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Section 410 Traffic Signs

Traffic signs shall be furnished and erected in conformance with the MUTCD and the Oregon Supplements to the MUTCD, modified as noted below. Modifications to these standards must be approved by the City Engineer.

410.1 Materials

Aluminum: All post mounted standard highway signs shall have a minimum thickness of 0.080 inches. All overhead signs and all street name signs shall have a minimum thickness of 0.100 inches.

Plywood: No plywood will be permitted on any sign without prior approval from the City Engineer.

Polyplate: The use of polyplate is not allowed.

Sheeting: 3M Scotchlite brand high intensity prismatic reflective sheeting ASTM D4956 Type IV shall be used as a background, except for overhead signs where wide angle prismatic (3M 3990) sheeting ASTM D4956 Type XI shall be used.

Posts: When a sign or combination of signs on a post is 36 inches or less in total height, the post shall be a minimum of 2 x 2-inch x 10-foot, 12-gauge perforated post.

When a combination of signs is more than 36 inches in height, the post shall be a minimum of 2 x 2-inch x 12-foot, 12-gauge perforated post. The sign post shall be embedded a minimum of 12 inches into its base.

Round metal posts will not be permitted. Wood posts may be used only with prior approval of the City Engineer and must be configured and drilled for breakaway as per ODOT specifications.

Base: The breakaway post base shall consist of a 2.25 x 2.25 inch (I.D.) x 36-inch Galvanized base with a 2.5 x 2.5 inch (I.D.) x 18-inch sleeve placed flush with base. All sleeves and bases shall be 12-gauge perforated material.

Fastening: Drive rivets shall be used to fasten signs onto metal sign posts. To prevent vandalism, no nuts and bolts will be permitted to fasten any sign to metal sign posts. Galvanized washers shall be used behind all drive rivets used to affix signs to posts. Two drive rivets at right angles or angle bolts shall be used to fasten post to base.

Letter Spacing: Spacing between letters, words, numbers, and/or symbols shall be in conformance with the *Standard Alphabets for Highway Signs* manual.

Abbreviations for Street Name Suffixes:

Avenue:	Ave	Loop:	Lp
Boulevard:	Bld	Place:	Pl
Circle:	Cir	Road:	Rd
Court:	Ct	Street:	St
Drive:	Dr	Terrace:	Ter
Lane:	Ln	Way:	Wy

Reflective or Non-Reflective Sheeting Application: Manufacturer's splices of sheeting will be permitted. Only one manufacturer's splice will be permitted per sign. No splices by the Contractor will be permitted. If the reflective sheeting needs to be spliced, the splice(s) shall be horizontal with the upper section(s) of sheeting overlapping the lower by a minimum of 3/8 inch. Only one splice will be permitted per sign.

Section 420 Street Name Signs

Post Mounted: Street name signs should be placed in diagonally opposite corners so that they will be on the right-hand side of the intersection for traffic on the minor street. At least two sets of street name signs will be mounted at each intersection.

On T-intersections, the street name signs will be designated at two locations. One set of street name signs shall be placed at the end of a "T" intersection, and the second set shall be placed at the right-hand corner of the intersecting street.

Overhead: All overhead street name signs shall be a minimum of 24 inches in height. The minimum letter size shall be 12 inches, series "C." Prefixes and suffixes shall be 6 inches, series "C." The minimum border width for overhead street name signs shall be 1 inch and have zero (0) margin. Wide angle prismatic sheeting 3M 3990 shall be used on all overhead signs.

420.1 Street Name Sign Details

For streets with posted speeds of 25 mph or less, see Standard Drawing 410 for letter sizing and arrangement.

For streets with posted speeds of 30 mph or greater, see Standard Drawings 411 and 412 for materials, letter sizing, and arrangement.

Section 430 – Traffic Signals

430.1 Design and Installation Requirements

Traffic signal installation shall conform with the following:

- A. MUTCD
- B. Oregon Supplements to the MUTCD
- C. Standard Specifications for Highway Construction (ODOT)
- D. Standard Specifications for Micro Computer Signal Controller (ODOT)
- E. Oregon Standard Specifications for Construction and Oregon Standard Drawings
- F. Oregon Electrical Specialty Code and National Electrical Code

Note: The engineer shall submit a copy of the final electrical inspection to the City prior to City acceptance of the signal.

