "Approved Double Check Valve Assemblies".

Installations shall 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 shall 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 shall not be used for systems with chemical additions.

9-30.16(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 shall 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 insure proper operation, will be conducted by SPU Inspection Services. RPBAs shall be inspected and tested annually during the life of the Contract by backflow device testers certified by the Washington State Department of Health.

Installation shall 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 shall not be installed below ground.

9-30.16(6) RESERVED

SECTION 9-31 ILLUMINATION AND ELECTRICAL MATERIALS

9-31.1 LUMINAIRES

9-31.1(1) GENERAL

Luminaires shall have attached to the housing, an ANSI approval decal (3 inches square) which shall be readily visible from the ground, indicating lamp type by color code (i.e., blue for Mercury Vapor, gold for High Pressure Sodium, red for Metal Halide); and lamp wattage by numerical code, i.e.:

Numerical Code	Lamp Wattage
15	150 Watt
25	250 Watt
40	400 Watt

Legends shall be a minimum of 2 inches in height and weather resistant.

The Contractor shall be prepared to provide a sample luminaire for testing when requested by the Engineer.

9-31.1(2) ROADWAY LIGHTING LUMINAIRE

Luminaires shall be "cobrahead" style and shall consist of a luminaire housing, lamp, ballast, and photoelectric control. Luminaires shall be in accordance with SCL Material Standard 5723.1 except as modified herein.

Luminaire light distribution patterns shall conform to the IES classification system for Type III medium cutoff for less than 200 watts and Type II short cutoff for 200 watts and more.

Glare control shall be accomplished by use of a flat lens. Minimum streetside utilization shall be 39 percent at 1.5 transverse mounting height. Distribution shall be free from striations and hotspots.

9-31.1(3) LAMPS

High pressure sodium lamps shall be clear lamps suitable for operation in any position meet the following minimum ratings:

Wattage	Minimum Life (Hours)	Initial Lumen Output
150	24,000	16,000
250	24,000	28,800
400	24,000	50,000

9-31.1(4) RESERVED**9-31.1(5) PHOTOELECTRIC CONTROLS**

Photoelectric controls shall be used with all luminaires and shall meet the requirements of SCL Material Standard 5693.0.

9-31.1(6) UNDERDECK MOUNTED UNDERCROSSING LUMINAIRE

Underdeck luminaire shall be pendant-mounted as called for on the Drawings. The ballast shall be integral with the luminaire. Ballast housing and structural parts shall be of cast aluminum. Mounting devices shall provide positive, vibration-proof locking. Luminaires shall be UL listed as "Enclosed and Gasketed" and shall be suitable for wet locations. All exposed screws and/or rivets shall be of stainless-steel Material.

All exposed cast aluminum parts are to be furnished with a baked-enamel paint.

The ballast housing and optical assembly shall be provided with easy-to-read moisture-proof nameplates that can be read without disturbing the luminaire when installed.

Ballast and optical assemblies shall include provision for field mounting of safety chains.

Luminaires shall have a wiring compartment with a single fuse holder.

Mounting of the optical assembly to the ballast assembly or pendant cap shall be secured by positive vibration-proof means. The optical and ballast or pendant cap assemblies shall include a positive aligning electrical disconnect allowing the socket to be shipped factory assembled in the optical assembly.

The luminaire shall be enclosed and gasketed and shall include an activated charcoal filter to permit passage of air.

Heat-resistant polycarbonate plastic shall be used for the refractor. The optical assembly shall be hinged and latched for lamp access. An automatic disconnect shall ensure that optical assembly is electrically cold when servicing. The optical assembly shall be removable from the ballast without tools.

The filter assembly shall be factory installed, but easily removable and shall be located to prevent accidental dislodgement when the luminaire is installed.

The unit shall provide at least 3% uplight dispersed widely across the surrounding area.

Luminaire shall be suitable for continuous service in an ambient temperature of 40°C. The unit shall be weatherproof and dustproof.

Ballasts shall be multi-tap, high power factor, regulator type.

9-31.1(7) WALL-PACK LUMINAIRE

The luminaire shall 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 shall mount against the wall (or pole) and the refractor housing assembly shall fasten to it by means of concealed hinges and a single point, positive acting latch. There shall be plated steel retaining chain attached between the main housing and refractor frame. Overall dimensions shall be approximately 16 inches square by 10-3/8 inches deep.

Units shall 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 shall require no tools for lamp replacement.

The optical train shall consist of the lamp, fluted specular aluminum reflector, and molded prismatic borosilicate thermal shock-resistant glass refractor. The dimensions of the refractor shall be approximately 16 inches square by 4 inches deep and shall have internal splitting prisms and external dispersing prisms. The refractor frame color shall be anodized aluminum.

The integral ballast shall 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 shall be multi-tap to allow field adjustments of voltage.

All insulation shall be UL listed Class H; core, coil, and capacitors shall 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 shall be finished with a black polyester powder paint coating. The complete unit shall be UL listed as "Suitable for Wet Locations". The unit shall be Moldcast catalog no. PCL-1 or approved equal, to be furnished with photocontrol, wireway conduit adapter, and polycarbonate shield.

The wall-pack luminaire shall be furnished with photocontrol, wireway conduit adapter, and polycarbonate shield.

9-31.2 RESERVED

9-31.3 WIRE

Street light wire in conduits shall be stranded copper single conductor, with 600 volt type THWN color-coded insulation, size as indicated on the Drawings, and in accordance with SCL Material Standard 6122.3.

Wire used inside of poles and bracket arms (including wood pole mounted bracket arms) or bonded to signal spanwires shall be No. 10 stranded copper "Pole and Bracket" cable with an insulation thickness of 45 mils and a belt thickness of 95 mils. Where the proper combination of colored conductors is unavailable in "Pole and Bracket" cable, No. 12 20-10 cable in accordance with SCL Material Standard 6404.4 may be substituted when allowed by the Engineer on a submitted Shop Drawing.

Duplex wire shall consist of one black conductor and one white conductor for circuits with one "hot" conductor and one neutral conductor; and one black conductor and one red conductor for circuits with 2 hot conductors. Multiple conductors shall be color coded in accordance with the NEC. Neutral wire shall always be white. Ground wires shall be green and insulated. The first hot conductor shall be black, the second hot conductor shall be red, and the third hot conductor shall be blue. Triplex wire shall be used for overhead applications, and shall conform with SCL Material Standard 6007.5 but shall be sized as indicated on the Drawings. Wire shall be continuously color coded. Color coding will not be required for triplex wire.

Plastic molding for covering wire attached to the side of wood poles shall be in accordance with SCL Material Standard 5820.5.

9-31.4 RESERVED

9-31.5 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 shall 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 shall be a high strength bronze alloy of the split bolt type specified in Material Standard 6688.7.
 - b. Copper to Aluminum Connector - The connector shall be of the one or two bolt type labeled CO/ALR and include an approved spacer bar.
 - c. Aluminum to Aluminum Connector - The connector shall be of the 1 or 2 bolt type and meet the requirements of SCL Material Standard 6693.5.
 - d. Split bolt connections shall be insulated in accordance with Section 8-30.3(5).
2. **Below Grade Installations** (Including on Structures):
 - a. Below grade splices shall be made in a 2 piece rigid body transparent moisture proof spliced enclosure. The body shall be webbed to ensure centering of the splice and even distribution of the encapsulant. The body and encapsulant shall be composed of Material which do not support fungi or mold. The encapsulant shall be a reenterable (gel like), transparent type. (Non-reenterable encapsulant may be approved if each splice is approved by the Engineer prior to installing encapsulant.)
 - b. Connectors shall 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 indicated on a submitted and reviewed by the Engineer Shop Drawing. Mechanical crimp splices shall 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 shall be used at terminal blocks.

