ENGINEERING POLICY BALLOT

Effective: April 1, 2021

Level 2

Level two revisions require the approval of the **Assistant Chief Engineer** and the **Federal Highway Administration** only. The **Senior Management Team** is encouraged to review the content and provide comment to the appropriate director. For all other parties, these revisions are posted for information only.

ENGINEERING POLICY BALLOT

Effective: April 1, 2021

Issue 1: Temporary Rumble Strip Policy Revision

Approval: **Level 2 – Assistant Chief Engineer**

Sponsor: Ashley M. Buechter- TS

Summary: This proposed revision updates the EPG guidance/policy for use of short-term and long-term temporary rumble strips in construction and operation work zones.

Publication: EPG 616

Issue 2: Accessible Pedestrian Signal Guidance

Approval: **Level 2 – Assistant Chief Engineer**

Sponsor: Ashley M. Buechter- TS
Katy M. Harlan - TS

Summary: This proposed revision provides updates to Sec. 902 and 1092 by adding construction and material specifications for accessible pedestrian signals (APS). Additional revisions include changes to Std. Plan 902.05 sheets 1 and 2, to better show the required APS push button system signage and installation. EPG 902.6.9 has been completely rewritten for APS signals and detectors. New EPG articles 902.6.10 - 902.6.15, includes additional guidance for APS installations as well as updated figures. The ADA checklist has also been updated to reference the correct EPG guidance. A new checklist for APS installation acceptance and inspection will also be added to the EPG.

Publication: Sec 902 & 1092, Standard Plans 902.05, EPG 902

Issue 3: Flashing Beacons and Signs in School Areas

Approval: **Level 2 – Assistant Chief Engineer**

Sponsor: Katy M. Harlan - TS

Summary: EPG 902.12 is being revised to update the guidance related to adding flashing beacons by outside parties. The new EPG article 903.19 updates the guidance for installing signs in school areas, including stop for school buses loading/unloading signage (state law) and analyses for school speed zones.

Publication: EPG 902 & 903

Issue 4: Sign Placement on Span Wire Signals

Approval: **Level 2 – Assistant Chief Engineer**

Sponsor: Thomas Honich – TS
Ashley Buechter – TS
Katy M. Harlan - TS

Summary: This is a proposed new sheet to Std. Plan 902.70 (sheet 3). Currently there is no standard plan for contractors to use when installing signs on span wires. This new standard will take information from a figure in the EPG and make it a standard. This new standard will include the proper sign placement, attachment detail, and backing bar supports.

Publication: Standard Plan 902.70

616.6.87 Temporary Rumble Strips (MUTCD 6F.87)

Temporary rumble strips are a strategy for reducing distracted driving and achieving MoDOT's work zone safety goals. Temporary rumble strips ~~shall be~~are used in construction and maintenance work zones (planned and unplanned) in accordance with this guidance. Milled in ~~Permanent~~ rumble strips are discussed in EPG 626 Rumble Strips.

Support. Temporary rumble strips are comprised of a series of ~~raised~~ elongated ~~bumps~~ strips ~~placed~~ installed laterally within~~upon~~ the travel lane~~surface~~ of the roadway to provide an audible and vibratory alert to drivers of the upcoming work zone. ~~Since each project is unique, the Core Team should decide when temporary rumble strips should be included in the project.~~

Temporary rumble strips are used in contract (including Job Order Contracts (JOCs)) or maintenance work zones and consist of two types; namely temporary long-term rumbles strips or temporary short-term rumble strips.

~~Long term Rumble Strips~~Temporary long-term Rumble Strips

Support. Temporary long-term rumble strips come with two installation methods; those with an adhesive backing on each strip and those formed by milling depressions into the pavement. Both installations prevent the movement of the strips while located in the travel lane.

Standard. ~~The~~ When temporary long-term rumble strips ~~are made~~ with an adhesive backing are used, installation shall ~~to prevent movement. A set of long term rumble strips shall~~ consist of 5 strips, spaced 10 to 12 ft. on center or per manufacturer's recommendation, whichever is longer~~.~~ as indicated in Figure 616.6.87.1 and Figure 616.6.87.2,

Option. Milled, ~~long term~~ temporary rumble strips are an option for ~~projects~~ work zones that will last several~~go into the winter~~ months. See EPG 626 Rumble Strips for milled in rumble strip guidance. ~~The milled pavement shall be repaired by the contractor prior to project completion.~~

Standard. If used in work zones, pavement that has been milled will be restored to the condition prior to the installation prior to final acceptance of the project.

~~Short term Rumble Strips~~Temporary short-term Rumble Strips

Support. The temporary short-term rumble strips are made to be portable and stable, without using adhesive or other anchoring. They are thicker, wider and heavier than temporary long-term rumble strips~~,~~ but can be easily moved with the work zone operation. Due to their weight, take appropriate caution when ~~should be taken when~~ handling temporary short-term rumble strips by using proper ~~lifting~~ techniques.

Standard. A set of temporary short-term rumble strips shall consist of 3 strips spaced as per Figure 616.6.87.1 and Figure 616.6.87.2 or per manufacturer's recommendation, whichever is longer. ~~minimum of 10 ft. on center~~.

616.6.87.1 Temporary Rumble Strips for Contract Work Zones

Standard. Any work zone, including Job Order Contracts (JOCs), on the three roadway types listed below and having a duration of 60 minutes or longer shall use temporary rumble strips. Depending on the work zone duration and type, one of the following temporary rumble strip options shall be used:

- Temporary long-term rumble strips shall be used in stationary day-time or night-time work zones with a duration of 60 minutes or more when a lane(s) are impacted.
  OR
- Temporary short-term rumble strips shall be used in stationary day-time work zones with a duration of 60 minutes but less than 12 hours when a lane(s) are impacted.

Unless roadway conditions in relation to the guidance in Article 616.6.87.4 allow otherwise, temporary rumble strips shall be used in work zones lasting 60 minutes or longer and on the following roadways:

- Divided roadways, posted 55 mph and greater
- Shared four-lane roadways
- Two-way, two-lane roadways, posted 60 mph and greater
- Consider temporary rumble strips on all other roadways

If temporary rumble strips are omitted as directed by this standard, the decision with explanation of why, shall be documented in one of the following ways:

- Design Exception with District and Division Engineer Concurrence.
- Change Order with District and Division Engineer Concurrence.

Support. When temporary long-term or temporary short-term rumble strips are included in projects performed by contractors, Job Special Provisions (JSPs) for each type of temporary rumble strip used is required. Additional information, including maintenance, repair, and monitoring of temporary rumble strips, can be found in the following JSPs:

Temporary long-term rumble strips: http://spexternalsignin/sites/de/JSP/JSP1304.doc

Temporary short-term rumble strips: http://spexternalsignin/sites/de/JSP/JSP1305.doc

616.6.87.2 Temporary Rumble Strips for Maintenance Operation Work Zones

Guidance. Regardless of duration or type of stationary maintenance operation being performed, the use of temporary long-term or short-term rumble strips in stationary work zones are encouraged.

Standard. Any Bridge Maintenance work zone, on the three roadway types listed below, having a continuous duration of more than 3 days shall use temporary long-term rumble strips.

Unless roadway conditions in relation to the guidance in Article 616.6.87.4 allow otherwise, temporary rumble strips shall be used in work zones lasting 60 minutes or longer and on the following roadways:

- Divided roadways, posted 55 mph and greater
- Shared four-lane roadways
- Two-way, two-lane roadways, posted 60 mph and greater
- Consider temporary rumble strips on all other roadways

If temporary rumble strips are omitted from a Bridge Maintenance work zone, as directed by this standard, the decision with explanation why, shall be documented in the following way:

- For Bridge Maintenance operations, written documentation (in email form) to the District Engineer and Maintenance Division Director for concurrence.

Support: Additional information, including maintenance, repair, and monitoring of temporary rumble strips, can be found in the following complete JSPs:

Temporary long-term rumble strips: http://spexternalsignin/sites/de/JSP/JSP1304.doc

Temporary short-term rumble strips: http://spexternalsignin/sites/de/JSP/JSP1305.doc

Standard. Information in the temporary long-term and temporary short-term rumble strip JSPs, that pertains to Maintenance work zones, is as follows:

Temporary Long-term Rumble Strips:

- Temporary long-term rumble strips shall be 10 feet to 12 feet in length, fabricated from a polymer material, and be orange in color.
- Temporary long-term rumble strips shall have a minimum width of 4 inches, but no greater than 6 inches. The long-term rumble strips shall have a minimum thickness of 0.25 inch, but no greater than 0.50 inch.
- Temporary long-term rumble strips shall have a pre-applied adhesive backing for securing to the asphalt or concrete roadway surface.
- Temporary long-term rumble strips layout and spacing shall be in accordance with Figure 616.6.87.1 and Figure 616.6.87.2 or per manufacturer's recommendation, whichever is longer. The temporary long-term rumble strips shall be installed and removed in accordance with manufacturer's recommendation. The temporary long-term rumble strips shall be monitored and repaired, and maintained if necessary until the temporary long-term rumble strips are removed.
- Each set shall consist of 5 individual strips spaced 10 to 12 feet on center.
- The temporary long-term rumble strips removal process shall not damage the roadway surface. If any damage occurs to the pavement during the removal of long-

term rumble strips, the damaged pavement will be replaced or repaired by Maintenance.

Temporary Short-term Rumble Strips:

- Temporary short-term rumble strips shall be 10 to 12 feet in length, minimum of 8 inches wide, ¾ to 1¼ inch thick, fabricated from a polymer material, and orange in color.
- Temporary short-term rumble strips shall not curl or deform across the width of the strip, maintaining its rigidity.
- Each set shall consist of 3 individual strips spanning a single lane, spaced in accordance with the plans or as directed by the engineer. Temporary short-term rumble strips layout and spacing shall be in accordance with Figure 616.6.87.1 and Figure 616.6.87.2 or per manufacturer's recommendation, whichever is longer. Temporary short-term rumble strips shall be installed and removed in accordance with manufacturer's recommendation.
- Maintenance shall monitor, maintain alignment, and repair if needed the short-term rumble strips during the duration of the work zone. Temporary short-term rumble strips shall not be placed on roadways when workers are not present.
- Temporary short-term rumble strips shall not extend onto the shoulder without the approval of the District Maintenance Engineer (for Maintenance operations).

616.6.87.4 Placement of Temporary Rumble Strips for Contract and Maintenance Work Zones

Guidance. Generally, temporary rumble strips will be placed before the feature requiring attention (e.g., merge, lane shift, reduced speed) giving the motorist enough time to act safely. The recommended distance before the feature should be referenced or shown on the plans or figures. The location should be adjusted when needed to comply with the guidance below or based on performance observations.