430.2 Design Drawing Requirements

Traffic Signal installation plans shall consist of the following separate sheets:

<u>Plan Sheet</u>	<u>Minimum Scale*</u>
1. Signal Legend and Details	N/A
2. Signal Plan	1-inch = 20 feet
3. Pole Information	N/A
4. Signal Detection Plan	1-inch = 20 feet
5. Signal Details (Includes all ODOT and City Standard Drawings)	N/A

* Larger scales than the minimum scales shown may be necessary to depict complex features clearly and to allow reduction of drawings to one-half their original size without reducing their clarity.

430.3 City Requirements

- A. The traffic signal control program (NWVOYAGE) for the 2070E controller shall be furnished by the contractor, unless otherwise approved by the City Traffic Engineer.
- B. Emergency Vehicle Preemption (EVP) detectors shall be installed on all approaches to the signal. EVP detectors shall not be installed on ends of mast arms.
- C. Traffic detection shall consist of video detection, or as directed by the City Traffic Engineer.
- D. When detection loops are permitted by the City Traffic Engineer, detection wiring shall be extended to the cabinet for each local and advance field detector and by each lane.

- E. Pedestrian indications shall be international symbols with count down modules. All indications shall be light-emitting diodes (LEDs).
- F. Traffic controller cabinet and riser shall be anodized aluminum.
- G. Traffic controller and cabinet shall be supplied after testing by the Oregon Department of Transportation and complete with operation components and software.
- H. All vehicle signal indications shall be LED units. The LED indications shall be hard wired in the signal head.
- I. All conduit under roadways shall be a minimum of three (3) inches in diameter. All other conduit shall be a minimum of two (2) inches in diameter unless otherwise approved by the City Engineer.
- J. All traffic signal poles shall contain recessed terminal cabinets.

430.4 Field Wire

All traffic signal conductors shall be control cables and shall be 20-conductor, 12 conductor or 9-conductor 14 AWG IMSA 20-1 and color coded as shown in the tables below:

Table 430.1-A – Color Code Chart for Control Cable (20 Conductor)

Color Code Chart for Control Cable 20 CONDUCTOR 14 AWG IMSA 20-1 TRAFFIC SIGNAL CABLE			
Conductor Number	Base Color	2 nd Color	Use
1	Red		Main Phase Red
2	Orange		Main Phase Yellow
3	Green		Main Phase Green
4	Red	Black	Cross Phase Red
5	Orange	Black	Cross Phase Yellow
6	Green	Black	Cross Phase Green
7	Black	Red	Left Phase Red
8	White		Left Phase Yellow
9	Black	White	Left Phase Green
10	Red	White	Main Phase Don't Walk
11	Green	White	Main Phase Walk
12	Black		Cross Phase Don't Walk
13	Blue	White	Cross Phase Walk
14	White	Black	Ped Push Button Common
15	Blue		Main Phase Push Button
16	Blue	Black	Cross Phase Push Button
17	Red	Green	Overlap Phase Red
18	Orange	Red	Overlap Phase Yellow
19	Blue	Red	Overlap Phase Green
20	White	Red	Spare

Table 430.1-B – Color Code Chart for Control Cable (12 Conductor)

Color Code Chart for Control Cable 12 CONDUCTOR 14 AWG IMSA 20-1 TRAFFIC SIGNAL CABLE			
Conductor Number	Base Color	2 nd Color	Use
1	Red		Main Phase Red
2	Orange		Main Phase Yellow
3	Green		Main Phase Green
4	Black	Red	Left Phase Red
5	White		Left Phase Yellow
6	Black	White	Left Phase Green
7	Red	White	Don't Walk Phase
8	Green	White	Walk Phase
9	Blue		Push Button Phase
10	White	Black	Ped Push Button Common
11	White	Red	Spare
12	Blue	Red	Spare

Table 430.1-C – Color Code Chart for Control Cable (9 Conductor)