9-31.6 FUSES AND FUSE HOLDERS

The in-line fuse holder shall consist of a fuse, a two-section fuseholder body and two insulating boots, all rated at 600 volts. The fuse shall be of the voltage and amperage specified. Fuses rated at 30 amps and less shall be 600V AC non-time delay with a 100,000A interrupting rating. The fuse size shall be 13/32 inches by 1-1/2 inches in a holder rated 30 amp, 600V. Fuses rated 30 to 60 amps shall be 300V AC time delay type with a 100,000A interrupting rating. The fuse size shall be 13/32 inches by 2-1/4 inches in a holder rated 60 amp, 300V.

The fuseholder body shall be made of waterproof molded plastic, in two sections: the line-side section and the load-side section. Their purpose is to provide a visible means of disconnect for circuit repairs or maintenance. The fuse shall be held in the load-side section only. Each section shall be totally enclosed at the wire entrance end and the sections shall be joined by a threaded, gasketed joint. The fuseholder body shall be designed to confine any electric arc, should the fuseholder be closed on a live circuit.

Fuse holder terminals shall be compression or screw type, sized for the actual wire utilized. Only one wire shall be installed in any terminal.

Insulating boots shall be used to waterproof the wire connections. The type of insulating boot shall be a single conductor boot for the load-side and a single conductor boot for the line-side.

The fuse shall be a current limiting type with a high speed opening and an interrupting rating of 100,000 rms symmetrical amperes. The fuse shall have a minimum time delay of 25 seconds at 200 percent load, but not great enough to result in a safety loss during overload or short-circuit conditions.

The fuse shall be designed so that the carrying capacity or opening time is little affected by ambient temperature and shall operate with low watt loss to reduce heating.

9-31.7 GROUND RODS, CLAMPS, AND HARDWARE

Ground rods shall be fabricated from cold-finished carbon steel shafting in accordance with ASTM A 108 as it applies to Grade 1018. Galvanized ground rods shall not be used.

The covering of the steel core shall be a sheath of electrolytic-grade copper having a minimum thickness of 0.010 inches. The rods shall have rolled threads at each end for joining together with couplings. Rods shall be 10 feet in length and 5/8 inch diameter. Rods shall conform to SCL Material Standard 5642.1, except for length, and shall conform to NEC requirements.

Couplings for sectional rods shall be made of high-strength, corrosion-resistant bronze, internally threaded to fit standard rods.

Driving studs shall be made of high-strength, hardened steel of SAE 1045 or equal quality.

Ground rod clamps shall meet the requirements of SCL Material Standard 5640.3. Ground rod clamps shall conform to NEC requirements.

Ground plates shall be a minimum of 2 square feet surface area copper plate.

9-31.8 ENCLOSURES

Enclosures located outside shall be weather-proof type, NEMA Type 3R. All doors and covers shall be gasketed. All enclosure metal shall be formed of stainless steel or aluminum as noted on the Standard Plans, and shall be constructed to the dimensions shown on the Drawings. All doors shall be provided with a heavy duty hasp suitable for padlocking.

All joints shall be seam welded. Enclosures shall be fabricated to allow for anchor bolt mounting.

A permanent sign shall be attached to the exterior of the enclosure cover or door. The sign shall be engraved into a 2 inch x 6 inch stainless steel plate with a minimum thickness of 18 gauge. The lettering shall be in 3 lines as follows:

**DANGER
HIGH VOLTAGE
KEEP OUT**

The letters shall be 1/2 inch high with a stroke width of 3/32 inch, and shall be filled with a red paint.

The completed sign shall 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.

9-31.9 RECEPTACLES

All duplex receptacles shall 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 RESERVED

9-32.2 RESERVED

9-32.3 SIGNAL HEADS, VEHICLE

9-32.3(1) GENERAL

9-32.3(1)A SIGNAL HEAD COMPONENTS

Signal heads shall be in accordance with the "Institute of Transportation Engineers" publication, current edition of "ADJUSTABLE FACE VEHICLE TRAFFIC CONTROL SIGNAL HEAD STANDARD" and the following additional requirements:

The equipment shall be designed for operation under temperature and humidity conditions encountered in the Pacific Northwestern United States.

Materials and workmanship shall conform to the best commercial standards of the industry.

Signal hanger pins shall include a stainless steel washer between each cotter key and the signal hanger.

A terminal block of an approved type shall be mounted inside at the back of each signal head. It shall have sufficient studs to terminate six (6) lamp wires independently to six (6) field wires. The screws shall 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 shall be permanently tagged to facilitate field work. Lamp socket wires shall consist of a white wire and a wire of the same color as the lens connected to the terminal block.

All signal heads shall be installed as indicated on the Drawings.

The housing, door, visor exterior and mounting hardware/framework shall be dark green in color. The visor interior and both sides of the back plate shall be optical black or flat black in color. The paint shall be of the best quality synthetic resin enamel.

Adjustable signal heads shall 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 shall be 8 inches or 12 inches in diameter, as indicated on the Drawings.

Each section shall consist of a housing, door assembly, Light Emitting Diode (LED) technology module optical unit and backplate and shall be so constructed as to provide complete interchangeability of parts.

Weather-resistant mildew-proof gasketing shall be provided between the housing and door assembly and between the lens and LED module, which shall exclude dust and moisture.

9-32.3(1)B HOUSING

The housing shall be cast aluminum alloy, free of flaws, cracks, blowholes and other imperfections.

Each vehicular signal head shall have a 1/4 inch drain hole in the bottom of the head.

Each section shall 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 shall be interchangeable and so constructed that sections can be added or removed. The top and bottom shall 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 shall 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) shall be a maximum distance of 1-1/4 inches on 8 inch signal and 2-1/2 inches on 12 inch signals from the top or bottom edge of the signal housing.

9-32.3(1)C DOOR ASSEMBLY

The door assembly shall consist of the door, lens and visor.

The door of each section shall be made of aluminum alloy and shall be hinged to the housing so as to permit access or removal. The door shall be secured to the housing by a single finger type locking device. The door-locking device shall be easily removable to allow door removal.

Each section shall have a visor made from aluminum alloy sheet of a tunnel design attached to the door by means of 4 panhead screws. The mounting holes shall be slotted. Visor length shall be 8 inches for 8 inch signals and 12 inches for 12 inch signals.

The lens shall be glass, circular in shape of the color, type and size specified. The lens shall be designed to give an outward distribution of light with a minimum above the horizontal. Each lens shall be true to color and shall conform to the current ITE Standard. The lenses shall have a minimum visible diameter of 7-3/4 inches (eight inches nominal) or 11-1/2 inches (12 inches nominal).

9-32.3(1)D OPTICAL UNIT

All vehicle signal head sections shall be provided with a Light Emitting Diode (LED) technology module optical unit and shall be in accordance with the latest edition of the "Vehicle Traffic Control Signal Heads (VTCSH)" published in the equipment and Materials Standards of the Institute of Transportation Engineers (ITE). A sample of the LED module to be used, the manufacturer's specifications, and a Manufacturer's Certificate of Compliance to the VTCSH specifications shall 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 shall fit into traffic signal housings built to the VTCSH standards without modification to the housing and shall not require special tools for installation. It shall be weather tight and fit securely in the housing and shall connect directly to the electrical wiring terminals.

The lens Materials to enhance ON/OFF contrasts shall not affect luminous intensity or chromaticity and shall be uniform across the face of the lens and shall be UV stabilized. The lens shall be a replaceable part without the need to replace the complete module.

The module shall be a single, self-contained device, not requiring on site assembly for installation and with its power supply packaged within the module enclosure and shall 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 shall be rated for use in the ambient operating temperature range of -40°C (-40°F) to +74°C (+165°F).

The LED signal modules when operated at nominal voltage and 25°C (77°F) shall 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 shall be adequately supported to withstand mechanical shock and vibration from high winds and other sources. Materials used for the module enclosure shall be made of UL94V0 flame retardant with the exception of the lens. The lens shall have no scratches (abrasions), cracks, chips, discoloration, or other defects. Any such defects shall be cause for rejection.

