IV. MATERIALS AND PERSONNEL FOR TRAFFIC CONTROL

A. Channelizing Devices

1. General Application

The primary function of channelizing devices is to warn and alert drivers, riders, and pedestrians of worksites in or near the traveled way, and to guide and direct them safely past. The effectiveness of the device is determined by position and visibility. Channelizing devices are used:

a) To protect the work site.
b) To provide for pedestrian movement around the work site.
c) To channel and divert traffic in advance of the work site.
d) To define the traveled way through and around the work site.
e) To define a change in the position of the existing lanes around the work site.
f) To define curves and the edges of the roadway on detours.
g) To separate opposing lanes of traffic.

Channelizing devices shall conform to the following requirements:

a) They shall be constructed of material that will withstand impact without appreciable damage to the device by a striking vehicle or passing traffic.
b) They shall comply with the requirements of the National Cooperative Highway Research Program Report 350.
c) All channelizing devices used at night shall be reflectorized unless otherwise specified herein.
d) The predominant color for the devices shall be orange.

2. Vehicular Barricades

a. General Requirements

Barricades are channelizing devices used primarily for enclosing a work area, for road closures and detours, for pedestrian control, for marking obstructions and where warranted, for guiding traffic around the work area. All barricades shall be constructed of durable materials in conformance with the dimensions and standards indicated on Table IV - 1 and Figure IV - 1:

Markings for all barricade rails shall consist of weatherproof reflectorized sheeting with alternate orange and white stripes.

Both orange and white stripes shall be reflectorized. The presence of warning lights mounted on the barricade shall not lessen this requirement, nor shall paint containing glass beads be used to provide the reflective surfaces. The 6” wide

reflectorized stripes shall slope downward at an angle of 45 degrees in the direction traffic is to pass. Where barricades extend entirely across a roadway, the stripes should slope downward in the direction toward which traffic should move. Where both right and left turns are provided, the chevron striping shall slope downward in both directions from the center of the barricade. Barricades shall be posted in such a manner so as to clearly indicate the extent of the obstruction of excavation.

Barricades shall never be placed in an active lane of traffic, including bicycle lanes and shoulders used by bicycles, without advance warning including an arrow sign or arrow board, and appropriate delineation and advance warning signing.

If it is necessary to ballast barricades to maintain them in an upright position due to high winds or passing vehicles, sand bags or other non-rigid material should be used.

When barricades are used during the hours of darkness an operable flashing or steady burning light shall be attached to each barricade.

When used for the purpose of road blockage, barricades should be no further apart than five feet to prevent vehicles from driving between them. If it is necessary to provide space for special traffic, (i.e., local residents, construction vehicles, buses, etc.) signs reading “EXCEPT TRUCKS,” “EXCEPT BUSES,” “CLOSED TO THRU TRAFFIC,” “LOCAL ACCESS ONLY” or whatever message is appropriate shall be displayed to approaching traffic.

Generally, barricades shall be one of three types: Type I, Type II, or Type III. Characteristics and dimensions for these three types are shown on Table IV - 1 and illustrated in Figure IV - 1. The Contractor’s name or identifying number shall appear on the barricade but not on the uppermost reflective panel. While each situation should be evaluated for the most desirable application, generally, the different type barricades should be used as follows:

b. Type I and II Barricades (Figure IV - 1)

Type I and Type II barricades are generally considered portable barricades. Their primary use is to outline work areas, excavations, spoil piles, and similar obstacles. A Type I or Type II barricade may be used to protect pedestrians from vehicular movements. Type II barricades may be used for street closures only in emergency situations or for very short durations.

c. Type III Barricade (Figure IV - 1)

Because of their high visibility and more permanent nature ,Type III barricades shall be used whenever it is necessary to close any street for an extended period of time, to protect work areas of prolonged construction projects, or to close a lane or divert traffic from one lane to another on high speed, high-volume facilities

where Type II barricade could be easily overturned by passing traffic.

Street closures require a minimum of 270 square inches of retroreflectivity facing drivers per barricade.