Color Code Chart for Control Cable 9 CONDUCTOR 14 AWG IMSA 20-1 TRAFFIC SIGNAL CABLE			
Conductor Number	Base Color	2 nd Color	Use
1	Red	White	Main Phase Don't Walk
2	Green	White	Main Phase Walk
3	Black		Cross Phase Don't Walk
4	Blue	White	Cross Phase Walk
5	White	Black	Ped Push Button Common
6	Blue		Main Phase Push Button
7	Blue	Black	Cross Phase Push Button
8	White	Red	Spare
9	Blue	Red	Spare

Section 440 – Traffic Striping and Marking

440.1 General

- A. Traffic striping and markings shall comply with the *MUTCD* and the Oregon Supplements to the *MUTCD*.
- B. Material specifications shall conform to *Oregon Standard Specifications for Construction* and *Oregon Standard Drawings*.
- C. Raised markers (reflectors and buttons) shall be used in conjunction with permanent marking layouts.
- D. Approved striping material and layout shall be submitted to and approved by the City Traffic Engineer prior to installation.

440.2 Materials

Except as provided below, permanent pavement striping and markings shall be non profile Methyl Methacrylate durable permanent pavement marking material.

Symbols within a bike lane shall be pre-formed alkyd thermoplastic.

Alkyd Hot Thermoplastic may be used on existing asphalt concrete pavement upon approval of the City Traffic Engineer.

Foil back tape may be used for temporary markings.

Raised pavement markers shall be one of the following brands.

- Stimsonite brand model #88
- Ray-o-lite brand model #S.S.
- 3M brand series 290/291

Raised pavement marker adhesive shall be hot bituminous adhesive meeting ANSI #4280/D4283.

440.3 Application

Use sprayers or extruders approved by the pavement marking material manufacturer and made specifically for the purpose of applying beaded markings.

Pavement marking material shall be applied only to dry pavement surfaces and only when the pavement surface temperature is above 50 degrees Fahrenheit.

All longitudinal stripes shall be applied at a minimum thickness of 0.12-inch.

All transverse markings, symbols and legends shall be applied at a thickness of 0.12-inch to 0.150-inch.

Stencils shall be used when applying material for symbols or legends.

Apply reflective glass beads at a sufficient rate and ensure proper bead embedment and density to obtain a minimum reflectivity reading of at least 300 millicandellas for white and 250 millicandellas for yellow.

440.4 Pavement Surface

New or existing asphalt concrete: Apply material only when the surface is dry, clean and free of contaminants such as surface oils. Some products may require the asphalt to cure for several weeks prior to placement of striping materials.

Portland cement concrete: Apply material to concrete that has reached a minimum comprehensive strength of 3000 psi and only when the surface is dry, clean, and free of contaminants such as curing agents, laitance, and surface oils. Remove contaminants by approved mechanical means such as turbo blasting or grinding.

Existing pavement markers that are damaged by blast cleaning or wire brushing shall be removed and replaced by the Contractor at his expense.

Section 450 – Street Illumination

450.1 General Design

Street illumination design and installation shall conform with the *Oregon Standard Specifications for Construction* and *Oregon Standard Drawings*

Street Lighting installation plans shall consist of the following separate sheets:

<u>Plan Sheet</u>	<u>Minimum Scale*</u>
1. Street Lighting Legend	N/A
2. Street Lighting Plan	1-inch = 30 feet
3. Street Lighting Schematic and Details	N/A
4. Street Lighting Standard Details (Includes all ODOT and City Standard Drawings)	N/A

* Larger scales than the minimum scales shown may be necessary to depict complex features clearly and to allow reduction of drawings to one-half their original size without reducing their clarity.

All street light plans shall include pole location by station, wiring, conduit, junction boxes, photo cells, controller cabinet, power source location lighting analysis output points, driveway locations and trees along with any other pertinent information. All back-up lighting analysis, line loss and service cabinet circuit load calculations shall be submitted for review along with the plans.

All street lighting shall be designed using the Illuminating Engineering Society guidelines as modified in this manual. Street lighting fixture style and aesthetic elements shall be determined through the development review process. When trees are being proposed with street lights, all street light poles should be located near property lines and at least 20 feet from any trees, unless approved by the city Traffic Engineer.