Each individual LED signal module shall 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, shall 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 shall not exceed 800 candelas for the red.

The electrical, wiring and terminal blocks shall meet the requirements of section 13.02 of the VTCSH standard. Fluctuations in line voltage over the range of 80VAC to 135VAC shall not affect luminous intensity by more than ± 10 percent. The circuitry shall 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 shall result in the loss of not more than 5 percent of the signal module light output. The module shall be operationally compatible with NEMA (TS-1 or later) load switches. All LEDs shall be of the AllnGap technology or proven equal in brightness and bulb life.

Manufacturers shall 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 requirements of Section 1-05.10, the manufacturer shall 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% of original values for a period of 36 months. This warranty shall become effective after installation of the modules and acceptance by the Engineer.

9-32.3(1)E BACKPLATE

The signal, with backplate, shall be designed to meet or exceed the load requirements in accordance with Section 2 of "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals", AASHTO 1994 edition. Back plates shall be furnished and attached to each signal head assembly. Back plates shall be louvered type to reduce wind loading, constructed of anodized, 3-S half-hard aluminum sheet, 0.058 inches minimum thickness. The back plates shall be riveted together with a minimum of 8 5/16 inch stainless steel pop rivets. No bolts or screws will be permitted. Back plates shall not interfere with either the operation of the door or the mounting of the signal. Mounting hole pattern shall match pattern on signal head housing. The front and back of the back plates shall be finished with 2 coats of flat black enamel.

Back plates shall 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 shall have a 5 inch border relative to the 8 inch head. Therefore, the border on the 12 inch head shall be approximately 3 inches.

Back plates shall 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 shall be a maximum distance of 1-1/4 inch from the corners of an 8 inch signal housing, and 2-1/2 inch from the corners of a 12 inch signal housing.

9-32.3(2) BI-MODAL VEHICLE SIGNALS SECTION

The signal section shall display both yellow and green arrow indications from the same face and shall use a fail-safe 2-lamp system to direct light of either color into a fiberoptic display. The section shall be adaptable to conventional 12 inch vehicle signal heads.

9-32.3(3) RESERVED

9-32.3(4) DIRECTIONAL LOUVERS

Where so indicated on the Drawings, louvers shall be furnished and installed in signal visors. Directional louvers shall be so constructed as to have a snug fit in the signal visor. The outside cylinder shall be constructed of No. 22 U.S. gauge sheet steel, and the vanes shall be constructed of No. 27 U.S. gauge sheet steel. Dimensions and arrangement of vanes shall be as indicated on the Drawings.

Louvers shall be galvanized after fabrication by the hot dipped process in conformance with ASTM A 153 and painted flat black.

9-32.3(5) RESERVED

9-32.4 SIGNAL HEADS, PEDESTRIAN

9-32.4(1) GENERAL

The pedestrian signal head shall conform to ITE Standards (Standard for Adjustable Face Pedestrian Signal Heads, current edition) and shall consist of a Light Emitting Diode (LED) message module, case, eggcrate visor, and directional louvers.

The entire pedestrian signal including LED message module, and all ABS or polycarbonate plastic parts shall be warranted against defects in workmanship, or materials, or both.

The case, sun shield and mounting hardware shall be painted dark green in color. The eggcrate visor interior and directional louvers shall be painted flat black in color.

The maximum overall dimension of the signal shall 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 shall be designed so that all components are readily accessible from the front by merely opening the signal door.

Pedestrian signals shall display international symbols (Portland orange "Up Raised Hand" and the lunar white "Walking Person") illuminated by multiple configuration LED encased in a molded plug-in plastic message module. The Hand-Person symbols shall be a minimum of 12 inches in height and 7 inches in width.

9-32.4(2) MESSAGE MODULE

All pedestrian signal displays shall be the Light Emitting Diode (LED) type. Each LED pedestrian signal module shall be designed as retrofit replacements for optical units in a Seattle Standard Plan no. 520 pedestrian signal housing and shall not require special tools for installation. The installation of an LED pedestrian signal module shall not require modification to the Seattle Standard housing.

A sample of the LED module to be used, the manufacturer's specifications, the warranties specified in this Section, and a Manufacturer's Certificate of Compliance indicating all Specifications are met shall be submitted to the Engineer for approval. Included in the submittal shall be the manufacturer's recommendations for how the Contractor permanent marks the date of installation on the outside plate. If approved, the sample will then be held for comparison to the remainder of the units to be installed. The approved sample will be allowed for use as the last LED installation.

Each LED pedestrian signal module shall be a single, self-contained device, not requiring on-site assembly for installation into any Seattle Standard pedestrian signal housing. However, the power supply for the LED pedestrian signal module may be packaged as a separate module.

All pedestrian "HAND" modules shall be Portland Orange and shall conform to current ITE standards for size, chromaticity and intensity. LED pedestrian "HAND" modules shall be manufactured with a matrix of LED light sources. All pedestrian walking "MAN" modules shall be Lunar White and shall conform to current ITE Standards for size, chromaticity and intensity. LED pedestrian walking "MAN" modules shall be manufactured with a matrix of LED light sources. The "HAND" and walking "MAN" message bearing surfaces shall be filled symbols and not outline symbols. The LED pedestrian signal modules shall be operationally compatible with the traffic signal controllers and conflict monitors existing at the Project Site.

The LED pedestrian signal module shall be rated for use in the ambient operating temperature range of -40° F to 165° F. Each LED pedestrian signal module shall be protected against dust and moisture intrusion in accordance with the NEMA Moisture Resistant STD 250-1991 for Type 4 enclosures regarding the protection of all internal components. The assembly, manufacturing, and mounting of the LED pedestrian signal module shall 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. The manufacturer's name, trademark, and serial number shall be permanently marked on the outside surface of the back of the LED pedestrian 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. LED pedestrian signal modules used in any single project shall be from the same manufacturer, and substitution will not be allowed.

LED pedestrian signal modules shall operate at a maximum power consumption of 15W. Each LED pedestrian signal module shall operate from a 60±3 Hz AC line over a range of 80VAC to 135VAC. Nominal operating voltage for all measurement shall be 120±3 volts rms. The LED circuitry shall prevent flicker at less than 100 Hz over the specified voltage range. Fluctuations in the specified line voltage shall not affect luminous intensity by more than ±10%. The signal module on-board circuitry shall 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 shall be wired so that catastrophic failure of one LED light source will result in the loss of not more than 20% of the signal module light sources. LED pedestrian signal modules shall provide a power factor of 0.90 or greater when operated at nominal operating voltage, and 77°C. Total harmonic distortion induced into an AC power line by the LED pedestrian signal module shall not exceed 20%. Each LED pedestrian signal module and associated onboard circuitry shall meet Federal Communications Commission (FCC) Title 47, Sub Part B, Section 15 regulations concerning the emission of electrical noise. Two secured, color coded, 600V, 20AWG minimum, jacketed wires, conforming to the National Electrical Code, rated for service at 221°C, are to be provided for electrical connection.

Written Warranty: In addition to the requirements of Section 1-05.10, the manufacturer shall provide a written warranty against defects in materials and workmanship for the LED pedestrian signal modules for a period of 60 months, and against loss of intensity below 50% of original values for a period of 36 months. This warranty shall become effective after installation of the modules and acceptance by the Engineer.

9-32.4(3) CASE

The case shall consist of a housing and door each made from 1 piece, aluminum alloy die casting. It shall be dustproof, weatherproof and corrosion resistant and shall provide for easy access to and replacement of all components. The housing shall have an integral cast top, bottom, sides, and back. Four integrally cast hinge lug pairs shall be provided for operation of a swing down door.