(Table IV - 1)

TYPE	I	II	III
Width of Rail	8” min. - 12” max.	8” min. - 12” max.	8” min. - 12” max.
Length of Rail	2’ min. - var. max.	2’ min. - var. max	4’ min. - var. max.
Number of Rail faces reflectorized	2 (one each direction)	4 (two each direction)	3 if facing traffic in one direction. 6 if facing traffic in two directions.
Width of Stripes *	4 inches / 6 inches	4 inches/ 6 inches	6 inches
Height	3’ minimum	3’ minimum	5’ minimum

* For rail less than 3’ long, 4” wide stripes shall be used. For rails 3’ or longer, 6” wide stripes shall be used.

3. Vertical Panels (Figure IV - 1)

A vertical panel is a channelizing device that aids the driver in determining the location and alignment of the traffic lane. Vertical panels may be used to divide the opposing streams of traffic at night, to divert a traffic lane, or to outline the edge of a hazard along the roadway. When a vertical panel is used to divide opposing flows of traffic, both sides of the barricade shall be striped with proper angle slashes.

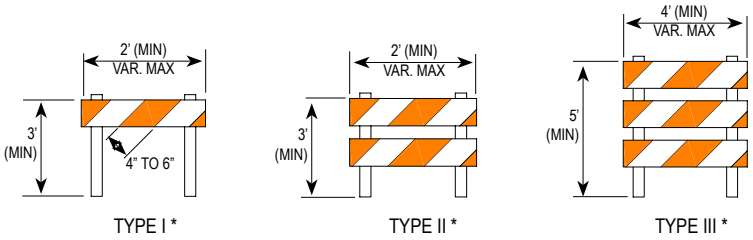
4. Cones (Figure IV - 1)

Cones may be used to channel and divert traffic in advance of work sites and to define the travel way through the work site. Traffic cones may be used during daylight hours, but alone are not sufficient for nighttime use.

Minimum height for traffic cones shall be 18”. Where traffic speeds are high (greater than 40 mph) or where increased target value is needed, 28” – 36” high cones shall be used. Because they are easily knocked over by wind or by passing vehicles, cones may be doubled up to increase their weight and should be checked frequently (minimum of once per shift and once after shift) to ensure that they are in the intended position.

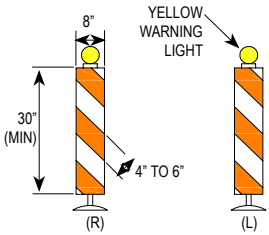
For nighttime use, cones shall be at least 28” and retroreflectorized. Retroreflectorization shall be provided by a minimum 6” white band placed at a maximum of 3” from the top and an additional 4” wide white band located approximately 2” below the 6” band.

Cones shall be predominately orange.

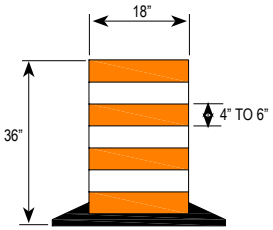


* WITH WARNING LIGHTS ON TRAFFIC SIDE IF REQUIRED

VEHICULAR BARRICADES

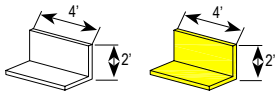


VERTICAL PANELS

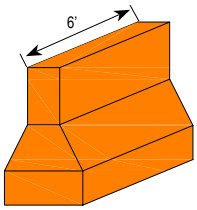


DRUMS ARE TO BE PREDOMINANTLY ORANGE, BUT A MINIMUM OF 2 ORANGE STRIPES AND 2 WHITE STRIPES ALTERNATING PER DRUM ARE REQUIRED.

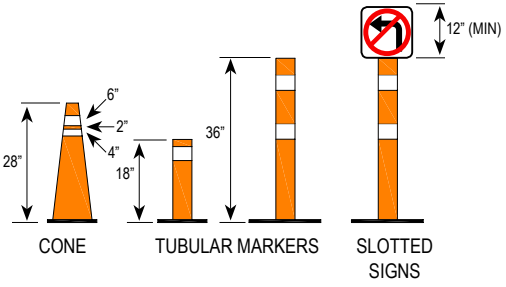
DRUMS



TEMPORARY OBJECT MARKER



WATER FILLED BARRIER



CHANNELIZATION AND WARNING DEVICES

(Figure IV - 1)

5. Tubular Guideposts (Figure IV - 1)

Tubular guideposts cover a wide range of devices, all of which can be effectively used to channelize and divert traffic in the same application as cones. Generally, these devices consist of a round or rectangular plastic tube fastened to a base plate of similar material as shown in Figure IV - 1. Reflectorization shall be provided by a minimum of two 3" white bands, placed a maximum of 2" from the top with a maximum of 6" between the bands.