All electrical components shall be UL approved and testing lab approved from labs accepted by the State of Oregon.

All street lights shall be Light-Emitting Diode (LED).

The contractor shall be responsible to provide all required traffic control.

The contractor shall be responsible for making arrangements with PGE for connecting the street lighting system to the local distribution system.

The following codes and references shall be used in designing all street light systems:

- A. Oregon Electrical Specialty Code and National Electric Code
- B. An Information Guide for Street Lighting by AASHTO
- C. America National Standard Practice for Roadway Lighting ANSI/IESNA RP-8-00.
- D. Fundamentals of Traffic Engineering by the Institute of Transportation Engineers.

Note: The Engineer shall submit a copy of the final electrical inspection to the City prior to City acceptance of the street light system.

Lighting Levels: Average Maintained Illuminance on the Horizontal

Table 450.1 – Lighting Levels: Average Maintained Illuminance on the Horizontal

Minimum Average Maintained in Foot Candles			
Roadway Classification	Commercial	Mixed-use and Institutional	Residential
Arterials	2.0	1.4	1.0 *
Collectors	1.2	0.9 *	0.6 *
Neighborhood Routes	1.2	0.9	0.6
Local Streets	0.9 *	0.6 *	0.5 *
Private Streets	0.6	0.5	0.5
Roadside Walk and Bikeways	0.9	0.6	0.5
Other Pedestrian and Bicycle ways		Average Foot Candles	
Walk, Bicycle Parking Spaces, and Bikeways Distant From Roadways		0.5	
Pedestrian Tunnels		4.0	
Pedestrian Overpasses		0.5	
Pedestrian Stairways		0.6	

Note: The City and the appropriate natural resource agencies shall determine whether or not lighting shall be provided for shared-use paths in designated natural resource and wildlife areas.

*Increase light level by 50 percent at intersections.

The minimum average uniformity of lighting shall be 6 to 1 for local streets and 3 to 1 for all other areas.

The minimum average foot candles shall be more than 10% above the requirement.

All street lights shall be option 'C' as defined below unless otherwise approved in writing by the Operations Director. The Operations Director shall approve all street illumination options (A, B, or C) with PGE prior to installation.

450.2 Option 'A' Lighting

Under this option, PGE will install, own, and maintain street lighting.

450.3 Option 'B' Lighting

Under this option, the developer will install the street lighting, the City shall own the poles and fixtures, and PGE will maintain it.

450.4 Option 'C' Lighting

Under this option, the developer will install the street lighting and the City of Beaverton will own and maintain it. The developer shall maintain the street lighting system during the maintenance period. A 72-hour burn-in period is required prior to acceptance into the maintenance period. All option 'C' lighting shall comply with the following requirements:

450.4.1 Conduit

All new installations and replacements of existing wire shall be in schedule 40 PVC or rigid metal conduit, which shall conform to the applicable requirements of Article 347 of the *National Electrical Code (NEC)*. All conduits shall be installed per the “wet location” requirements of the *NEC*.

Rigid conduit shall extend from the power source to a junction box, which is to be located not more than three (3) feet from each pole served. All conduits shall be marked using a "Warning Tape" which shall be located per industry standards.

Cables between the junction box and the lighting pole shall be installed inside a car flex or flexible schedule 40 PVC when using direct bury poles; otherwise rigid conduit shall be used. Splices shall never be done within the conduit. All conduits shall have a burial depth of 36 inches to 42 inches below finished grade. For conduit runs between the street light pole and the junction box, conduit size shall be a minimum of one (1) inch and for runs between junction boxes a minimum of two (2) inches.

All conduit ends shall have terminal adapters with bushings or bell brushings installed. All conduit ends shall be sealed with “Molded Plug” preformed closed cell foam conduit and pipe seals. All conduit ends, with bushings installed, shall be between four (4) inches and six (6) inches below the bottom of the junction box lid. All conduit ends in junction boxes or foundations shall have a one-inch clearance from other conduits, rods, pole walls, and junction box walls. Conduits shall enter through the bottom of the junction box with factory 90-degree elbows.