The housing shall 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 shall have an opening to accommodate 1-1/2 inch pipe brackets. The bottom opening of the signal housing shall have a standard 72 tooth locking boss integrally cast into the case. The teeth shall be clean and sharp and provide full engagement. The radial angular grooves of the boss shall provide positive positioning of the entire signal to eliminate rotation or misalignment of the signal.

The door shall 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 shall be attached to the case with the use of stainless steel spring pins. Hence, latching or unlatching of the door shall require no tools.

A 1/4 inch drain hole shall be provided in the bottom of the case. All unused openings shall be capped with corrosion-resistant metal caps, and weatherproofed with approved washers.

Clamshell mounting shall be a two-piece cast aluminum alloy assembly. One piece shall be the pole "half", the other piece the signal housing "half". The clamshell assembly shall have two integrally cast hinge lug pairs so, that when the clamshell is mounted in final position for pedestrian traffic, the clamshell shall rotate horizontally to the open position for easy access to the control wiring inside the clamshell.

9-32.4(4) EGGCRATE VISOR

Each signal shall be provided with an eggcrate type visor designed to eliminate sun phantom.

The eggcrate type visor shall be installed parallel to the face of the Hand - Person message lens and shall be held in place by stainless steel screws. The eggcrate assembly shall consist of vertical members and horizontal members. The completed assembly shall be approximately 1-1/2 inches deep.

The basic Material used in construction of the eggcrate shall 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 shall be enclosed in a mounting frame constructed of 0.040 inches minimum thickness aluminum or polycarbonate plastic. This frame shall be approximately 1-1/2 inches deep and may contain alternate mounting holes for use on alternate types of pedestrian signals.

9-32.4(5) RESERVED

9-32.4(6) RESERVED

9-32.5 PEDESTRIAN PUSHBUTTON ASSEMBLY

The assembly shall consist of a pushbutton, deep cast aluminum box, molded one-piece aluminum mount, with signs and mounting hardware as indicated on the Standard Plan no. 522.

The pushbutton shall be of tamperproof and all weather construction. The pushbutton shall consist of a 2-1/4 inch chrome plated metal plunger and an oil tight switch with single momentary silver contact, rated 125 volts, 10 amperes, all encased in a metal enclosure with stainless steel mounting screws.

The assembly shall be made weatherproof and shockproof by means of synthetic rubber gaskets between the cover and the enclosure and between the plunger and the cover so that it shall be impossible to receive an electrical shock under any weather conditions.

9-32.6 DETECTOR LOOPS

Detectors shall be used for actuating traffic-actuated controllers and sample stations. A complete detector loop installation shall consist of loop wire and lead-in cable from the loop to the amplifier. Loop wires and lead-in cables shall be 600 volt rated.

Loop wire in concrete pavement shall be either #14 AWG USE or IMSA 51-3. Loop wire in asphalt pavement shall be IMSA 51-7 with either black PVC or polyethylene tube.

The lead-in from the detector junction box to the controller cabinet or remote amplifier cabinet shall be either three pair #16 AWG 7x24, or 6 pair #16 AWG 7x24 stranded tinned copper, polyvinyl chloride/nylon individual insulated, overall PVC jacketed, twisted pair cable(s) with aluminum foil-polyester shield. The three pair and the six pair lead-in cables shall have a #18 AWG stranded tinned-copper drain wire. The conductors shall be twisted together approximately 3 turns per foot. Connections of the loop wire to the lead-in wire shall be made only in a handhole with a waterproof splice as indicated on the Drawings.

9-32.7 OVERHEAD INTERIOR ILLUMINATED SIGN

The equipment shall be designed and manufactured for operation under temperature and humidity conditions encountered in the Pacific Northwestern United States.

The sign, when mounted, shall be designed to meet or exceed the load requirements in accordance with Section 2 of "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals", AASHTO 1994 edition.

The sign size shall be as indicated on the Drawings. The housing shall be a double faced design made of extruded aluminum alloy or polyvinyl, dark green in color or with a brushed aluminum finish. The interior shall be painted white.

Standard signal mounting hardware shall be used to mount illuminated signs to all street furniture. The sign shall be fitted with a 1-1/2 inch iron pipe (IP) with tapped straight thread hub on top, for mast arm and span wire mount, and on top and bottom for bracket mount.

The front message panel shall be translucent white Rohm and Haas Plexiglass, or TufLite white fiberglass, or equal. The back message panel shall be constructed of aluminum alloy or polyvinyl, colored dark green or brushed aluminum finish to match the housing, unless the sign is double faced in which case it shall be the same as the front message panel. Sign message shall be as indicated on the Drawings.

A terminal block for power input hookup shall be accessible by opening either message panel.

Signs shall be completely wired and assembled.

Unless otherwise indicated in the Contract, the sign shall be equipped with 4-24 inch T12-CW fluorescent tubes with weatherproof tube type sockets and ballast transformer. The ballast transformer shall be non-flashing 425 mil-amp type, 0°F starting, 120 VAC, 60 Hz.

Hardware (i.e., rivets, screws, bolts, nuts, etc.) and non-aluminum parts shall be stainless steel.

Each interior illuminated sign assembly shall be fused. All fuses shall be accessible by opening either of the message panels. Both message panels shall be of the sliding type with stop bars to prevent total removal, and for ease of maintenance.

9-32.8 RESERVED

9-32.9 INTERCONNECT CABLE

9-32.9(1) UNDERGROUND

Interconnect cable (UIC) shall be #19 or #22 solid aerial/duct communication cable and shall conform to REA Specification PE-39 or I.M.S.A. Specification No. 20-2. The number of pairs and size shall be as indicated on the Drawings.

9-32.9(2) AERIAL ("FIGURE 8")

Interconnect cable (AIC) shall be #19 or #22 solid "figure 8" communication cable and shall conform to REA specification PE-38, or I.M.S.A specification no. 20-4. The number of pairs and size shall be as indicated on the Drawings.

9-32.9(3) INDOOR

Interconnect cable shall 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 shall be as indicated on the Drawings.

9-32.10 RESERVED

9-32.11 SIGNAL WIRING

9-32.11(1) TRAFFIC SIGNAL CABLE

Color Code Base/Tracer)	1c	2c	3c	5c	7c	10c	13c
Black	#12	#14	#14	#14	#14	#14	#14
White	---	#14	#14	#14	#14	#14	#14
Red	---	---	#14	#14	#14	#14	#14
Green	---	---	---	#14	#14	#14	#14
Orange	---	---	---	#14	#14	#14	#14
Blue	---	---	---	---	#14	#14	#14
White/Black	---	---	---	---	#14	#14	#14
Red/Black	---	---	---	---	---	#14	#14
Green/Black	---	---	---	---	---	#14	#14
Orange/Black	---	---	---	---	---	#14	#14
Blue/Black	---	---	---	---	---	---	#14
Black/White	---	---	---	---	---	---	#14
Red/White	---	---	---	---	---	---	#14

Signal Cable shall have solid copper conductors and shall conform to I.M.S.A. specification No. 20-1 (polyethylene insulated, polyethylene jacketed signal cable).

9-32.11(2) PEDESTRIAN PUSHBUTTON CABLE

Pedestrian pushbutton cable shall be single pair #16 AWG 19x29 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 shall be twisted together approximately 3 turns per foot.

9-32.11(3) ELECTRICAL SERVICE CONNECTIONS

All traffic signal services shall be 2 parallel 120 volt, 60 HZ AC electrical services with accompanying equipment.

Individual service conductors shall be color or number coded type XHHW or THWN No. 8 AWG stranded copper. The outer jacket of cable shall be flame retardant, moisture, heat and sun light resistant thermoplastic or cross linked synthetic polymer suitable for underground conduit or aerial installation with suitable non-hygroscopic fillers.

All final connections and energizing of signal systems (overhead secondary or secondary in vaults or handholes) shall be performed by Seattle City Light.

9-32.11(4) FUSES AND FUSE BLOCKS

See Section 9-31.6.