Standard. Temporary rumble strips shall be placed perpendicular to traffic.

~~**Support**~~**Guidance.** The following information is applicable to both temporary long-term and temporary short-term rumble strips, except where noted.

- Temporary rumble strip placement should be reviewed and consideration given to geometric conditions prior to placement.
- Preferred placement of temporary rumble strips is on tangent roadway segments. Avoid placement at or just beyond a vertical curve~~steep~~ crest.
- Temporary rumble strips work best when ~~they are~~ in complete contact with the roadway surface and~~,~~ therefore ~~they~~ should not be used on heavily rutted roadways or on roadways with loose material.
- Temporary rumble strips should not be placed through marked pedestrian crossings, marked pedestrian paths, or on marked bicycle routes. Engineering judgment should be used to avoid placement in these areas. ~~When temporary rumble strips are placed on roadways used by bicyclists, attempts should be made to provide a clear path of 4 ft. at each edge of the roadway or on each paved shoulder. One method to provide the clear~~

path is to offset the temporary rumble strip from the center of the lane. Four ft. of shoulder should be available to bicyclists when applicable.

- **Guidance.** Temporary rumble strips that are too long for the lane width may overhang onto a shoulder if approved by the engineer. Four ft. of shoulder should be available to bicyclists when applicable.
- Temporary rumble strips should not be placed where routine braking is expected on the rumble strip. Routine braking on the strips may cause movement of the strips and require more effort than otherwise would be needed to keep them in place. Relocating the rumble strips may be necessary if movement persists.
- Multiple sets, of both temporary long-term and temporary short-term rumble strips can be used to get the attention of drivers.

Standard. Temporary rumble strips shall be periodically checked for movement and corrected when needed. The frequency of checks shall be sufficient to limit the negative impacts and perceptions associated with misaligned rumble strips. Checks shall become more frequent with poor performance.

Guidance. In order to monitor rumble strips for possible shifting, temporary Sshort- -term rumble strips should be used when workers are present to monitor the rumble strips for possible shifting.

Temporary rumble strips should not be placed where routine braking is expected on the rumble strip. Routine braking on the strips may cause movement of the strips and require more effort than otherwise would be needed to keep them in place; relocating the rumble strips may be necessary if movement persists.

SECTION 902

TRAFFIC SIGNALS

902.1 Description. This work shall consist of furnishing and installing traffic signal equipment and material as shown on the plans. All work shall be in accordance with NEC, NESC and NEMA standards.

902.2 General. Existing traffic signals shall be maintained in effective operation by the contractor, except for shutdowns approved by the engineer for alterations or final removal. After any modifications have been made or after work is begun on an existing signal installation, the contractor shall maintain the signals in accordance with Sec 902.21. The contractor shall notify local traffic control agencies at least two days, excluding weekends and state holidays, prior to operational shutdown of any traffic signal. The contractor shall notify the engineer at least two days, excluding weekends and state holidays, prior to disconnecting existing vehicle or pedestrian detection. All traffic signal equipment that the contractor uses or installs on the project, whether furnished by the Commission or the contractor, either on a temporary or permanent basis, shall, upon installation or upon initial use by the contractor, be operated and maintained by the contractor until the project is complete and accepted. Any malfunction of an existing signal installation resulting from the contractor's operation, regardless of the nature of the work, shall be corrected at the contractor's expense in accordance with Sec 902.21. Signal timing will be provided to the contractor by the engineer. Programming of the controller will be the responsibility of the contractor, except when waived by the engineer. If any adjustments are required to the operation of an existing signal installation due to the contractor's operation, the contractor shall provide a minimum of two working days notice to the engineer.

902.3 Temporary Traffic Signals. Installation of temporary traffic signals shall consist of furnishing and installing poles for span wire signals, span and tether wires, control and power cable, power supply and connection to a power source, the controller, signal heads, detectors, luminaires, and all mounting hardware, unless specified otherwise. Maintenance of the installation and all other equipment and material necessary to provide the temporary installation will be the responsibility of the contractor. If the temporary traffic signal installation is not shown on the plans, the contractor shall submit a plan to the engineer for approval prior to the installation of temporary signals. Any existing or Commission furnished signal equipment to be used in the temporary signal shall be shown on the temporary signal plan. Temporary signals shall have the signal heads covered until placed in operation. A minimum of two signal faces, in accordance with Sec 1092, shall be oriented toward each street approach positioned a minimum of 8 feet apart, center to center, and a minimum of 16 feet above the surface of the traveled way to the bottom of the backplate. Existing signals shall not be taken out of operation until the temporary signals are ready for operation and approved by the engineer. A flashing operation shall be used during shutdown of the temporary signals.

902.3.1 All temporary signal equipment shall be removed by the contractor after the new installation is in operation, or as directed by the engineer. Contractor furnished equipment that will become the property of the Commission shall be of new stock and shall meet all applicable specifications. Contractor furnished equipment that will remain the property of the contractor may be new or used. Commission owned equipment will remain the property of the Commission, unless specified otherwise, and shall be disposed of as shown on the plans or as directed by the engineer.

902.3.2 The contractor shall pay all electrical costs incurred by operation of the temporary signals and new signal systems until the signals are accepted for maintenance. For temporary signal installations where an existing signal power supply is not available, the contractor shall make any necessary arrangements to provide power to the temporary signals. Portable generators shall not be used to provide power to temporary signals. No direct payment will be made for power costs. All wire and cable for temporary signals shall be suspended overhead with proper clearance or buried a minimum of 18 inches underground.

902.3.3 Temporary signal installations shall be installed to meet the construction schedule. The contractor shall provide a minimum of two working days notice to the engineer prior to the signal turn-on. The contractor shall maintain the signals in proper operating condition, in accordance with Sec 902.21. Any damage to the traffic signal installation from any cause whatsoever shall be repaired by the contractor at the contractor's expense.

902.4 Material. All material shall be in accordance with Division 1000, Material Details, and specifically as follows:

Item	Section/Specification
Concrete	501
Galvanized Coating of Traffic Signal Posts and Appurtenances	1080
High-Strength Bolts, Nuts and Washers	712
Carbon Steel Bolts, Nuts and Washers	712
Structural Low Alloy Steel	712
Luminaires	901
Signs	903
Reinforcing Steel for Concrete	1036
Wood Poles for Power Supplies and Temporary Installations	1050
Concrete Sealer	1053
Concrete Curing Material	1055
Electrical Conduit	1060
Electrical Conductors	1061
Pull and Junction Boxes	1062
Fiber Optic Interconnect	1092
Signal Equipment	1092
High-Strength Anchor Bolts and Nuts	ASTM F1554, Grade 55
Stainless Steel Bolts, Screws and Washers	ASTM A193, Grades B5, B6, B7 or B16
Stainless Steel Nuts	ASTM A194

902.4.1 Anchor bolts, bolts, nuts and washers, except stainless steel, shall be galvanized in accordance with AASHTO M 232 (ASTM A153), Class C or mechanically galvanized in accordance with ASTM B695, Class 55. Except for anchor bolts, galvanizing thickness shall not exceed 6 mils. For anchor bolts and nuts, and for high strength bolts and nuts, except those in accordance with ASTM F3125 Grade A325, the contractor shall furnish to the engineer a test report certified to be the last completed set of mechanical tests for each size in each shipment. For high strength bolts and nuts in accordance with ASTM F3125 Grade A325, the contractor shall furnish a copy of the manufacturer's inspection test report for each production lot or shipping lot furnished to the engineer and shall certify the bolts furnished are in accordance with the requirements specified. Bolts and nuts specified to meet ASTM A307 shall be accompanied by a manufacturer's statement that the bolts and nuts were manufactured in accordance with ASTM A307.

902.4.2 Concrete. Concrete shall be of the class specified in the contract. Material, proportioning, mixing, slump and transporting of concrete shall be in accordance with Sec 501 for the specific class specified. Concrete shall be placed, finished and cured in accordance with Sec 703.

902.4.3 Equipment and material shall be of new stock unless the contract provides for relocation of existing units or use of units furnished by others. New equipment and material shall be the product of reputable manufacturers, shall be in accordance with Caltrans 170 Specifications, ICEA, IMSA, ITE, MUTCD, NEMA, RETMA, NEC and the regulations of the National Board of Fire Underwriters, as applicable, and shall meet the approval of the engineer.

902.4.4 The configuration and installation of equipment mounted on substation and service poles shall be in accordance with the requirements of the utility company or municipality furnishing electrical power.

902.4.5 The Commission will include Form D-15 in the Electronic Deliverables listing the lighting and signal equipment to be installed. The contractor shall complete the list by writing in the name of the equipment manufacturer and catalog number of each item listed. A list of preapproved equipment and material is available on the MoDOT web site. For each category of the preapproved list, only those items listed under each category of the latest revision will be accepted for use. All other equipment and material to be installed that does not fall under a category on the preapproved list shall be in accordance with Sec 902.4. A completed list shall be submitted electronically to the engineer and shall be approved in writing before items are installed. Approval of the items on the list will not relieve the contractor of responsibility for satisfactory performance of the installation.

902.5 Signal Heads. Each signal head of one or more signal faces shall be conventional or, if designated on the plans, optically limiting. The contractor may furnish aluminum or polycarbonate signal heads. The position of signal indications shall be as specified in the contract. Each traffic signal face shall consist of a number of identical signal section housings rigidly fastened together. Signal heads shall not be painted in the field.

902.5.1 Housing, Door and Visor. If existing housings are to be combined with new housings, the new housings shall be adaptable to the existing.

902.5.2 Louvers. Louvers, if specified in the contract, shall be installed in a tunnel visor with the fins or baffles in a vertical position.

902.5.3 Hardware. Fittings shall be secured to the signal housing by a closed threaded nipple and hex nut. Cast nipples shall not be used.

902.5.4 Backplates. Stainless steel bolts, nuts and flat washers shall be used to fasten the backplate to the head. Bolt lengths shall be selected to not interfere with maintenance operations. Any connection to the top of any signal section shall be watertight.

902.5.5 Optically Limiting Signal Heads. The signal section shall be a self-contained assembly consisting of an optical unit, section housing, housing door, terminal block and necessary gaskets to ensure a weatherproof unit. The optically limiting signal head shall be capable of separate mounting or inclusion in a signal face containing two or more signal sections. If existing housings are to be combined with new housings, the new housings shall be adaptable to the existing. Each signal section shall be installed and directed and the optical limiter masked in accordance with manufacturer's recommendations to provide indications in accordance with the plans or as directed by the engineer.

902.5.6 Painting and Finishing. All metal parts reused for modification of a signal installation shall be painted in accordance with the requirements for new material. If the painted surface of any equipment is damaged, the surface shall be repaired to the satisfaction of the engineer.