All turns in conduits other than at junction boxes shall be conduit sweeps. Conduit shall terminate near the box wall to leave the major portion of the box clear. Conduit outlets shall be located on the side of the box that corresponds to the direction of the conduit run, and shall be no closer than four (4) inches from the bottom of the box lid and at least two (2) inches above the gravel fill. Conduit ends shall be oriented towards the top of the box such that the conductors may be pulled out of the conduit from the top of the box without touching the side of the box.

450.4.2 Cable and Wire

Circuits and Cable runs shall be designed to provide separate and independent circuits for street lights. Wire size shall be determined by the loading and distance of each circuit for a 240V lighting system. Wire shall be sized to limit voltage drops to a maximum of two (2) percent between the utility service connection and the control panel and a maximum of three (3) percent for new installations and maximum of five (5) percent for additions to existing circuits from the control panel to the most distant fixture served.

Solid aluminum or copper wiring shall not be used. All wire shall be stranded copper, single conductor, with a 600 volt insulation. The minimum wire size shall be #10 AWG stranded copper wire, type XHHW for the lighting circuit. The photocell circuit wires shall be #12 AWG stranded copper, type XHHW. The maximum wire size shall be #1 AWG stranded copper. Equipment ground wire shall be stranded copper, single conductor, either bare or with a 600 volt green insulation.

Cable installation shall conform to the *National Electric Code* and the design standards of the City of Beaverton. All wire and cable splices and connections shall be made within approved junction boxes and shall be accomplished with approved fasteners. Any splices and connections that are prone to flooding (near a water source, within a floodplain, within an area of known flooding, or an area of high ground water) shall be installed per the “wet location” requirements of the *NEC*.

Wire insulation color shall conform to the following:

1. 120 volt photo electric circuit wires shall be #12 AWG stranded copper wire, type XHHW. A yellow wire from the controller to the photo cell, purple wire for the return to the cabinet.
2. 240 volt line distribution wires shall be a minimum of #10 AWG stranded copper wire, type XHHW. One wire shall be black in color; the other wire shall be red in color. When two or more separate circuits are run in the same conduit, the second pair of conductors shall be blue and brown. Additional colors for addition circuits may be required with the approval of the City of Beaverton Operations Department’s lead electrician.
3. Grounded conductors shall be white.
4. Grounding conductors shall be green insulated or bare stranded wire.

Color coding of each conductor shall remain consistent throughout the entire system. Factory supplied striping of conductors will be accepted when the required color insulation is not available. Color tape will not be accepted as an alternate for insulation color coding.

Electrical wire splices located in junction boxes, poles, or other similar locations shall be made moisture and water proof by using either a heat shrink tubing with pre-applied sealant or electrical insulating rubber tape overwrapped with electrical vinyl tape. Each splice shall be taped separately.

450.4.3 Poles

Arterial and Collector Streets: Anchor base poles shall be used on arterial and collector streets.

The standard pole for arterial and collector streets shall be of the anchor base type with a mounting height up to 35 feet, “Whatley” aluminum poles or approved equal with a 14-inch bolt circle and a bolt size of 1 inch x 36 inch x 4 inch.

Residential Streets: The standard pole for residential streets shall be of the direct burial or embedded type with a mounting height of 25 feet, “Whatley” pole or approved equal. Poles shall be bronze in color and constructed of smooth filament wound fiberglass. If the poles are to be located behind the sidewalk, an aluminum mast arm bronze in color and of sufficient length to locate the fixture over the roadway will be required. The standard length of the arm shall be six (6) feet. If the pole is located next to the curb the standard length of mast arm shall be eight (8) inches. All arm lengths shall be consistent within the project.

All direct bury poles and pre-formed pole bases shall be back filled with ½ yard of compacted ¾ inch - 0 inch crushed rock.

All Other Applications: All other applications shall be evaluated on a case-by-case basis.

Pole Access: All lighting poles shall be constructed with a nominal 2-1/2 inch by 5-inch hand hole. In plan view, the hand hole shall be at 90 degrees from the mast arm or curb side of the pole. The hand hole shall be secured with cast aluminum, galvanized steel or fiber glass cover painted to match the pole and held in place with a stainless steel tamper resistant set screw.