9-32.11(5) POLE JUNCTION BOXES AND TERMINAL BOXES

Junction and terminal boxes shall be watertight (NEMA 4) rated, cast iron box and cover. Finish shall be hot dipped galvanized. Cover shall mount with a neoprene gasket and brass cover screws. Top and bottom conduit holes shall be

bossed, drilled and tapped. Conduit holes in rear of terminal boxes shall be drilled and tapped. The threads in poles and junction boxes shall be sealed to prevent water entry and rusting. Cabinet size shall be as indicated on the Drawings.

9-32.11(6) GROUND RODS, CLAMPS AND BONDING

See Section 9-31.7.

9-32.11(7) SQUEEZE CABLE FITTINGS

Cable fittings for entry of cable through metal walls of poles, signs and signals shall be squeeze-type cable fittings with water-tight neoprene bushings. Size shall be carefully chosen to match the cable diameter to assure a water-tight fitting without damaging the cable.

9-32.12 SPAN WIRE

Span wire shall be 5/16 inch, 7-strand aluminum covered steel span wire conforming to ASTM B 415 with rated breaking strength of 10,270 lbs. in accordance with SCL Material Standard No. 5664.1.

Catenary span wire shall be 7/16 inch, 7-strand aluminum covered steel span wire conforming to ASTM B 415 with rated breaking strength of 20,800 lbs. in accordance with SCL Material Standard No. 5664.1.

9-32.13 POLE LINE HARDWARE

Strain insulators shall be wet process, porcelain, conforming to EEI-NEMA TDJ-54 as follows:

5/16 inch wire	Class 54-2
7/16 inch wire	Class 54-3

Tether wire shall be 1/8 inch galvanized steel stranded wire conforming to ASTM A475, extra high strength grade (rated at 1500 pounds minimum), Class A galvanized.

Bull rings (purse seine rings) shall be low carbon steel with an ultimate strength of 25,000 pounds. The ring shall be closed with a weld equal to or greater than 90 percent of the unwelded steel. The ring shall be galvanized with at least 2 ounces of zinc per square foot, which is equivalent to 3 mils of thickness. The steel shall be 3/4 inches in diameter and shall form a ring with a 3 inch ID. Higher strength steel shall be used when more than 4 signal heads are being supported.

All pole hardware, bolts, plate rods, hangers, clamps, wire guards and pole bands shall be hot-dipped galvanized in conformance with the requirements of ASTM A 153, or shall be stainless steel.

All miscellaneous pole line hardware required to complete the Project as planned shall be standard Material manufactured for pole line construction.

Pole band assembly shall consist of four (4) band sections and shall be four (4) way adjustable mounting connection on four (4) sides. Each band shall have four (4) 3/4-inch diameter all threaded studs and four (4) 3/4-inch regular nuts per stud (total 16 nuts per assembly). Pole band assembly shall have 20,000 pounds ultimate tensile strength. All parts of the pole band shall be hot-dipped galvanized in conformance with the requirements of ASTM A153. See Standard Plan no. 569.

9-32.14 GALVANIZING REPAIR PAINT

Field repair of galvanized surfaces shall be a coating of heated zinc alloy solder to a minimum thickness of 2 mils in accordance with ASTM A780.

SECTION 9-33 POLES, PEDESTALS, AND FOUNDATIONS

9-33.1 GENERAL

9-33.1(1) POLES, MAST ARMS, AND LUMINAIRE ARMS

All metal poles, mast arms and luminaire arms shall be designed and fabricated to conform with the requirements of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals", 1994 edition (hereinafter referred to as "AASHTO"), and EEI-TDJ 135 and 139. All load requirements shall be accommodated as indicated on the Standard Plans.

Poles shall be galvanized steel, timber, or aluminum in accordance with the Drawings.

Poles not meeting the requirements of the Drawings and Specifications will be rejected.

9-33.1(2) ANCHOR BOLTS

Anchor bolts for light poles (steel or aluminum) shall conform to ASTM A307 or ASTM A 576, unless otherwise specified in the Contract. Anchor bolts for steel strain poles Type T, and mast arm poles shall conform to ASTM A 576 (Type 1040 or 1045), ASTM A675 (Gr. 90), or ASTM A 36 Mod, with $F_y = 55$ ksi minimum. Anchor bolts for steel strain poles Types V, X, Z shall conform to ASTM F 1554-99, Grade 105, Class 2A including supplementary requirements S2, S3 and S5. Each anchor bolt shall 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 shall be galvanized in accordance with ASTM A153. Anchor bolts shall not be bent or cut after fabrication. Bending of anchor bolts shall be cause of rejection and removal of entire foundation.

Anchor bolt extenders (sleeve nuts), where required, shall be of a strength greater than the existing anchor bolts. The bolt extenders shall have a hexagonal tightening nut, and shall be galvanized in accordance with ASTM A153.

9-33.1(3) GALVANIZING

Before galvanizing, all sharp edges on welds and cut-ins inside the pole shaft, mast arm and luminaire arms shall be removed or filed smooth to prevent damage to the wires in the pole.

Structural Material shall be zinc-coated by hot-dip process in accordance with ASTM A 123 and the final coating shall measure 0.003 inches or more in thickness as determined by a magnetic thickness gauge. Hardware and appurtenances shall be coated in accordance with ASTM A153. Threads shall be re-cut after galvanizing without exposing base metal. Galvanizing certification of compliance with the applicable ASTM Standards signed by an ASTM accredited independent testing laboratory shall be submitted to the Engineer before shipment.

The finished pole shall be straight and free from injurious defects. Poles distorted by the galvanizing process shall be straightened without damage to the galvanizing coating. The finish coating shall be smooth and free of dross. After galvanizing, the interior of the pole and arms shall be free from sharp edges to prevent damage to wiring.

9-33.1(4) GROUND LUGS

Metal poles shall 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 shall be provided.

9-33.1(5) NUT COVERS

On light poles, the Contractor shall furnish and install separate nut covers to cover anchor bolts and nuts only (not the base flange). Nut covers shall fit snugly to the bolt. Nut covers shall be made of the same Materials as the pole and shall 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 shall be within plus or minus 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 shall conform to the requirements of 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 shall be inspected for Material compliance and acceptance by the Engineer prior to installation.

The term "steel strain pole" as used herein refers to any steel pole subjected to a span wire load (including METRO 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 shall be as indicated on the Drawings. An aluminum or stainless steel pole identification plate shall be securely attached immediately above the handhole, and shall indicate gauge, manufacturer, bolt circle, design principle moment in kip-feet, length, and date of manufacture.

Outside diameter of pole shafts shall be as indicated in the Standard Plans.

9-33.2(2) STRENGTH AND DEFLECTION REQUIREMENTS

The pole shaft shall have strength sufficient to support all indicated loads.

The following design loads shall be used: Dead load shall consist of the weight of the signals, luminaires and bracket arms, signs and supporting structure, and associated appurtenances; wind and ice loads shall be as indicated by AASHTO. The signal head mast arm shall be of such size and gauge as to resist the bending moment.

The design of steel strain poles that support overhead trolley loads shall be governed by King County METRO Transit design standards as detailed on the Drawings.

Structural steel having a yield point of 33,000 psi or more shall be used for all structural parts. Silicon content of the steel shall be no more than 0.04 percent to prevent discoloration during galvanizing.

The total deflection at the top of metal poles resulting from all dead loads applied shall not exceed 2.5 percent of pole height.

The deflection of the mast arm after loading shall not cause the end of the mast arm to extend below a horizontal line from the center of the arm flange. The maximum rise of the mast arm after loading from a horizontal line shall be 2 degrees.

The tenon for the luminaire shall be between 1 and 4 degrees above horizontal with the luminaire installed and all other loads applied to the pole.

9-33.2(3) BOLT CIRCLE

Mast arm flange and pole base bolt circles shall be as indicated on the Standard Plans.