6. Drums (Figure IV - 1)

Because of their universal nature, drums can usually be used in the same application as other channelization devices including Type I and Type II barricades (i.e., to define work areas, divert traffic, protect workers and support signs.) The predominant color on drums shall be orange with at least two horizontal, circumferential white and orange stripes 4" to 6" wide. Drums shall be retroreflectorized and shall never be placed in the roadway, including bicycle lanes and shoulders commonly used by bicyclists, without advance warning signs and/or proper delineation. A flashing warning light should be added when drums are used singly or at night. Steady burning warning lights or arrow warning signs should be added when they are used for ballast when it is necessary to prevent overturning such as when signs are attached. Use of double collars is recommended in high speed applications or whenever stability is a concern.

7. Others

Various other approved channelizing devices may be used such as temporary flex beam guardrails and median barriers. Glue-down delineators may be used with approval for locations that require longer-term or low-maintenance application. Caution tape is not recommended except in emergencies.

B. Channelizing Device Placement

For maximum effectiveness, the following rules shall be observed in placing channelizing devices for the purpose of channeling and/or diverting traffic:

1. Place channelizing devices in continuous rows. For each row the devices should be of the same type.
2. The channelizing devices should be placed and anchored if necessary to prevent being knocked out of position by passing traffic. Where used to define traffic lanes, sufficient lane width should be provided so that trucks and buses will not strike them. Additional lane width and clearance may be required on curves and at intersections, where the "tracking effect" of wide swinging semi trucks tend to knock over or crush improperly placed devices.

3. The channelizing devices shall be placed with their broadsides, lamps, and reflectors facing traffic.
4. Where used to close a traffic lane and to transition oncoming traffic, the minimum taper length and spacing between the devices shall be as indicated in Table X - 1. The minimum desirable length indicated in Table X - 1 applies to roadway conditions of relatively flat grades and straight alignment. Adjustments may be necessary to provide adequate sight distance on the approach to the channelization. Similarly, the proximity of interchange ramps, crossroads, etc., to the worksite may dictate the need for adjustments. In general, improved traffic flow will result when the adjustments consist of increasing the length of the taper rather than reducing the length below the minimum as stated in Table X - 1.

C. High Level Warning Device

The primary use of a high level warning device is to provide advance warning of a work area by being visible to a driver even when the work area is obstructed from view by other vehicles or construction equipment.

High level warning devices shall consist of either three flags, a Type “B” warning light or a vehicle mounted flashing yellow warning light for daytime use. For nighttime use, a Type “A” light may be substituted for a Type “B” light; flags alone shall not be used.

High level warning devices with flags or warning lights shall be a minimum of 8’ high and shall be designed to resist overturning by the wind while minimizing vehicular damage should they be inadvertently struck. Flags should be 16” square or larger and iridescent red or orange in color.

High level warning devices are optional for all temporary work in the roadway and may be used to supplement warning signs, except when replaced by an advance warning arrow panel in appropriate locations (see section D-6.). 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 should be placed in the middle of the closed lane and shall always be placed behind appropriate channelizing devices as indicated in the illustrations. Normally, one unit should be used for each lane closed; however, additional units may be used if appropriate.

D. Illumination and Lighting Devices

Often, persons working in the right of way only see the job site during the daytime. It is also necessary to protect the public and the job site during the hours of darkness.

During the day obstructions may be clearly visible, and channelizing devices may be merely of secondary importance. However, at night the work area may not

be visible, and the public is reliant upon properly illuminated warning devices. Barricades, signs and other traffic control devices are useless and can be potential hazards unless they can be seen after dark.

All traffic control devices, except parking and pedestrian control signs, used during the hours of darkness shall be properly reflectorized as described elsewhere herein. In addition to these requirements, other devices may be applied during the hours of darkness.

1. Torches and Lanterns

Torches include the entire single unit, portable, constant burning, low intensity type lights of either the battery powered or open flame variety. Lanterns include all enclosed flame type units. Because they are undependable and provide little illumination, these devices shall not be used.