902.6 Pedestrian.

902.6.1 Accessible Pedestrian Signal (APS). This work shall consist of furnishing, installing and placing into operation an APS that assist the pedestrian who has visual or physical disabilities in activating the pedestrian phase. APS shall be installed as part of a pushbutton assembly and shall have both audible and vibrotactile walk indications. APS shall be installed per the manufacturer's recommendations and specifications. Cable runs shall be continuous and unspliced.

902.6.1.1 Vibrotactile. The vibrotactile walk indications shall be provided by a tactile arrow on the pushbutton that vibrates during the walk interval and shall be aligned parallel to the direction of travel on the associated crosswalk.

902.6.1.2 Audible. The audible walk indication shall be audible from the beginning of the associated crosswalk.

902.6.1.2.1 Audible Locator Tone. Locator tone tells the pedestrian that the intersection is equipped with APS and where it is. Pushbutton locator tones shall have duration of 0.15 seconds or less and shall repeat at 1-second intervals. Pushbutton locator tones shall be intensity responsive to ambient sound and be audible 6 to 12 feet from the pushbutton, or to the building line, whichever is less. The locator tone shall operate during the DON'T WALK and flashing DON'T WALK intervals only and shall be deactivated when the pedestrian signal is not operative.

902.6.1.2.2 Wait Message. Acknowledge tone tells the pedestrian they have placed a call and informational message tells the pedestrian to "Wait". If the accessible pedestrian signals are within 10 feet of each other the verbal wait message "Wait to cross" street name at intersecting street name shall be used.

902.6.1.2.3 Walk Message. The verbal messages shall provide a clear message that the walk interval is in effect. If the accessible pedestrian signals are within 10 feet of each other, the audio tone feature shall not be used. The verbal message is provided at regular intervals throughout the timing of the walk interval shall be the term "walk sign," which will be followed by the name of the street to be crossed.

902.6.1.2.4 Volume. Automatic volume adjustment in response to ambient traffic sound level will be provided up to a maximum volume of 100 dB. The units shall be responsive to ambient noise level changes up to no more than 5 dB louder than ambient sound.

902.7~~6~~ Signs. Signs for signal installations, including all material required for sign mounting, shall be furnished by the contractor. Signs shall be manufactured in accordance with Sec 903, and mounted as shown on the plans.

902.8~~7~~ Posts and Mast Arms. Prior to installation, manufacturer and drawing numbers shall be submitted by the contractor to the engineer for approval in writing. Four copies of applicable pre-approved drawings shall be supplied with the poles.

902.9~~8~~ Span Wire Assemblies. Span wire assemblies shall include 3/8-inch steel messenger wire, 1/4-inch tether wire, guy wire, all bolts, nuts, washers, clamps, cable straps, and other appurtenances shown on the plans or necessary for proper installation. Messenger wire shall be Class A galvanized, high-strength grade, seven-wire strand in accordance with ASTM A 475. Tether wire shall be seven-wire high-strength steel cable. Splicing of messenger and tether wires will not be permitted. Clamps shall be fabricated from low alloy steel. Steel posts for span wire assemblies shall have wire inlets and cable guides with 1-1/2 inch raintight insulator bushings and other features specified in the contract, and shall be in accordance with Sec 1092. Wood poles and steel posts for span wire assemblies shall be as specified in the contract and as shown on the plans. Luminaire bracket arms, if specified, will be at the contractor's expense. Conduit, junction boxes, service entrance caps, attachment hardware or other appurtenances on the wood poles or steel posts as shown on the plans will be at the contractor's expense.

902.10~~9~~ Power Supply Assembly. The power supply assembly shall be in accordance with Sec 901.

902.1~~0~~1 Luminaire Control. If luminaires are specified as part of the signal conduit and wiring system on the signal posts or on separate light poles, a lighting control cabinet shall be provided and installed as shown on the plans.

902.12~~1~~ Traffic Controller Assemblies.

902.12~~1~~.1 Wiring. All wiring shall be insulated, stranded copper wire and shall be neatly bundled and secured with plastic cable ties. For double controller cabinets, all wiring for each intersection shall be terminated in the same compartment of the cabinet as the signal controller for that intersection. Incoming field circuits shall be routed horizontally from the conduit to the back of the cabinet, then vertically to the terminal block. All terminals shall be labeled and not be visibly obstructed. All field leads shall be identified by means of round aluminum identification tags with a minimum thickness of 0.1 mil attached to the cables with a copper wire to correspond with the plans. The outgoing signal circuits shall be of the same polarity as the line side of the power supply, and the common return of the signal circuits shall be of the same polarity as the ground side of the power supply. The power supply shall be provided through three single conductor cables. The ground side of the power supply shall be carried throughout the controller in a continuous circuit, and shall be secured to a ground bus bar in an approved manner. All field conductors shall be terminated in the controller cabinet.

902.12~~1~~.2 Back Panel Wiring. All wiring on the backside of the controller back panel shall be neatly bundled and secured with plastic cable ties. Any multi-conductor cable between the controller or auxiliary equipment and the back panel shall be contained in an expandable braided sleeve. All wiring shall be discrete insulated wires and shall be soldered directly to lugs on the back of terminal blocks and sockets. Printed circuit boards shall not be used.

902.13~~2~~ Interconnect Types. The interconnect type shall be as shown on the plans.

902.13~~2~~.1 Programming. The contractor shall install the system software in all computers to be used with the system as directed by the engineer, and shall program the local intersection controllers and the system master with all operating parameters and timing provided by the engineer.

902.1~~2~~3.2 Telephone Cable and Conduit. The telephone connection for the closed loop system will be coordinated by the engineer. The contractor shall contact the engineer a minimum of two weeks prior to the installation of the power supply assembly. The telephone network interface block shall be located on the power supply assembly. Two separate one-inch rigid conduits shall be installed for the telephone cable and shall be encased in the concrete

base of the power supply and the base of the controller cabinet. One conduit shall be for the telephone cable from the telephone company pedestal to the power supply assembly, and the other conduit shall be from the power supply to the controller cabinet. Trenched telephone conduit may be installed parallel in the same trench as the conduit containing power cable. If telephone company cables cannot be installed at the same time as the telephone conduit, then a nylon pull string shall be installed in the conduit. Telephone cables shall not be exposed, except to facilitate connection to the telephone interface block. Telephone cables shall not be installed in the same conduit as the power cables. Any exposed conduit openings shall be filled with pliable duct sealant. The contractor shall supply the telephone cable between the telephone interface on the power supply and the telephone interface in the controller cabinet. The cable shall be a four-twisted-pair, shielded cable in accordance with local telephone company recommendations.

902.1~~2~~3.3 Closed Loop Interconnect. This work shall consist of furnishing, installing and testing a complete arterial master closed loop system comprised of intersections as shown on the plans. The system shall include all equipment listed or shown on the plans, and shall include any incidental items necessary for the satisfactory operation of the system.

902.13~~2~~.4 Twisted Pair Interconnect. This work shall consist of furnishing, installing and testing a complete twisted pair interconnect system comprised of intersections shown on the plans. The twisted pair system shall include all equipment listed or shown on the plans and shall include any incidental items necessary for the satisfactory operation of the system.

902.13~~2~~.4.1 Twisted Pair Interconnect Cable. Splices will not be permitted between controllers.

902.13~~2~~.4.2 Twisted Pair Interconnect Installation. Twisted pair interconnect cable and the system shall be installed in accordance with the manufacturer's recommendations and as shown on the plans.

902.1~~2~~3.5 Wireless Telemetry Interconnect System. This work shall consist of furnishing, installing and testing a complete wireless interconnect system comprised of intersections shown on the plans. The wireless interconnect system shall include all equipment listed or shown on the plans and shall include any incidental items necessary for the satisfactory operation of the system. Telemetry radios and antennas shall be installed and set up in accordance with the plans, these specifications, and the manufacturer's recommendations for a fully functioning system.

902.13~~2~~.5.1 Antenna System. Antennas shall be positioned to receive maximum signal strength by adjusting the antenna direction while monitoring signal strength through the telemetry radio. Antenna mounts shall be securely fastened to the poles as shown on the plans. Antenna cable shall be installed inside metal poles and conduit as shown on the plans. External cable on poles shall not exceed 3 feet unless approved by the engineer. Approved external cable runs exceeding 3 feet shall be secured using manufacturer specified hangers at a maximum spacing of 3 feet. Cable terminations shall be made in accordance with the manufacturer's recommendations. Connectors shall be installed after cable has been pulled into place. Connectors outside of cabinets shall be sealed in accordance with the manufacturer's recommendations. Any holes made in metal poles shall be deburred and protected with grommets. Drip loops shall be provided between the antenna connector and the metal pole entrance or first pole clamp. Cable bends shall be in accordance with the manufacturer's specified bending radius. Antenna cable shall be continuous without splice between the antenna and the antenna surge protector in the controller cabinet.

902.1~~2~~3.5.2 Grounding. A separate ground rod shall be installed for each pole with an antenna. The ground rod shall be as shown on the plans and shall be installed in a pull box

adjacent to the pole, where available. Ground wires shall be No. 2 AWG minimum, and shall be securely attached to the ground rod by cadwelding. The ground wire shall be attached to the ground lug in metal poles. For wood pole mounting, the ground wire shall be attached directly to the antenna mount and securely fastened to the pole with wire clamps at 3 feet maximum spacing. Copper compression lugs shall be used to attach the ground wire to ground lugs in poles or on antenna mounts.

902.12~~2~~3.6 Fiber Optic Interconnect System. All system equipment shall be installed in accordance with the plans, standard specifications and the manufacturer's recommendations, and shall result in a fully functioning system.

902.12~~2~~3.6.1 Splice Cabinet. The splice cabinet will be required only when shown on the plans. The splice cabinet shall be installed adjacent to controller cabinets and shall be a Type 336 cabinet with an Electronic Industries Alliance (EIA) 19-inch rack cage and a fiber distribution unit. Splice cabinets shall be installed on a separate concrete base as shown on the plans and in accordance with Sec 902.15.

902.12~~2~~3.6.2 Fiber Optic Closed Loop System Components. The principal components of the fiber optic closed loop system, including but not limited to, the local intersection controller(s), the on-street system master and the system software, shall be supplied by the contractor and shall be compatible with any existing systems.

902.12~~2~~3.6.2.1 System Master Controller. The system master controller shall consist of a fiber-ready NEMA or Type 170 controller as shown on the plans, prom module, Type 170 only, and all necessary connectors and cables. The system master shall include a fiber optic data link. The system master controller shall be installed in the local controller cabinet designated on the plans. A separate cabinet will not be required.