9-33.2(4) WELDS

Circumferential butt welds shall have permanent back-up rings and full penetration for 100 percent of the circumference. All exposed butt welds shall be ground flush. All welds shall conform to the requirements of Section 6-03.3(25).

9-33.2(5) HANDHOLES, FESTOONS, AND CABLE OUTLETS ON POLES

Steel poles shall have one oval 4 inch x 6-1/2 inch handhole, as shown in the Standard Plans, reinforced so as to result in no loss of shaft strength. The handhole shall have matching cover attached with stainless steel bolts. The cover shall be rain tight and removable. The handhole shall 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, shall be as indicated in the Standard Plans.

Cable outlets (on poles) as shown on Standard Plan no. 563b shall be schedule 40 steel pipe extending perpendicularly from the pole. Both ends of the pipe shall be rounded for wire protection. The cable outlet shall be installed, drilled and edges rounded before galvanizing.

9-33.2(6) RESERVED**9-33.2(7) ANCHOR BASE PLATES**

A one-piece steel anchor base plate shall be secured to the lower end of the shaft by continuous electric arc welds as shown in the Standard Plans. The welded connection shall develop the full strength of the adjacent shaft section.

9-33.2(8) POLE AND MAST ARM CAPS

All metal poles (except davit poles) and mast arms shall 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(9) BRACKET ARMS

Bracket arms shall be per SCL Material Standard 5705.1 or 5705.2 or manufactured as indicated on the Standard Plans and in accordance with AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals", 1994 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 shall include the bolts, nuts and washers galvanized for wood and steel poles and stainless steel for aluminum pole types. Bracket arms shall be the same style as depicted on the Drawings. Small differences in dimensions may be acceptable to the Engineer when structural calculations accompany these indicated dimension differences on the Shop Drawings (see Section 1-05.3(12)).

Bracket arms shall accommodate the luminaire slipfitter attachment. The terminal end of the arm shall be a straight, tubular section with external dimensions of 2 inches NPS by 6-1/2 inches long.

Bracket arms mounted on metal poles shall be constructed of the same Material as the poles. If the bracket arm and metal pole are of dissimilar metals, they shall be separated by an approved plastic dielectric pad of 5 mils minimum thickness.

The longitudinal axis at the end of the bracket arm shall be not less than 1 degree nor more than 4 degrees above the horizontal with the luminaire installed under load (see Std Plan no. 572).

All tubing used for aluminum bracket arm members shall be seamless, Alloy 6063 - heat treated to T-6 after fabrication. Aluminum bracket arms shall meet the requirements of ANSI C136.13.

9-33.3 ALUMINUM POLES

Aluminum street light poles shall meet the requirements of SCL Material Standard 5739.8, except as modified herein and in the Contract.

The shaft shall be round with a continuous taper of approximately 1/8 inch per foot, and shall be made of a high-strength, corrosion-resistant aluminum alloy. The shaft shall have a satin finish, and shall be protected with a wrapping during shipping and installation. A rip cord shall be provided for easy removal of wrapping. An aluminum pole cap shall be attached with stainless steel bolts. The diameter at the top of the pole shall be 4-1/2 inches \pm 1/8 inch.

Poles shall have an oval 4 inch x 6 inch minimum handhole fabricated into the pole in a position 90 degrees clockwise from the side on which the bracket arm is located and reinforced so as to result in no loss of shaft strength. The handhole shall have a matching aluminum cover attached with stainless steel bolts and shall be located 18 inches above the base plate.

Cast aluminum anchor and transformer base shall be made of high-strength, corrosion-resistant aluminum alloy of sound and uniform quality.

Anchor base poles shall have a 3/8 inch tapped hole in the bottom edge of the handhole and 3/8 inch stainless steel bolt and lock washer for grounding. Transformer bases shall have the ground lug inside the base adjacent to the access door. The lug shall be equipped with a stainless steel bolt (1/4 inch minimum), nut and lockwasher.

Anchor bolts for aluminum poles shall be the same as required for steel poles.

9-33.4 WOOD POLES**9-33.4(1) GENERAL**

Strain poles shall be either Douglas Fir, class 1, or Western Red Cedar, class 1.

Street light poles shall be Western Red Cedar, class 2.

Poles shall 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 shall be branded by burning the pole face, as specified by ANSI 05.1, 12 feet, 6 inches above the pole butt. Metal marking tags will not be accepted.

Poles shall be butt-treated in accordance with AWPA C7, and the entire butt section of the pole shall be incised. After framing and roofing, the cuts shall be well brushed with the hot preservative.

9-33.4(2) DOUGLAS FIR

Douglas fir wood poles shall meet SCL Material Standard 5082.0.

9-33.4(3) WESTERN RED CEDAR

Western red cedar wood poles shall meet SCL Material Standard 5072.0.

9-33.5 RESERVED

9-33.6 STEEL PEDESTALS AND ALUMINUM PEDESTALS

9-33.6(1) STEEL PEDESTALS

Shafts shall be constructed of welded structural steel, open-hearth lap welded steel or standard steel pipe conforming to the requirements of ASTM A 53. Shafts shall be 4 inch schedule 40 galvanized steel pipe with threaded end for mounting to the base. The overall height of the shaft and base shall be as indicated on the Drawings.

Pedestal base shall be of cast iron conforming to the requirements of ASTM A48, Class 40 and made in accordance to the configuration on the Standard Plans. Bases for pedestals shall be threaded, octagonal cast iron equipped with an access door for wiring. A 13-1/2 inch diameter bolt circle size shall be used. The base shall have a grounding lug inside which is accessible from the handhole. The base shall be silver in color.

9-33.6(2) ALUMINUM PEDESTALS

Shafts shall be 4 inch schedule 80 aluminum pipe with one threaded end for mounting to the base. The overall height of the shaft and base shall be as indicated on the Drawings.

Pedestal base shall be of cast aluminum conforming to the configuration on the Standard Plans. Bases for pedestals shall be threaded, square, aluminum and equipped with an aluminum access door for wiring. A 13-1/2 inch diameter bolt circle size shall be used. The base shall have a grounding lug inside which is accessible from the handhole. The base shall be aluminum in color.

9-33.7 PEDESTRIAN PUSHBUTTON POSTS

Pedestrian pushbutton posts shall be constructed of 2 inch I.D. schedule 40 galvanized steel pipe with length as indicated on the Drawings. The post collar, pipe flange, bolts, nuts and washers shall conform to the details of the Drawings.

9-33.8 BACK GUY ASSEMBLIES AND GUY WIRE

Unless otherwise indicated in the Contract, guy wire shall be 5/16 inch, aluminum covered steel strand wire.

Guy assembly components including the deadend grips, the porcelain strain insulator, and the automatic feed-thru deadend shall be sized so as to meet or exceed the rated breaking strength of guy wire.

Anchors for back guys shall 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 shall be sized based upon its load and soil conditions by the Engineer.

The following components shall conform with the requirements of SCL Material Standards:

Component	SCL Material Standard
Guy Wire	5664.1
Guy Hook with Integral Spurs	5651.15
Deadend Grip	5651.4
Porcelain Strain Insulator	6901.1
Plastic Wire Guard	5651.8
Automatic Feed-thru Deadend	5650.3
Plate Anchor	5620.7
Single Strand Eye Nut	5652.1
Sidewalk Pipe Guy Fittings	5650.1

The pipe brace shall be galvanized extra strong steel pipe.

SECTION 9-34 ELECTRICAL AND SIGNAL CONDUITS

9-34.1 GENERAL

Conduit shall be PVC coated galvanized rigid steel, galvanized rigid steel, or schedule 80 PVC conforming to Articles 346 (rigid metal conduit) or 347 (rigid nonmetal conduit) of the NEC type and size as indicated on the Drawings. All conduit, elbows, fittings, and accessories shall be UL listed.

Factory bends and elbows shall be utilized in all cases where they provide the required deflection.