2. Flashing Yellow Warning Light (vehicle mounted)

Flashing or rotating yellow/orange warning lights for mounting on vehicles shall cast a yellow/orange light radially through 360 degrees. Such lights should be approximately 5” high and 5” in diameter and shall be rated at a minimum 750-candle power. Strobe type LED flashers may be a lesser dimension.

When mounted on equipment they shall be positioned such that maximum visibility from all sides is achieved. Lights shall be such that a minimum sustained flash rate of 60 flashes per minute is produced. Light pulsations may be achieved by either rotation of the light source or a strobe type unit.

3. Steady Burning Electric Lamps

As used herein, steady burning electric lamps shall mean a series of low wattage yellow electric lamps. Where lights are needed to delineate the traveled way through and around obstructions or to separate opposing traffic in a construction or maintenance area, the delineation should be accomplished by use of steady burning lamps.

4. Floodlights

Electric lights can be used for floodlighting hazardous conditions, signs, channelizing devices, and flagger stations. Lights used for illuminating signs or channelizing devices shall be sufficient in size and number to provide effective illumination and legibility under normal atmospheric conditions. Precautions shall be taken when placing lights to insure the prevention of glare.

5. Warning Lights

As used in this Manual, barricade warning lights are portable, lens directed, enclosed lights. The color of the light emitted shall be yellow and may operate either in the flash or steady burn mode. These devices shall meet the current Institute of Transportation Engineers (ITE) purchase specification for flashing and steady burning warning lights.

WARNING LIGHTS

	Type A Low Intensity	Type B High Intensity	Type C Steady Intensity
Lens Directional Faces	1 or 2	1	1 or 2
Nighttime Visibility	3000’		3000’
Daytime Visibility		1000’	
Minimum Height	36”	36” – 96”	36”
Hours of Operation	Dusk to Dawn	24 Hours a Day	Dusk to Dawn

Type A Low Intensity Flashing Warning Lights are most commonly mounted on advance warning signs, Type II barricades, vehicle panels, or on independent supports, and are generally used to warn road users of an extremely hazardous situation.

Type B High Intensity Flashing Warning Lights are normally mounted on advance warning signs or high level warning devices. Extremely hazardous site conditions within the construction area may require that the lights be mounted on Type I and Type II barricades, signs, or other supports. As these lights are effective in daylight as well as dark, they are designed to operate 24 hours per day.

Type C Steady Burn Lights are intended to be used to delineate the edge of the traveled way on lane changes, on lane closures and on other similar conditions. When mounted on vertical panels they may be used to separate opposing flows of traffic.

6. Advance Warning Arrow Panel

Advance warning arrow panels are sign panels with a matrix of lights capable of either flashing or sequential displays. Advance warning arrow panels shall be used on roadways with speed limits of 40 mph or greater, and should be used within the Central Business District and roadways with speed limits of 35 mph. Advance warning arrow panels are intended to supplement other traffic control devices. Arrow panels will not solve difficult traffic problems by themselves, but they can be very effective when properly used to reinforce signs, barricades, cones, and other traffic control devices. Necessary signs, barricades, or other traffic control devices shall be used in conjunction with the advance warning arrow panel.

Arrow panels provide additional advance warning and directional information where traffic must be shifted laterally along the roadway. Arrow panels are effective in encouraging drivers to leave the closed lane sooner. They assist in diverting and controlling traffic around construction or maintenance activities being conducted on or adjacent to the traveled way and give traffic positive guidance about a roadway path diversion that they might not otherwise expect.

Arrow panels are generally used for day or night lane closures, roadway diversions, and slow moving maintenance and construction activities on the traveled way. They are particularly effective under high speed and high density traffic conditions. At night, they are effective where other traffic control devices cannot provide adequate advance warning of a roadway path diversion. During daylight, arrow panels are effective under high density traffic conditions that might block the road user's advanced view of construction or maintenance activities ahead.

E. Pavement Markings

The City Traffic Engineer shall review with the Contractor situations that merit either the removal of existing pavement markings or the application of temporary markings. Where existing pavement markings conflict with the temporary markings, consideration shall be given to their removal depending upon the extent of conflict and the relative hazard produced. The City Traffic Engineer shall make the final determination. All pavement markings shall be removed and/or applied by the Contractor as approved or directed by the Traffic Engineer. Upon completion of construction, all pavement markings and channelization removed or damaged shall be replaced by the Contractor.