902.12~~2~~3.6.2.2 Local Controller Assembly. The local controller assembly shall consist of a fiber-ready NEMA or Type 170 actuated traffic controller assembly in accordance with Sec 1092 and the plans. The local controller shall include a fiber optic data link.

902.12~~2~~3.6.3. Fiber Optic Interconnect Cable.

902.12~~2~~3.6.3.1 The contractor shall provide trained and experienced personnel to supervise the installation of the fiber optic cable. Fiber optic cable shall be installed by trained personnel having a minimum of one-year current installation experience in fiber optic systems. The contractor shall provide a certification for each person installing fiber cable. The certification shall show the amount of experience, the company or companies where experience was obtained and fiber optic training received. Methods of fiber optic installation, connections, splicing or other types of work with fiber optic cable shall be approved by the engineer before implementation by the contractor.

902.12~~2~~3.6.3.2 Installation of the fiber optic cable shall also be in accordance with the manufacturer's recommendations and practices. If the manufacturer's recommendations or practices appear to conflict with this specification, the matter shall be brought to the attention of the engineer for resolution.

902.12~~2~~3.6.3.3 Fiber optic interconnect cable shall be installed in continuous runs for each system, in conduit, pull boxes, splice cabinets or traffic signal controller cabinets. Splices outside of the splice cabinets or controller cabinets will not be permitted. Only those fiber tubes to be accessed in splice cabinets, controller cabinets and distribution units shall be opened, and only active fibers in that tube or tubes shall be cut and spliced. The manufacturer's recommended procedures for a mid-span access shall be followed. Continuous fiber tubes shall be neatly coiled, ensuring that the minimum bend radii are not violated, and

shall be organized in the fiber distribution unit. The continuous fibers in the fiber tube(s) that have been opened shall be coiled in the appropriate splice tray. The fibers to be spliced shall be connected by fusion splicing methods with a maximum loss of 0.10 decibels, and the splice shall be held and secured in a fusion splice organizer on the trays. The dark fibers in the 6-fiber cable shall be secured to the splice organizer on the appropriate tray, but will not need to be spliced.

902.12~~2~~3.6.3.4 The contractor shall document the location and termination of all fibers in the appropriate cabinet. Written documentation shall be left in the cabinet and one copy shall be provided to the engineer.

902.12~~2~~3.6.3.5 Each end of the interconnect cable shall be sealed with a manufacturer approved end cap or pulling grip for use during installation. These caps or grips shall be removed only after complete installation of the cable and for the cable acceptance testing. End caps shall be installed to remain in place where fibers are not to be terminated.

902.12~~2~~3.6.3.6 The minimum bending radius and the maximum pulling force of the interconnect cable, as defined by the fiber optic cable manufacturer, shall not be exceeded during installation. Pulling of the cable shall be hand assisted at each pull box, splice cabinet and controller cabinet. The cable shall not be kinked, crushed or forced around a sharp corner. Pulling equipment may be used, however, all pulling equipment and hardware shall maintain the cable's minimum bend radius. Equipment that may contact the cable, such as sheaves, bending shoes, capstans and quadrant blocks, shall be designed for use with fiber optics. Where pulling equipment such as a winch is used, cable tension shall be continuously monitored. This may include use of a winch with a calibrated maximum tension or a dynamometer or in-line tensiometer.

902.12~~2~~3.6.3.7 If a lubricant is used, the lubricant shall be of the water based type as approved by the cable manufacture and shall be compatible with the pre-lubricated polyvinyl chloride conduit. Prior to use, the lubricant type and manufacturer’s name shall be supplied to the engineer for approval.

902.12~~2~~3.6.3.8 Sufficient slack shall be left at each splice cabinet and controller cabinet to allow proper termination. Each pull box adjacent to a signal cabinet or a splice cabinet shall contain a minimum of 60 feet of coiled cable. Mid-block pull boxes shall contain a minimum of 10 feet of coiled cable. Stored cable shall be neatly coiled as per the manufacturer's minimum bending radius specification. Where the size of the box precludes the coiling of cable above the minimum bending radius, the cable shall pass straight through the pull box.

902.12~~2~~3.6.3.9 The conduit containing only fiber optic interconnect cable shall be polyvinyl chloride or high density polyethylene conduit in accordance with Sec 1060 and shall be orange in color. A No. 14 AWG stranded copper tracer wire or a pull tape with a tracer wire shall be installed in the conduit.

902.12~~2~~3.6.3.10 At each pull box and controller cabinet, the interconnect cable shall be visibly marked "Caution - Fiber Optic Cable" by self-adhesive, weatherproof tags.

902.12~~2~~3.6.4 Testing. After the fiber optic cable installation, each fiber in each section shall be tested for attenuation and continuity, as a minimum. The contractor shall provide all personnel, equipment, instrumentation and supplies necessary to perform all testing. Any sections that fail the testing shall be replaced at the contractor’s expense, and retested. All testing shall be performed in an accepted manner and in accordance with the testing equipment manufacturer's recommendations. All data shall be recorded and submitted to the engineer.

902.1~~2~~3.6.4.1 Attenuation. The end-to-end attenuation shall be measured for each link after installation by insertion loss testing.

902.1~~2~~3.6.4.1.1 The launch cable shall be connected to the light source and the receive cable to the power meter. The two reference cables shall then be connected via a termination hub. A reference power reading (P1) shall then be taken and recorded.

902.1~~2~~3.6.4.1.2 The system link to be tested shall then be inserted between the launch and receive cables using two termination hubs. A test power reading (P2) shall then be taken and recorded.

902.1~~2~~3.6.4.1.3 The link attenuation (A) in decibels shall be recorded as the mathematical difference between the reference power (P1) and the test power (P2).

902.1~~2~~3.6.4.1.4 Insertion loss testing shall be performed in both directions along the link. The direction of the test shall be recorded in the documentation.

902.1~~2~~3.6.4.2 Transmitter/Receiver Power Levels. The output power levels at the network hardware transmitters and receivers shall be measured and recorded for system documentation. The power meter shall be connected to the transmitter side of the equipment with a system jumper. The transmit power level shall then be read and recorded. The transmitter shall then be re-connected to the cable link and the power meter connected to the receiver side of the equipment. The receiver power level shall then be read and recorded.

902.1~~2~~3.6.4.3 Continuity. Continuity tests shall be used to determine whether a test or system jumper does or does not pass light. A continuity test shall also be used to assure the fibers have not been crossed over in the jumper and to assure that the transmit fiber goes to the receiver fiber. To perform the continuity test, a high-intensity flashlight shall be aimed into the connector at one end, while an observer watches for a flicker of light at the other end.

902.1~~2~~3.6.4.4 Optical Time Domain Reflectometer. An Optical Time Domain Reflectometer (OTDR) shall be used to evaluate the quality and length of cable reels prior to use. The fiber loss in decibels/km and the length of each reel shall be recorded in the documentation. The maximum attenuation of the cable shall be 3.5 decibels/km nominal, measured at room temperature at 850 nanometers, equivalent for single mode. A hard copy of OTDR signature traces for all system links shall be made and provided in the documentation.

902.1~~2~~3.7 System Acceptance Test. In addition to the standard testing requirements, the contractor shall successfully complete and document a four-part system acceptance test, in the presence of the engineer, unless approved otherwise, as follows:

(a) System Master Acceptance Test

(b) Office Computer Acceptance Test

(c) Notebook Computer Acceptance Test

(d) System Operational Test

902.1~~2~~3.7.1 System Master Acceptance Test. The system master acceptance test shall be conducted after all traffic signal improvements and the initial eight-hour training session has been completed. The test shall include the following:

(a) The contractor shall simulate a fault at a local controller and verify that the fault is recorded in the permanent log in the master and that the master automatically dials the office computer and transmits the same information.

(b) The contractor shall verify that scheduled timing plans change based on time of day.

(c) The contractor shall change one offset at a local controller and verify the change has been made and implemented at the local controller.

(d) The contractor shall verify a traffic responsive plan change is made at the appropriate time. This shall be demonstrated with simulated detector data.

(e) The contractor shall verify all programming data for the master and all locals can be downloaded/uploaded via the front panel RS-232 connection on the system master.

902.1~~2~~3.7.2 Office Computer Acceptance Test. The office computer acceptance test shall be conducted after successful completion of the system master acceptance test and shall include the following:

(a) A simulated fault at a local controller shall be recorded in the office computer log. The contractor shall verify the entry by printing a log report.

(b) The contractor shall reschedule a timing plan change and verify that the event happens at the new time.

(c) The contractor shall make a timing plan change and verify the change has been made at the local controller.

(d) The contractor shall print a report that shows all plan changes for the previous 24 hours.

(e) The contractor shall print a report showing volume and occupancy values from all system detectors for the previous 24 hours.

(f) The contractor shall call up a real-time intersection display.

902.1~~2~~3.7.3 Notebook Computer Acceptance Test. The notebook computer acceptance test shall consist of the same tests performed for the office computer acceptance test, except all reports shall be displayed on the screen. This test shall be conducted only after the office computer acceptance test has been successfully completed. In addition, a complete local controller database shall be uploaded and downloaded from one controller to another using only the notebook computer, the cable provided and the two controllers.

902.1~~2~~3.7.4 System Operational Test. The system operational test shall be conducted after the system master, office computer and notebook computer acceptance tests have been successfully completed. The system operational test shall consist of a 30-day operational period, during which system failures are recorded. Any failure or malfunction of equipment during the test period shall be corrected at the contractor's expense, and the signal or system shall be tested for an additional 30 consecutive day period. This procedure shall be repeated until the signal equipment has operated to the engineer's satisfaction for 30 consecutive days. System failures will be defined, as a minimum:

(a) Local intersection controller failing to respond to the system master.

(b) System master failing to respond to either the office or notebook computer.

(c) A system detector failure.

902.12~~2~~3.8 Thirty-Day System Operational Test. The 30-day test shall replace the 15-day test period outlined in Sec 902.21. Liquidated damages will only be accumulated between the end of working days and the start of the final 30 consecutive day test period.

902.13~~2~~.9 Documentation. Complete system documentation shall be provided. Documentation, as a minimum, shall include the results of all testing and shall be recorded along with date of test, name of person performing the test, brand name, model number, serial number of equipment used during test, and any other pertinent information and data.

902.13~~4~~4 Detectors.

902.14~~3~~.1 Induction Detector Probes. Detector probes installed under bridge decks shall be protected by completely encapsulating the probe in a conduit system. Probes shall be oriented such that the detection zone is above the bridge deck, and shall be installed in gasketed junction boxes anchored to the bottom of the deck. The junction boxes shall have a minimum size of 6 x 6 x 4 inches and the probes shall be rigidly anchored in the box. The probes shall be no more than 18 inches below the top of the bridge deck. Conduit shall be sized such that the probe and cable can be pulled through the conduit. Any conduit bends shall be such that the probe and cable can be pulled through the bend. External conduit on the structure shall be in accordance with Sec 902.16.