Field bends, when required, shall 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, shall be uniformly and adequately zinc coated by a hot dip galvanizing process. The average weight of zinc coating shall 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 shall be not less than 0.7 ounces of zinc per square foot of single surface area. The weight of zinc coating will be determined in accordance with AASHTO T 65. Determinations and nominal weights shall conform to the requirements of the Underwriters Laboratory Publication No. 6 (current edition). In addition, the exterior as well as the interior conduit samples shall withstand 4 dips in the PREECE test in accordance with ASTM A239.

Every length of rigid metal conduit shall 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 indicated in the Contract. Installation shall conform to appropriate articles of the NEC.

Rigid steel conduit may be substituted where PVC is indicated 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 shall be identical and interchangeable.

9-34.2(2) THREADS

The exposed thread ends of rigid steel conduit shall be hot dipped galvanized in accordance with the foregoing. Field cut threads shall be painted with galvanized repair paint acceptable to the Engineer.

9-34.2(3) COUPLINGS AND FITTINGS

Couplings and fittings for rigid steel type conduits shall be hot-dip galvanized, with the same quantities of zinc noted above. Couplings shall withstand 4 dips in the PREECE test as specified above.

9-34.2(4) PVC COATING

All galvanized rigid steel conduit shall be PVC (polyvinyl chloride) coated with dark gray, and U.V. resistant type plastic where indicated on the Drawings.

The zinc surface prior to plastic coating shall be conditioned with chromic acid to provide an anchor for the plastic coating.

Both interior and exterior shall 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 shall be bonded to the outside of the pipe (excluding the threads) with a thickness between 0.035 inch and 0.045 inch. The PVC coating shall be applied by the plastisol dip method and shall contain ultraviolet inhibitors.

A urethane coating of a nominal 2 mil thickness shall be applied to the interior of all conduits.

A coupling with the same PVC coating shall be furnished loose with each length of conduit and shall 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 shall be the same as the outside diameter of uncoated pipe of the same nominal size. The wall thickness of the plastic sleeve shall be the same as the plastic coating on the pipe. The bond between the metal and the PVC coating shall 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 shall be coated with the same coatings on the outside and inside as described above. The fittings shall have PVC sleeves at all female openings similar to the sleeves on the couplings. The coated conduit shall conform to NEMA Standard No. RNI-2005.

All coated conduit brackets, supports, clamps, NEMA 4 junction boxes, drains, breathers, expansion/deflection fittings, seals, etc., shall be PVC coated by the producer of the conduit. Field repair and touch-up shall be made with Materials approved by the Engineer.

9-34.2(5) RESERVED

9-34.2(6) EXPANSION/DEFLECTION FITTINGS IN NON-HAZARD AREAS

Expansion/deflection fittings shall be installed in all structural expansion joints. The expansion portion of the set shall provide for 4 inches of movement, 2 inches in each direction, unless specified otherwise on the Drawings. The deflection portion of the set shall provide for a movement of 3/4 inch in all directions, and an angular deflection of 30 degrees from normal in any direction. Fittings shall be O.Z. Gedney Type AXDX or approved equal.

9-34.3 PVC CONDUIT

Plastic conduit and fittings shall be rigid PVC Type EPC schedule 80.

PVC rigid non-metallic conduit may be used for all installations except the first 10 feet above ground on a pole riser and the adjacent bend, unless specified otherwise in the Contract.

Rigid PVC shall meet the requirements of ASTM D 1785 and ASTM D 2466. The conduit shall be suitable for use above ground, for direct burial, and for corrosive atmosphere areas.

9-34.4 CONDUIT RISER

Refer to Section 8-33.3(3).

9-34.5 PULL CORD

Pull cords shall be 1/4 inch polypropylene meeting the requirements of Seattle City Light Material Standard 7272.2.

9-34.6 HANDHOLES

Handholes shall be precast concrete, reinforced, and of the type and size indicated on Standard Plan nos. 550a and 550b. Handholes shall have covers with a slide-lock device and a ground strap. Covers shall be 5/16 inch thick steel, and shall be hot-dip galvanized in accordance with ASTM A 123. Covers shall be identified with 3 inch high letters "TC" clearly visible on the top where traffic control cables occupy the handhole or "SL" where the handhole is used by street lighting only. The marking shall be accomplished by welding or shall be cast onto the cover. Handhole covers and frames shall have non-skid surfaces.

The non-skid surface shall be made of slip resistant steel plate and be 5/16 inch in thickness. An approved surface plate is Steel SlipNOT Grade 3-coarse by W.S. Molnar Co.

The cover shall be identified with permanent marking with the type of surface ("A2" for Algrip 2000; or "S3" for SlipNOT 3; or similar marking for approved equal), and the year of manufacture. The identification shall be bead-welded or clearly stamped on the underside of each lid, or labeled with an adhesive metallic foil-backed label. An example identification is "A2 2002" or "S3 2003".

SECTION 9-35 ELASTOMERIC BEARING PADS

Elastomeric bearing pads shall conform to the requirements of AASHTO M 251. The elastomer shall not contain any form of wax.

All bearing pads shall 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 shall not exceed 3/8 inch, and radius of edges shall not exceed 1/8 inch.

Shims contained in laminated bearing pads shall be mill rolled steel sheets not less than 20 gage in thickness with a minimum cover of elastomer on all edges of:

- 1/8 inch for pads up to 3 inches thick, and
- 1/4 inch for pads over 3 inches thick.

The shims shall be spaced to divide the pad thickness into equal laminations. The bond between the elastomer and metal shims shall be such that, when a sample is tested for separation, failure shall occur within the elastomer and not between the elastomer and the metal shim.

The grade or durometer hardness of the bearing pads shall be as noted in the Contract.

Elastomeric bearing pads shall be manufactured with the following tolerances:

Overall vertical dimensions:	
Design thickness 1 1/4 inches or less	-0, + 1/8 inch
Design thickness over 1 1/4 inches	-0, + 1/4 inch
Overall horizontal dimensions:	
36 inches and less	-0, + 1/4 inch
Over 36 inches	-0, + 1/2 inch

SECTION 9-36 DETECTABLE WARNING

9-36.1 GENERAL

The detectable warning plate (cast in place with curb ramp) and the detectable warning retrofit plate (surface applied to existing curb ramp) shall meet the requirements for tactile warning surfaces established by the WSDOT Local Agency Guidelines Appendix 42.102, Addressing ADA Accessible Facilities on Road, Street and Highway projects.

The detectable warning plate shall have truncated domes as indicated on Standard Plan no. 422a and shall:

1. be "City of Seattle Safety Yellow" in color;
2. resist breakage, fading, permanent deformation, and loss due to abrasion;
3. be durable, high impact resistant, and possess thermal and moisture stability;
4. possess durable wet and dry slip resistance, and
5. possess a compressive strength of 10,000 psi minimum.

Unless the Contract specifies otherwise, the nominal size of the detectable warning shall be 24 inches by the width of the ramp for the 422a curb ramp and 24 inches by the width of the landing for the 422b curb ramp.

9-36.2 DETECTABLE WARNING PLATE

9-36.2(1) GENERAL

The detectable warning plate may be either cast-in-place or surface applied and shall meet the following Material requirements:

Material Requirement	Concrete		Composite	
Compressive strength	ASTM C 39	10,000 psi min.	ASTM D 695-91	10,000 psi min.
Slip resistance, wet and dry	ASTM D 2047	0.80 min.	ASTM C 1028	0.90 min. ¹

¹ coefficient of friction on top of domes and on field area.