F. Flaggers

1. Qualifications

Since flaggers are responsible for human safety and typically make the greatest number of public contacts of all construction personnel, it is important that qualified personnel be selected. All flaggers must possess a card certifying that they have completed the flagger's course as approved by the State of Washington

Department of Labor and Industries. In addition, all setups involving flaggers must adhere to the Washington State Safety Laws (WAC Ch. 155-305 part E) and/or Ch. VI of the MUTCD.

2. Equipment

While flagging during daylight hours, a flagger must at least wear as an outer garment:

- A high-visibility safety garment designed according to Class 2 specifications in the ANSI/ISEA 107-2004, American National Standard for High-Visibility Safety Apparel, consisting of at least 775 square inches of background material that are fluorescent yellow-green, fluorescent orange-red or fluorescent red in color; and 201 square inches of retroreflective material that encircles the torso and is placed to provide 360 degrees visibility around the flagger.
- A high-visibility hard hat that is white, yellow, yellow-green, orange or red in color (WAC 296-155-305).

Jackets or vests shall be properly worn and buttoned or zipped for maximum 360 degree visibility and effectiveness.

The flagger shall also be equipped with a standard STOP SLOW hand paddle or pole type paddle. Sign paddles shall be at least 18” wide with 6” letters. A light semi-rigid handle should be provided. This combination sign may be fabricated from sheet metal or other light semi rigid material. The background of the STOP face shall be red with white letters and border. The background of the SLOW shall be orange with black letters and border. When used at night, the stop/slow paddle shall be retroreflective.

For nighttime operations, jackets and vests shall be retroreflectorized and meet the most current version of the Performance Class 3 requirements of the ANSI/SEA 107. In addition to the retroreflectorized clothing and STOP SLOW paddle, the nighttime flagger should also be equipped with a flashlight or other lighted signal device. The flashlight or signal device shall be equipped such that a red color is visible and shall be used to accentuate hand signals, which may otherwise not be visible. Care must be taken that the light is not of such intensity as to produce glare to oncoming traffic or obscure the sign message.

3. General

Sometimes traffic control equipment alone is inadequate and flaggers should be used, such as:

a. Where workers or equipment are intermittently blocking a traffic lane
b. Where equipment is backing
c. Where only one lane is available for two directions of travel. When the one lane section is visible from one end to the other end, traffic shall be controlled by means of a flagger at each end of the section. One of the two should be designated as the chief flagger for purposes of coordinating movement. They should be able to communicate with each other verbally or by means of signals. These signals should not be such as to be mistaken for flagging signals. When the end of a one-lane section is not visible from the other end, the flagger may maintain contact by means of radio or field phones, or additional flaggers may be stationed at intermediate points. If the one lane section is short, one flagger only may be used to handle both directions of traffic.
d. Where traffic control equipment is being placed or removed in the roadway.
e. In emergency situations until proper traffic control equipment can be obtained and properly installed.
f. When existing traffic signals are to be countermanded, in which case only a Uniformed Police Officer shall be the flagger.
g. To assist in the control of pedestrian traffic at intersections and crosswalks.

Other general rules pertaining to flaggers include:

a. At no time shall a flagging station be left without a flagger.
b. To keep traffic moving, road users who stop to question delays should be advised as briefly as possible of the reason and its approximate duration.
c. The flagger should not initiate conversations with roadway users and should avoid arguments.

4. Stations

Flagger stations shall conform to the following criteria whenever possible (see illustration in Chapter VIII):

a. They should be stationed far enough in advance of the work area to properly slow or stop traffic before it enters the work area.
b. Flaggers should stand adjacent to the road users being controlled or in the closed lane prior to stopping road users. A flagger shall only stand in the lane being used by moving road users after road users have stopped.
c. At a “spot” obstruction where a single flagger controls traffic from both directions, the flagger should normally be positioned on the shoulder opposite the work area.

d. Flaggers should stand apart from the other crew members and should not mingle with others while on duty. Flaggers should be aware of their position relative to construction equipment such that they do not blend in with their background.
e. Flagger stations shall be provided with advance warning signs as indicated in the illustrations in Chapter XI especially in the case where one lane is being utilized for two directions of travel.
f. During the hours of darkness, flagger stations shall be lighted.

5. Control Procedures and Signals

Flagger signals to traffic should use devices and methods as described in the MUTCD.