902.13~~4~~4.2 Induction Loop Detectors. A slot for the installation of induction loop cable shall be sawed in the pavement as shown on the plans. Slots shall not be sawed until seven days after placement of Portland cement concrete. Each loop shall have a separate lead-in slot to the conduit. A separate conduit shall be installed between the sawed loop slot and the first pull box for each loop. The conduit opening at the end of the lead-in slot shall be at the bottom of the sawed slot. The slot shall be clean. The cable shall be pushed into the slot without damaging the insulation. After the loop cable is spliced to the lead-in cable, and before the slot is sealed, the resistance of the loop and lead-in cable to ground shall be checked. The resistance test shall be performed by the contractor in the presence of the engineer and documented. After a satisfactory test, showing a resistance no less than 10 megaohms, the slot shall be sealed. The conduit opening at the end of the lead-in slot and any drilled conduit holes in the pavement shall be sealed with a pliable duct sealant prior to the application of loop sealant. All sawed slots shall then be sealed with an approved detector loop sealant. All detector cable between the loop and detector amplifier shall be twisted at least three turns per foot.

902.13~~4~~4.3 Microwave and Ultrasonic Detectors. Microwave and ultrasonic detectors shall be mounted at the locations shown on the plans in accordance with manufacturer's recommendations. All wiring shall be continuous and unspliced from the detector unit to the controller. The contractor shall make any necessary adjustments for proper operation of the detector.

902.13~~4~~4.4 Video Detection Systems. This work shall consist of furnishing, installing and placing into operation a vehicle detection system that detects vehicles by processing video images and providing detection outputs to a traffic signal controller. The system shall include all equipment shown on the plans and described in these specifications, and shall include any incidental items necessary for the satisfactory operation and maintenance of the system. The video detection system shall be installed per the manufacturer's recommendations. All cable runs shall be continuous without splice from the cabinet to the camera. If requested by the

engineer, a factory certified representative from the supplier shall be available for on-site assistance for a minimum of one day during installation.

902.13~~3~~4.4.1 Camera. The bottom of the video camera shall be mounted a minimum of 30 feet above the pavement.

902.13~~3~~4.4.2 Extra Service Outlet. A separate grounded service outlet shall be provided in the controller cabinet for supplying power to the video detection system. Use of the grounded service outlet located on the cabinet door will not be permitted.

902.13~~3~~4.4.3 Monitor. The monitor shall be installed to automatically power on when the cabinet door is opened and automatically power off when the cabinet door is closed. A manual on/off switch shall also be provided.

902.13~~3~~4.5 Detector Loop Sealant. Loop sealant shall be proportioned, mixed and installed per the manufacturer's specifications and recommendations. After the loop slots are cut into the pavement, the surface shall be thoroughly cleaned, and all loose debris shall be removed. After application of the sealant, the roadway shall be tack-free and capable of being open to the motoring public within four hours without tracking. Loop sealant shall fully encapsulate the loop wires as shown on the plans. Backer rods shall be placed to ensure a one-inch depth coverage of loops. Excessive overfill will not be permitted.

902.14~~4~~5 Pull and Junction Boxes. Pull and junction boxes shall be installed at locations as shown on the plans. Pull boxes placed in traveled ways, auxiliary lanes, shoulders and low profile islands shall be concrete.

902.14~~4~~5.1 Conduit shall enter the pull box in the side of the box and shall extend a minimum of 2 inches and a maximum of 4 inches as shown on the plans. If it becomes necessary to increase the excavation depth and extend the pull box, no direct payment will be made. The excavated opening outside the pull box shall be wide enough to allow compaction of the backfill material. Cinders, broken concrete, broken rock or other hard or undesirable material shall not be used for backfilling. The backfill material shall be placed in layers not to exceed 6 inches deep, and each layer shall be thoroughly compacted before the next layer is placed. Where preformed pull boxes are used, the holes for the conduit shall be drilled as recommended by the manufacturer. The holes shall be round and no more than 1/2 inch larger than the conduit.

902.14~~4~~5.2 Drains for pull boxes shall be constructed as shown on the plans.

902.14~~4~~5.3 The top surface of all pull boxes shall be flush with surfaced areas and approximately one inch above earth or sodded areas.

902.14~~4~~5.4 If preformed pull boxes are specified, the contractor may use standard concrete pull boxes in lieu of the Class 1 or 2 preformed pull boxes, or the Type A double concrete pull box in lieu of the Class 3 preformed pull boxes. For installations requiring different voltages for lighting and signal applications, the Type B double concrete pull box may be used in lieu of two preformed pull boxes at the contractor's expense. If the Type B double concrete pull box is specified, no substitutions will be permitted.

902.14~~4~~5.5 Class 5 preformed pull boxes shall be in accordance with all requirements in the contract documents. Installation of Class 5 pull boxes shall be as shown on the plans and in accordance with the manufacturer's recommendations.

902.15~~5~~6 Concrete Bases. Excavation for bases shall be made in a neat and workmanlike manner. While concrete is being placed, forms shall be level and sufficiently rigid to prevent

warping or deflection. Concrete shall be Class B or concrete of a commercial mixture in accordance with Sec 501. Conduit, ground rods and anchor bolts shall be held rigidly in place before and during concrete placement. Tops of all bases shall be finished level and the perimeter edged to a radius of 1/2 inch. Exposed surfaces of bases shall be finished in a workmanlike manner as soon as practical after removing forms. Concrete shall be cured in accordance with Sec 703.3.6.3.2 and shall be sealed in accordance with Sec 703.3.8.

902.15~~5~~6.1 Post Bases. Concrete bases for posts shall be in accordance with the dimensions shown on the plans. Metal forms no less than 26 inches high shall be used for all Type A bases. The top 12 inches of Type F bases shall be formed. Reinforcing steel for concrete bases shall be in accordance with Sec 706. Anchor bolts for steel posts and mast arms shall be as shown on the fabricator's approved shop drawings. Conduit shall extend above all post bases a nominal 4 inches.

902.15~~5~~6.2 Controller Bases. Concrete bases for controllers shall be constructed as shown on the plans. Aprons will be considered part of the controller base. A minimum of four anchor bolts shall be used for single controller cabinets and a minimum of six anchor bolts shall be used for double controller cabinets. The size of anchor bolts for controller cabinets shall be as specified by the cabinet manufacturer. A ground rod shall be placed into the ground with a minimum of 8 feet of earth contact as shown on the plans. Bases for double controller cabinets shall have two ground rods, one positioned in each compartment. Conduit shall extend above all controller bases no more than one inch. Bases for double controller cabinets shall have two conduits to the first pull box, one positioned in each compartment. All conduit openings in the controller cabinet or controller cabinet base shall be sealed with a pliable duct sealant in accordance with Sec 901.15 after wiring is completed.

902.16~~6~~7 Conduit Systems. The contractor may furnish and install rigid steel, intermediate metal, polyvinyl chloride (PVC) schedule 40 or high-density polyethylene (HDPE) conduit. Conduit shall be placed a minimum of 18 inches below finished grade and shall slope to a pull box at a minimum rate of 0.5 percent unless otherwise shown on the plans. A change in direction of conduit shall be accomplished by bending the conduit uniformly to a radius that will fit the location, or by the use of standard bends or elbows. The minimum radius of the bend shall be six times the internal diameter of the conduit. Nipples shall be used to eliminate cutting and threading where short lengths of conduit are required. If it becomes necessary to cut and thread steel conduit, exposed threads will not be permitted. All conduit and fittings shall be free from burrs and irregularities. All conduits shall be cleaned and swabbed before cables are installed. All fittings shall be tightly connected to the conduit. Open ends of conduit placed for future use shall be capped or plugged. If approved by the engineer, conduit may be installed either by trenching or pushing; however, payment will be made by the method specified in the contract for that conduit. Functionally equivalent English measure items may be substituted by the contractor for metric items specified or shown on the plans in accordance with Sec 901.15 upon approval from the engineer.

902.16~~6~~7.1 Tracer Wire. All conduits shall contain a bare or green-jacketed No. 14 AWG stranded copper tracer wire. Tracer wire shall not be pulled into the controller cabinet or bases. An additional 6 feet of tracer wire shall be coiled in each pull box. Tracer wire in pull boxes shall be capped, not electrically bonded to any ground wires, labeled "TRACER" and tagged in accordance with Sec 902.19.

902.16~~6~~7.2 Metal Conduit. All metal conduit ends shall be provided with a bushing to protect the cable from abrasion. All metal conduits shall be electrically bonded by conduit clamps and bare No. 6 AWG stranded copper wire. All metal conduits in the controller base shall be electrically bonded to the power company ground.

902.1~~6~~7.3 Polyvinyl Chloride and High-Density Polyethylene Conduit. A bare No. 6 AWG stranded copper ground wire shall be installed in all conduits, except PVC that contains only fiber optic cable, and shall be attached to the ground lug in signal posts, except as otherwise specified in this section. All bare ground wires shall be electrically bonded. All bare ground wires in the controller base shall be electrically bonded to the power company ground.

902.1~~6~~7.4 Conduit in Trench. Trenches shall be excavated to the width and depth necessary for conduit installation. All trenches shall be backfilled as soon as practical after the installation of conduit. Cinders, broken concrete and other hard or objectionable material that might cause mechanical damage to the conduit shall not be used for backfilling within 6 inches of the top of the conduit. The bottom of the trench shall be free of such material before the conduit is placed. Conduit shall not be placed without approval of the trench from the engineer. Backfill material shall be deposited in the trench in layers not exceeding 6 inches deep and each layer shall be compacted to the approximate density of the adjacent material by an approved method before the next layer is placed. Red burial tape imprinted with "CAUTION - BURIED CABLE BELOW" shall be installed in all trenches at approximately one-third to one-half of the depth of the trench. All disturbed areas shall be restored to the satisfaction of the engineer.

902.1~~6~~7.5 Pushed Conduit. If pushed conduit is specified, the conduit shall be installed without disturbing the existing surface. Pushed conduit may be placed by jacking, pushing, boring or other approved means.

902.1~~6~~7.6 Conduit in Median. If conduit in median is specified, the conduit shall be placed on the existing pavement prior to construction of the raised median. If conduit is to be placed in concrete traffic barrier, the conduit shall be held rigidly in place before placement of concrete.