Acceptable cast-in-place Materials are:

1. CASTinTACT consisting of precast concrete containing prestressed reinforcement and pre-stained and sealed with Miracote Mirastan II "City of Seattle Safety Yellow" and Mascoseal Silane 40%. A local Supplier of CASTinTACT is MASCO, 425-487-6161 (www.masco.net).
2. Armor-Tile as manufactured by Armor-Tile Tactile Systems. A Seattle Supplier is White Cap Construction Supply, (206) 783-8400 (www.armor-tile.com).
3. Step-Safe as manufactured by Castek Inc (Transpo) (914) 636-1000 (www.transpo.com)
4. Cast-In-Place Composite Tactile by ADA Solutions, (800) 372-0519 (www.adatale.com)

Acceptable surface applied Materials are:

1. Armor-Tile as manufactured by Armor-Tile Tactile Systems. A Seattle Supplier is White Cap Construction Supply, (206) 783-8400 (www.armor-tile.com).
2. Top Mark as manufactured by Flint Trading, Inc: (336) 475-6600 (www.flintrading.com).
3. Next Step as manufactured by Zumar Industires Inc. (800) 426-7967 (zumar.com)

For products other than named above, the Contractor shall provide the Engineer with a submittal on the alternate Material as specified in Section 9-36.4. See Section 8-14.3(7)B.

9-36.2(2) DETECTABLE WARNING PLATE COLOR

The color of the detectable warning plate and retrofit plate shall be "City of Seattle Safety Yellow" and shall be uniform in color throughout the plate. The color on the surface of the plate may be enhanced by the manufacturer with an application of an indelible stain.

A representation of "City of Seattle Safety Yellow" may be achieved by the paint mix listed below. Color obtained by a coating will not be acceptable.

Home Depot Custom Color Match:

Base: BEHR Premium Plus Exterior Semi Gloss Accent Base 5670, size 1 quart with the following colorants:

Colorant	OZ	48	96
Perm Yellow	1	15	1
Exterior Red	0	2	1
Brown Oxide	0	5	0

9-36.3 DETECTABLE WARNING RETROFIT PLATE

The detectable warning retrofit plate shall be a composite, shall meet the requirements specified in Sections 9-36.1 and 9-36.2(2), and shall meet the following requirements:

Property	Test Method	Material Requirement
Slip resistance, wet and dry	ASTM C 1028	0.90 min. ¹

¹ Coefficient of friction on top of domes and on field area.

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 shall make the following submittal to the Engineer for approval at least 5 Working Days in advance in accordance with Section 1-05.3(5):

1. All information required in items 1, 3, 4, and 5 in Section 8-14.3(7)B;
2. Two (2) rectangular or square samples of the "or equal" material with minimum 6 inch by 6 inch dimensions.
3. For the detectable warning retrofit plate, include information on the bonding material and its performance.

9-37 CONSTRUCTION GEOTEXTILES**9-37.1 GEOTEXTILE AND THREAD FOR SEWING**

The material shall be a geotextile consisting only of long chain polymeric fibers or yarns formed into a stable network such that the fibers or yarns retain their position relative to each other during handling, placement, and design service life. At least 95 percent by weight of the material shall be polyolefins or polyesters. The material shall be free from defects or tears. The geotextile shall also be free of any treatment or coating which might adversely alter its hydraulic or physical properties after installation. The geotextile shall conform to the properties as indicated in 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 shall consist of high strength polypropylene, polyester, or polyamide. Nylon threads will not be allowed. The thread used to sew permanent erosion control geotextiles shall be resistant to ultraviolet radiation. The thread shall be of contrasting color to that of the geotextile itself.

9-37.2 GEOTEXTILE PROPERTIES**TABLE 1**

Geotextile for underground drainage strength properties for survivability.

Geotextile Property	Test Method ²	Geotextile Property Requirements ¹	
		Low Survivability Woven / Nonwoven	Moderate Survivability 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 4833	67 lbs. / 40 lbs. min.	80 lbs. / 50 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	Test Method ²	Geotextile Property Requirements ¹		
		Class A	Class B	Class C
AOS	ASTM D 4751	.43 mm max. (No. 40 sieve)	.25 mm max. (No.60 sieve)	.18 mm max. (No.80 sieve)
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	Test Method ²	Geotextile Property Requirements ¹	
		Separation Woven/Nonwoven	Soil Stabilization Woven/Nonwoven
AOS	ASTM D 4751	.60 mm max. (No. 30 sieve)	.43 mm max. (No. 40 sieve)
Water Permittivity	ASTM D 4491	.02 sec ⁻¹ min.	.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 4833	80 lbs. / 50 lbs. min.	112 lbs./79 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.

TABLE 4
Geotextile for permanent erosion and ditch lining.

Geotextile Property	Test Method ²	Geotextile Property Requirements ¹		
		Permanent Erosion Control		Ditch Lining
		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.
Burst Strength	ASTM D 3786	400 psi/ 190 psi min.	500 psi / 320 psi min.	-----
Puncture Resistance	ASTM D 4833	80 lbs./ 50 lbs. min.	112 lbs. / 79 lbs. min.	80 lbs. / 50 lbs. min.
Tear Strength, min. in machine and x-machine direction	ASTM D4533	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	Test Method ²	Geotextile Property Requirements ¹		
		Class A	Class B	Class C
AOS	ASTM D4751	0.43 mm max. (No.40 sieve)	0.25 mm max. (No.60 sieve).	0.22 mm max. (No. 70 sieve)
Water Permittivity	ASTM D4491	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	Test Method ²	Geotextile Property Requirements ¹	
		Unsupported Between Posts	Supported Between Posts with Wire or Polymeric Mesh
AOS	ASTM D 4751	for slit film wovens .60 mm max. (No. 30 sieve) for all other geotextile types .30 mm max. (No. 50 sieve) .15 mm min. (No. 100 sieve)	for slit film wovens .60 mm max. (No. 30 sieve) for all other geotextile types .30 mm max. (No. 50 sieve) .15 mm min. (No. 100 sieve)
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, min. in machine direction only	ASTM D 4632	30% max. at 180 lbs. or more	-----
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

Notes ¹All geotextile properties in Tables 1 through 6 are minimum average roll values (i.e., the test result for any sampled roll in a lot shall meet or exceed the values shown in the table).

²The 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 in accordance with WSDOT Test Methods 914 and 915, respectively.

³With 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 shall meet the requirements of Section 9-03.9(2). Aggregate cushion for permanent erosion control geotextile, Class B or Class C, shall meet the requirements of Section 9-03.9(3) and 9-03.9(2).

9-37.4 GEOTEXTILE APPROVAL AND ACCEPTANCE

9-37.4(1) SOURCE APPROVAL

For each geotextile application, the Contractor shall 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 shall 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 shall not be 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 meet the requirements of WSDOT Test Method 914.

9-37.4(2) GEOTEXTILE SAMPLES FOR SOURCE APPROVAL AND ENGINEER TESTING

Each sample shall have minimum dimensions of 5 feet by the full roll width and shall be a minimum 6 square yards. The machine direction shall 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 (Section 1-06.3).

Samples shall be cut from the geotextile roll by a suitable method that produces a smooth geotextile edge without edge ripping or tearing. The samples shall 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 meets the specified properties.

Approval will be based on testing of samples from each lot. A "lot" shall 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 plant 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 indicated in 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 that 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(s) which failed will be accepted. All geotextile with defects, deterioration, or damage will be rejected and shall 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 shall be by Manufacturer's Certificate of Compliance:

Application	Geotextile Quantity
Underground Drainage	600 sq. yards
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 shall include the manufacturer's name, current address, full product name, geotextile structure including fiber/yarn type, geotextile roll number, proposed use(s), and certified test results.

9-37.4(5) APPROVAL OF SEAMS

If the geotextile seams are to be sewn in the field, the Contractor shall provide a section of sewn seam which can be sampled by the Engineer before the geotextile is installed.

The seam sewn for sampling shall 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 shall provide sewn seams for sampling which are oriented in both the machine and cross-machine directions. The seams sewn for sampling shall 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 shall be submitted by the Contractor to the Engineer and are to be included with the seam sample obtained for testing. This description shall include the seam type, stitch type, sewing thread type(s), and stitch density.

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