450.4.4 Lighting Fixtures

Lighting fixtures shall be Light-Emitting Diode (LED) with number of LEDs and lumens that are necessary to achieve the requirements. All lighting fixtures shall contain current drivers no higher than 525mA. Lighting fixtures shall be of the same color as the poles and mast arms. Fixtures shall be of the "power door" type with the electronic components mounted on a single removable panel that will facilitate dry room repairs or replacement.

All fixtures shall have a multi-tap current divers and be pre-connected to 240 volt taps. All circuits and fixtures shall be wired 240 volts and shall be grounded.

Every fixture shall have wattage labels visible from the street indicating the wattage for the drive current selected.

450.4.5 Control Cabinets

Details of the street lighting controller cabinet shall be submitted to the city for approval prior to fabrication. Contact the Operations Street Lighting Section for the current controller cabinet specifications. The location and type of street light circuit controller shall be shown on all street lighting plans. Whenever possible, the controller cabinets shall be installed away from intersections. The cabinet shall have a service panel that has a "Service Equipment" rated UL label attached to the panel. Each controller shall be painted light green and shall be placed on a concrete pad.

A 100 amp, single phase, 3 wire, 240 volt, dedicated unmetered service is to be provided by the developer. Each street lighting circuit shall be wired 240 volts. The street light control cabinet shall be a "Copper B-Line catalog no. CUP 4111SPL-GRN" In special circumstances, when a metered service is required, the street control cabinet shall be a "Copper B-Line catalog no. CMP4111SPL-GRN. The street control cabinet shall be mounted on a concrete pad with 30 pounds craft paper between the cabinet and the concrete pad. The concrete pad shall measure 24 inches x 24 inches x 18 inches deep. The concrete pad shall be MB1515 or approved equal. The concrete pad shall be set at the sidewalk grade and located not more than two (2) feet behind the sidewalk with front door facing the sidewalk. A concrete 12" apron shall be installed when control cabinet is in areas without sidewalk. The control cabinet shall be sealed around the bottom with silicone seal or caulk.

All street lights shall operate at 240 volts and shall be grounded.

All street light circuit shall be controlled by a single photocell installed on the street light fixture closest to the control cabinet. Photocell shall be a three-prong NEMA type twist lock with receptacle adjustable to point north meeting the specifications of Ripley's Model no. 6390TF-FO or approved equal. The photocell shall be used in conjunction with a lighting contactor in the control cabinet. All poles without a photocell shall contain a black cover shorting cap Ripley's Model 6005 or approved equal..

All circuits shall have a manual on/off switch that will over-ride the photo-electric cell. This switch shall be located within the interior of the control cabinet and shall be labeled, "On/Off".

All control cabinets shall contain GFCI 15Amp-125 Volt grounded receptacles mounted inside cabinet from a dedicated 20 Amp circuit.

A 10-amp resettable pushbutton circuit protector, Heinemann Model KD1-5 (Re-cirk-it), HEB, HEY or approved equal shall be installed between the circuit and each light fixture on that circuit. The circuit protector shall be accessible through the hand hole.

In systems with lights on both sides of the street, the circuitry shall be designed such that the lights on one side of the street can be “de-energized” without affecting the operation of the lights on the other side of the street.

450.4.6 Junction Boxes

All junction boxes shall be traffic rated concrete, composite concrete or fiberglass and shall be stamped "Street Lighting." All junction boxes outside of sidewalk shall include a 12" Portland cement concrete apron.

There shall be one (1) junction box for each street light pole. The junction box shall be located not more than three (3) feet from the pole that it serves. All junction boxes shall be set at finish grade or curb height, whichever applies.

All junction boxes shall have a 12" base of compacted $\frac{3}{4}$ inch - 0 inch crushed rock. If mud or dirt has infiltrated into the junction box, remove all contaminated fill and install new base. When conduit crosses a street, a junction box shall be set on each side of the street at the crossing. A junction box shall be set at each horizontal turn in the conduit of 45 degrees or more. Use a larger size junction box where needed.