902.1~~6~~7.7 External Conduit on Structure. For existing structures, or if provisions are not made in the plans for providing a conduit raceway in new structures as described in Sec 707, the conduit shall be external conduit on structure. Conduit on structure will include conduit on bridges, retaining walls or other structures, and shall be installed as shown on the plans or as directed by the engineer. The final location of all conduit and junction boxes shall be approved by the engineer before installation begins. Conduit shall not be attached to prestressed concrete girders or prestressed, precast concrete deck panels. The conduit shall be secured to the concrete with clamps at no more than 5-foot intervals. Concrete anchors shall be in accordance with federal specification FF-S-325, Group II, Type 4, Class I, and shall be galvanized in accordance with AASHTO M 232 (ASTM A153), Class C, or ASTM B695, Class 55, or constructed of stainless steel. The minimum embedment in concrete shall be 1 3/4 inches. The supplier shall furnish a manufacturer's certification that the concrete anchors meet the required material and galvanizing specifications. If necessary to anchor the conduit to steel bridge members, the attachment method shall not involve drilling, grinding or welding. Attachment method to steel members shall be approved by the engineer. Junction boxes shall be installed as shown on the plans or as directed by the engineer. Junction boxes shall be surface-mounted and installed such that covers are accessible. If the conduit crosses a bridge expansion joint, a conduit expansion fitting shall be used. The expansion fitting shall provide a minimum movement in either direction as shown on the plans or as specified by the engineer. Junction boxes, expansion fittings and any hardware or material required for conduit installation shall be at the contractor’s expense.

902.1~~7~~8 Signal Faces. Vehicle and pedestrian signal faces shall be covered or turned away from approaching traffic until placed in operation. When ready for operation, the signal faces shall be securely fastened in position facing approaching traffic. Incandescent lamps installed by the contractor shall be installed horizontally with the open segment of the filament facing up. Vehicle and pedestrian signal faces shall be aimed laterally at the approximate center of

the lane or lanes the signal face controls. Signal faces shall be aimed at a point behind the stop line a distance corresponding to the following requirements:

Approach Speed, mph	Distance, feet
30	160
40	240
50	330
60	430
70	560

902.1~~8~~9 Post Erection. Post bases shall be securely anchored to concrete bases. Pedestal posts shall be erected vertically without the use of leveling nuts. Metal posts for span wire and cantilever mast arms shall be adjusted by leveling nuts. All posts for span wire and cantilever mast arms shall be raked as directed by the engineer. All signal posts shall be grounded by a bare No. 6 AWG stranded copper wire running from the ground lug inside the post to a clamp fastened on metal conduit at the top of the concrete base to a ground rod or through nonmetallic conduit to the ground bus in the controller.

902.~~19~~ 20 Wiring.

902.20~~19~~.1 All cable runs shall be continuous and unspliced from the connections in the terminal block of the signal head or disconnect hanger to the terminal strip in the controller cabinet, from the signal terminal block to another signal terminal block or as shown on the plans. When a terminal compartment is provided, all cable runs shall be continuous from the terminal compartment to the terminal strip in the controller cabinet. When parallel connections are required from an overhead signal head on a mast arm to a side-mounted signal head, cable shall be routed from the controller to the terminal compartment of the signal on the mast arm and then parallel-circuited back to the side mounted signal. All other conductor cable combinations to signal heads shall be as shown on the plans or as directed by the engineer. Where double controller cabinets are specified, wires shall be sorted between the controller and first pull box such that field wires enter the associated controller compartment.

902.20~~19~~.2 Power cable runs shall be continuous and unspliced from the power disconnect switch located on the power supply to controller cabinet terminals. Power cable shall be encased in conduit of the size shown on the plans. Energized power cables shall run to circuit breakers. The neutral cable shall be terminated on the neutral bus bar and the equipment ground conductor shall be terminated on the ground bus in the controller cabinet.

902.20~~19~~.3 Where luminaires are required, pole and bracket cable shall be installed between the luminaire and the power source at the base of the post. Each luminaire shall be connected to the power source by No. 12 AWG conductors with suitably sized equipment grounding conductor. A premolded fused connector assembly shall be installed on each conductor carrying current between the source cable and the pole and bracket cable. The assembly and cable shall be insulated with a protective rubber boot designed for the premolded connector.

902.20~~19~~.4 Induction loop dimensions shall be as shown on the plans. The engineer will determine the exact location of loops. Each induction loop shall be connected to the detector by a separate lead-in cable. Single-conductor No. 14 AWG cable shown on the plans is an approximation of cable quantity required to construct the induction loop. If the number of turns shown on the plans is not in accordance with the manufacturer's recommendation for the sensing units furnished, the plans will be revised, and the induction loop cable will be field measured and quantities adjusted accordingly. Induction loop detector cable shall be installed in accordance with manufacturer's recommendations. Induction loop detector lead-in cable will be shown on the plans as two-conductor No. 14 AWG cable. Should the manufacturer recommend a different type of cable, the two-conductor cable shall be revised to the

manufacturer's specification, but will be considered completely covered by the contract unit price for loop detector lead-in cable. Cable for loop detectors shall be continuous from the terminal strip in the controller cabinet to a splice with the detector leads in the pull box adjacent to the detector. The conductor splice shall be soldered without an open flame. The soldered splice shall then be capped and inserted into a direct buried splice kit.

902.20~~19~~.5 Where practical, color codes shall be followed such that the red insulated conductor connects to the red indication terminal, orange to yellow and green to green. Circuits shall be properly labeled in the controller cabinet and all pull boxes by means of round aluminum identification tags with a minimum thickness of 0.1 mils, attached to the cables with a copper wire. Information stamped on the tags shall identify equipment served by the conductor cable in accordance with designations used on the plans.

902.~~1~~20~~9~~.6 Cables shall be pulled through conduit by a cable grip providing a firm hold on exterior coverings. Cable shall be pulled with a minimum of dragging on the ground or pavement. Frame-mounted pulleys or other suitable devices shall be used for pulling cables out of conduit into pull boxes. Lubricants may be used to facilitate pulling cable. Polyester rope will not be permitted to facilitate pulling of cable. Slack in each cable shall be provided by a 6-foot loop coiled in each pull box and a 3-foot loop coiled in each junction box. All signal posts and controllers shall be grounded by bare No. 6 AWG stranded copper wire.

902.2~~0~~1 Test Equipment. During installation of equipment and material, the contractor shall furnish to the engineer suitable equipment to test all or part of the completed facility to establish compliance with requirements of the contract. Minimum test equipment shall be a voltmeter, ohmmeter and ammeter. For testing induction loop detectors, the contractor shall also provide a suitable 500-volt, direct current, 0 to 100- megaohm range, hand-operated, resistance measuring device.

902.2~~1~~2 Test Period. After the project is open to normal traffic, the contractor shall notify the engineer in writing the date the signal or signal system will be ready for testing. Upon concurrence from the engineer, the contractor shall place the signal or signal system in operation for a 15 consecutive day test period. A signal operated independently of other signals or signal systems shall be tested as a single installation. A signal operated as part of a system shall not be tested until all signals in the system are ready to be tested. A system shall be tested as a unit. Any failure or malfunction of equipment during the test period shall be corrected at the contractor's expense, and the signal or signal system tested for an additional 15 consecutive day period. This procedure shall be repeated until the signal equipment has operated to the engineer's satisfaction for 15 consecutive days. The contractor shall, in the presence of the engineer, demonstrate the proper action of the controller's monitor as part of the testing system, if applicable.

902.2~~1~~2.1 When the test period is initiated and until the test period is completed, following the turn on of temporary traffic signals or after work is begun on an existing signal installation, the contractor shall provide at least one service technician to remain in the area and be available for day, night and weekend trouble calls. The contractor shall furnish the name, address and telephone number where each designated technician can be reached at all times. In the event of a malfunction, the contractor shall provide adequate traffic control for the intersection until the signals are restored to normal operation. Adequate traffic control shall be as shown on the plans or as directed by the engineer. If the signal or signal system malfunctions and a designated technician cannot be reached or cannot arrive at the intersection in a reasonable time in the judgment of the engineer, then the engineer may exercise the option to direct MoDOT personnel or a third party to correct the malfunction in the presence of the engineer. If this option is invoked, the entire cost of the work performed by MoDOT personnel or the third party will be computed as described in Sec 108.9 and deducted from the payments due the contractor.

902.21~~1~~2.2 Whether or not the engineer elects to correct the signal malfunction, nothing in this specification shall be construed or interpreted to relieve the contractor of any liability for personal injury or property damage that results either directly or indirectly from a signal malfunction during the test period. The contractor and surety shall indemnify and save harmless the State, the Commission, the Commission's agents, employees and assigns for any legal liability incurred for such a signal malfunction.

902.22~~2~~3 Maintenance Information. Before acceptance of the work, the contractor shall furnish the engineer with three copies of the manufacturer's instructions for maintenance and operation of all signal equipment including, but not limited to, controllers, conflict monitors, load switches, detectors, software, interconnect and auxiliary equipment. At a minimum, the manufacturer's instructions shall include organized written instructions, wiring diagrams, diagrams showing component layouts and parts lists with part numbers and serial numbers, where applicable. Serial numbers listed by the supplier will be verified with the shipping invoice and on the controller and conflict monitor received for installation. The contractor shall furnish three copies of wiring diagrams of the installation or system. The cabinet wiring diagrams shall include labeling for all field terminal connections and shall provide an orientation of the terminal layout that conforms to the intersection information specified.

902.23~~3~~4 Final Clean Up. Final clean up of right of way shall be in accordance with Sec 104.

902.24~~4~~5 Method of Measurement.

902.24~~4~~5.1 Measurement of temporary traffic signal installations will be made per lump sum.

902.24~~4~~5.2 Measurement for the following items will be made per each:

(a) Signal heads and luminaires,

(b) Posts,

(c) Power supply assemblies, including all specified equipment,

(d) Traffic controller assemblies, including all specified equipment,

(e) System software, including installation,

(f) System master, including all specified items,

(g) Telemetry radios and antennas for wireless interconnect systems, including all specified equipment,

(h) Video detection systems, including all specified equipment,

(i) Pull boxes, including all specified material,

(j) Training, including all specified training,

(k) Modems, including all specified equipment,

(l) Splice cabinet, including all specified items,

(m) Accessible Pedestrian Signals, including all specified items,

And includes all necessary material, hardware, equipment and specified incidental items.

902.2~~4~~5.3 Measurement of push button detectors, microwave detectors and induction probe detectors will be made per each. Measurement of two-channel card rack mounted detectors will be made per each detector card.

902.2~~4~~5.4 Final measurement of concrete for bases will not be made, except for authorized changes in construction or where appreciable errors are found in the contract quantity. Where required, measurement of concrete for bases, including all specified material, will be made to the nearest 1/10 cubic yard as shown on the plans. The revision or correction will be computed, and added to or deducted from the contract quantity.

902.2~~4~~5.5 Final measurement of conduit will not be made, except for authorized changes in construction or where appreciable errors are found in the contract quantity. Where required, measurement of conduit will be made to the nearest linear foot as shown on the plans. The revision or correction will be computed, and added to or deducted from the contract quantity.

902.2~~4~~5.6 Final measurement of conductor will not be made, except for authorized changes in construction or where appreciable errors are found in the contract quantity. Where required, measurement of conductor will be made to the nearest 10 linear feet as shown on the plans. The revision or correction will be computed, and added to or deducted from the contract quantity.

902.2~~4~~5.7 Measurement of signal sign areas will be made to the nearest 1/10 square foot for each sign and to the nearest square foot for the total.

902.2~~5~~6 Basis of Payment. Accepted traffic signals will be paid for at the contract unit price for each of the pay items included in the contract. No direct payment will be made for any incidental items necessary to complete the work unless specifically provided as a pay item in the contract.

902.2~~5~~6.1 Temporary traffic signals will be paid for at the contract unit price. No direct payment will be made for guys, conduit and junction boxes on poles, hardware, lighting bracket arms, or any other item for which separate payment is not provided.

902.2~~5~~6.2 Accepted post bases will be paid for at the contract unit price. Payment will be considered full compensation for all labor, equipment and material to complete the described work, and will include all excavation, removal and disposal of all material encountered within the limits of the work.

902.2~~5~~6.3 Luminaire bracket arms, if specified, will be at the contractor's expense.

902.2~~5~~6.4 No direct payment will be made for cable, conduit and any additional work required to connect the power supply assembly to the utility company facilities.

902.2~~5~~6.5 No direct payment will be made for the card rack assembly and card rack power supplies.

902.2~~5~~6.6 Payment for the telephone cable and associated pushed or trenched conduit will be considered fully covered under the contract unit price for the power supply assembly.

902.2~~5~~6.7 Furnishing and installing the system master controller, including all connectors and cables to provide a fully functioning system, will be paid for at the contract unit price per each. Payment for furnishing and installing telephone interface panels, an extra service outlet,

door alarm, dial-up modem and all aspects of the system acceptance test, including all incidental items required to provide a fully functioning system, will be considered completely covered by the contract unit price for the system master.

902.2~~5~~6.8 For closed loop systems, if the Commission does not furnish the system software, the system software will be paid for at the contract unit price per each. If the Commission furnishes system software or has committed to purchase system software in another contract, no payment will be made for the software. This shall include versions of previously supplied software. Installing and programming local intersection controllers and the system master will be at the contractor's expense.

902.2~~5~~6.9 Accepted video detection systems will be paid for at the contract unit price. Payment will be considered full compensation for all labor, equipment and material to complete the described work, and for placing the specified equipment into operation to the satisfaction of the engineer.

902.2~~5~~6.10 No direct payment will be made for junction boxes.

902.2~~5~~6.11 Furnishing and installing telemetry radios, power supplies, interface cables, diagnostic pads and other items necessary for the proper operation of the radios will be paid for at the contract unit price for the Spread Spectrum Telemetry Radio.

902.2~~5~~6.12 Furnishing and installing antenna cable, including connectors, surge arrestors and other items necessary for proper operation, will be paid for at the contract unit price of RG-8/U Coaxial Cable.

902.2~~5~~6.13 If training is specified in the contract documents, training will be paid for at the contract unit price. Payment will be considered full compensation for all labor, equipment and material to conduct the training.

902.2~~5~~6.14 The accepted quantities of fiber optic cable, including installation, termination and testing of the fiber optic interconnect cables, all connectors, hardware, tags and other incidentals needed to provide a fully functioning system, will be paid for at the contract unit price per linear foot. The installation, termination and splicing of fibers in splice cabinets and fiber distribution units, including all connectors and other incidentals, will be considered fully covered under the contract unit price.

902.2~~5~~6.15 The fiber optic data link in the system master, including all incidental items required for proper operation, will be paid for at the contract unit price per each for the system master.

902.2~~5~~6.16 Furnishing and installing the dial-up modem including all connectors and cables necessary for proper operation will be paid for at the contract unit price per each.

902.2~~5~~6.17 Furnishing and installing the local controller assembly, including all connectors and cables to provide a fully functioning system, will be paid for at the contract unit price per each.

902.2~~5~~6.18 Furnishing and installing the fiber optic data links (modems) in the local controllers including all incidental items required to provide a fully functioning system, will be paid for at the contract unit price per each for controller assembly.

902.2~~5~~6.19 Furnishing and installing the fiber distribution unit for controller cabinets, including all mounting hardware and incidentals, will be paid for at the contract unit price per each for controller assembly.

902.2~~5~~6.20 Furnishing and installing the splice cabinet, including the rack cage, fiber distribution unit, grounding and other incidental items will be paid for at the contract unit price per each.

902.2~~5~~6.21 Payment for the telephone cable and associated pushed or trenched conduit will be considered fully covered under the contract unit price for the power supply assembly.

902.2~~5~~6.22 No direct payment will be made for warranties.

902.2~~5~~6.23 No direct payment will be made for tracer or ground wires.

902.2~~5~~6.24 Highway signal signs and mounting hardware will be paid for at the contract unit price for each of the items included in the contract. No direct payment will be made for incidental items necessary to complete the work, unless specifically provided as a pay item in the contract.

902.26.25 Accepted Accessible Pedestrian Signals will be paid for at the contract unit price. Payment will be considered full compensation for all labor, equipment and material to complete the described work. Payment for signing will be included in the contract unit price for Accessible Pedestrian Signals.

1092.4.5.5.2.7 Fiber Distribution Unit. Each controller cabinet shall be equipped with a fiber distribution unit to provide a termination, storage and service access point for fiber optic cables. The fibers in the interconnect cable(s) shall be terminated on one side and duplex jumpers shall extend on the other side to the data links. The fiber distribution unit shall be a modular design to support a minimum termination/connection capacity of 12 fibers, one splice tray and strain relief for up to four cables. No splice tray will be required. The connector panel shall be designed to accommodate ST connectors for both multi-mode and single mode fibers, as appropriate. ST couplings with ceramic inserts shall be provided to accommodate all fibers brought into the controller cabinet from the splice cabinet. The unit shall provide both front and rear access with hinged door access. The unit shall be constructed of durable aluminum constructed for outdoor applications. Plastic doors may be considered for approval. The unit shall be sized to fit in the controller cabinet and shall be positioned to allow fiber cables to be routed with bending radii exceeding manufacturer's recommendation. The unit shall not conflict with other cabinet components or panels. Fiber cables shall not conflict with other cabinet wiring.

1092.4.5.5.3 Training for Fiber Optic Installation. When specified in the contract documents, training on system software and system operation shall be provided. Training shall be conducted by qualified instructors and shall be provided to personnel designated by the engineer on all facets of the system. Personnel shall be trained to operate the system, analyze system performance and revise critical operating parameters based on the analysis. The training shall be in a classroom atmosphere and shall be for a minimum of 16 hours over two days. The first eight-hour training session shall be conducted prior to the system acceptance test. The second eight-hour session shall be conducted at the conclusion of the system acceptance test. Maintenance personnel shall be trained on maintenance and repair of all serviceable equipment. Training shall include field level troubleshooting and bench repair. The training shall be for a minimum of eight hours in one day.

1092.4.6 Dial Up Modems. The dial-up modem shall be an auto-dial, auto-answer modem and shall be installed in the controller cabinet as specified on the plans. If specified, an identical modem shall be installed at the central office computer facility in the MoDOT district office. The modem shall be Hayes compatible capable of responding to the standard "Hayes command set" and shall be self-contained. The unit shall be powered by a nominal 120-volt alternating current from the duplex service outlet provided in the cabinet. The modem shall be capable of operating at all standard baud rates from 300 to 56k baud over a standard dial-up, unconditioned telephone line and shall be capable of reliable operation from -35 to 165 F. Installation shall include the appropriate interface cable to connect to an RJ-11 telephone jack on the telephone interface panel, the RS-232 cable from the modem to the system master and all other cabling, connectors and incidental items necessary for operation.

1092.4.7 Detectors.

1092.4.7.1 Induction Detector Probes. The encapsulated induction detector probe shall detect the passage or presence of all vehicles with a standard induction loop detector amplifier. The induction detector probe shall operate in a temperature range from -35 to 165 F with 0 to 100 percent humidity. The operating field intensity range shall be 0.2 to 1.0 oersted with a nominal inductance of 20 microhenries plus 20 microhenries per 100 feet of cable. The nominal direct current resistance shall be 0.5 ohm plus 3.2 ohms per 100 feet of probe cable. Induction detector probes shall be as specified on the plans and shall meet the following:

(a) The sensing probes shall be cylindrical having maximum dimensions of 7/8-inch diameter by 4 inches long. The sensing probes shall be suitable for installation in a one-inch diameter bored hole. The interconnecting four-conductor cable and lead-in cable shall be suitable for installation in a 1/4-inch wide pavement sawed slot.

(b) The jacket on the interconnecting cable and the casing on the sensing probe shall be an abrasion resistant polyurethane elastomer. The device shall be impervious to moisture and chemically resistant to all normal motor vehicle petroleum products. Lead-in cables shall be shielded, chemical resistant and completely waterproof.

(c) The combined probe sets, manufacturer specified lead-in cable and detector probe shall detect all vehicles up to a lead-in cable length of 750 feet with up to six probes per set.

(d) The conductor cable from the probes to the detector panel in the controller assembly shall be as specified by the detector manufacturer, shall be continuous and unspliced and shall be a minimum of 50 feet in length. Probes shall be assembled in a set to form a vehicle detector as shown on the plans. No more than six probes shall be assembled as a set. The cables between probes shall be long enough to provide the spacing shown on the plans plus 5 feet. If spacing is not shown on the plans, 15 feet of cable shall be provided between probes. Each set of probes shall have one lead-in cable.

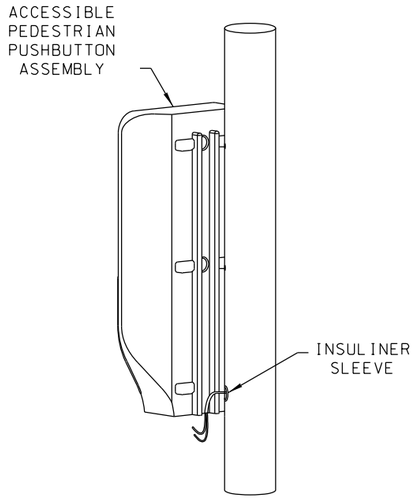
1092.4.7.2 Pedestrian Push Button. Pedestrian push-button detectors shall be of the pressure-activated type with essentially no moving parts. The housing shall be aluminum, black, round in shape and shaped to fit the curvature of the post to which it is attached and shall provide a rigid installation. Contacts shall be normally open, entirely insulated from the housing and actuator, and have connecting terminals. The housing shall have one outlet tapped for ½ inch pipe. The actuator shall be a minimum of 2 inches in diameter, raised, contrast visually with the housing and be made of brass or corrosion-resistant metal alloy or non-metallic material. A maximum force of 5 pounds shall be required to activate the switch. Switch shall be of the solid-state electronic, piezo type. The operating voltage shall not exceed 24 volts. The entire assembly shall be weatherproof, secure against electrical shock to the user and vandal resistant. Entire assembly shall be rated to operate between –30 degrees F to 165 degrees F and shall not allow ice to form such to impede the operation of the button.

1092.4.7.2.1 Accessible Pedestrian Signal (APS). APS pushbutton detectors shall be in accordance with Sec 1092.4.7.2, except a maximum force of 3.5 pounds shall be required to activate the switch. APS pushbutton detectors shall include tactile arrows and actuators made of brass or corrosion-resistant metal alloy or non-metallic material. Tactile arrows shall be located on the pushbuttons, raised, with high visual contrast (light on dark or dark on light).

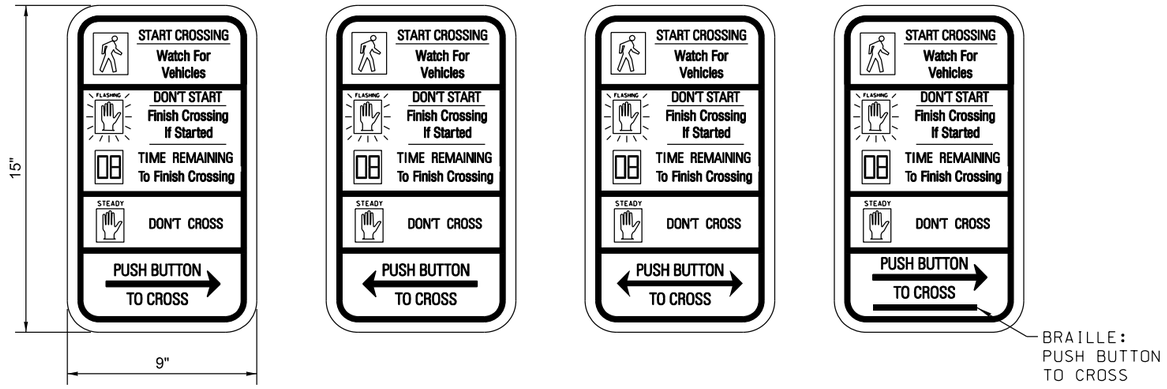
1092.4.7.3 Induction Loop Detectors. Induction loop vehicle detectors shall detect a vehicle stopped within the field of the loop or passing over the loop at speeds up to 80 mph. Induction loop detectors shall be card rack mounted. For double controller cabinets, card rack assemblies and detectors shall be installed in the same compartment as each respective associated controller.

1092.4.7.4 NEMA Card Rack Assemblies. The supporting and connecting rack shall contain space for a minimum of two power supplies and shall have a minimum of eight card positions for two-channel detector units. Upper and lower slide guides shall be provided for the power supply and each detector card. Where detectors are specified, the rack and power supplies shall be included with the detectors, and no direct payment will be made.

(a) The card mounting rack shall be attached to the controller cabinet by a hinge or pivot assembly, which allows the rack to rotate horizontally so as to expose the rack wiring to facilitate maintenance operations. The rack shall be positioned to rotate out freely 90 degrees without conflicting with other wiring, equipment or the

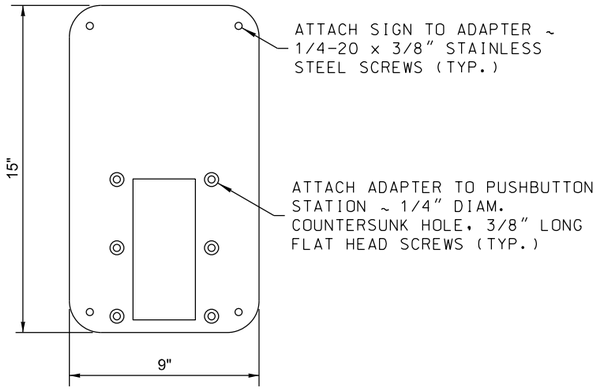


WIRE ROUTING
PERSPECTIVE VIEW

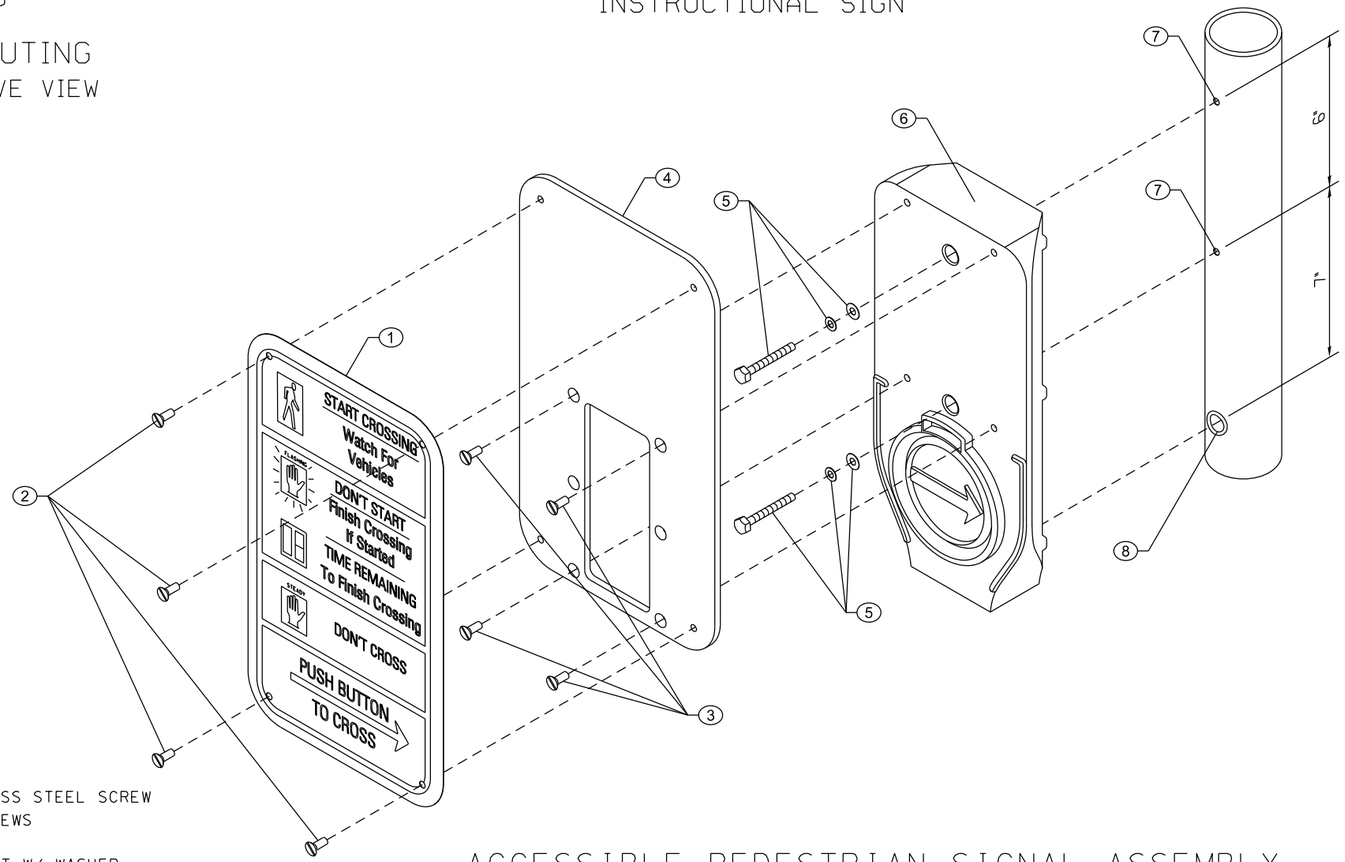


R10-3e (RIGHT) R10-3e (LEFT) R10-3e (MOD.) R10-3e (WITH BRAILLE)

PEDESTRIAN PUSHBUTTON
INSTRUCTIONAL SIGN



PEDESTRIAN PUSHBUTTON
FRAME ADAPTER



KEY

1. FACE PLATE
2. 1/4-20 x 3/8" LONG STAINLESS STEEL SCREW
3. 1/4-20 STAINLESS STEEL SCREWS
4. PUSHBUTTON FRAME ADAPTER
5. 1/4-20 STAINLESS STEEL BOLT W/ WASHER AND LOCK WASHER
6. PUSHBUTTON STATION
7. DRILL AND TAP SHAFT FOR 1/4" DIAM. BOLT
8. DRILL AND TAP SHAFT FOR 5/8" WIRE GUIDE HOLE - ADD INSULINER

ACCESSIBLE PEDESTRIAN SIGNAL ASSEMBLY

METAL POLE INSTALLATION

GENERAL NOTES:

ACCESSIBLE PEDESTRIAN SIGNAL ASSEMBLY MAY BE MONOLITHIC OR A SEPARATE ACTUATOR AND SIGN.

SIGNS FOR SIGNAL INSTALLATIONS, INCLUDING ALL MATERIAL REQUIRED FOR SIGN MOUNTING, SHALL BE FURNISHED BY THE CONTRACTOR. SIGNS SHALL BE MANUFACTURED IN ACCORDANCE WITH SEC 903, AND MOUNTED AS SHOWN ON THE PLANS.

ACCESSIBLE PEDESTRIAN SIGNAL ASSEMBLY CAN BE MOUNTED TO SIGNAL POLE, PEDESTRIAN POLE, OR PEDESTRIAN PUSHBUTTON POLE.

INCLUDE A 9" X 15" R10-3E SIGN WITH EACH ASSEMBLY.

REQUIRES POLE ADAPTER WHEN MOUNTING TWO UNITS ON THE SAME PEDESTAL POLE. ADDITIONAL MOUNTING EXTENSION BRACKETS SHALL BE PROVIDED IF A 10" MAXIMUM REACH FROM AN ACCESSIBLE SIDEWALK CANNOT BE ACHIEVED.

IF THE CURB RAMP IS NOT ALIGNED WITH THE CROSSWALK, THE ACCESSIBLE PEDESTRIAN SIGNAL ASSEMBLY SHALL POINT IN THE DIRECTION OF TRAVEL, NOT IN THE DIRECTION OF THE CURB RAMP ORIENTATION.

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105 WEST CAPITOL
JEFFERSON CITY, MO 65102
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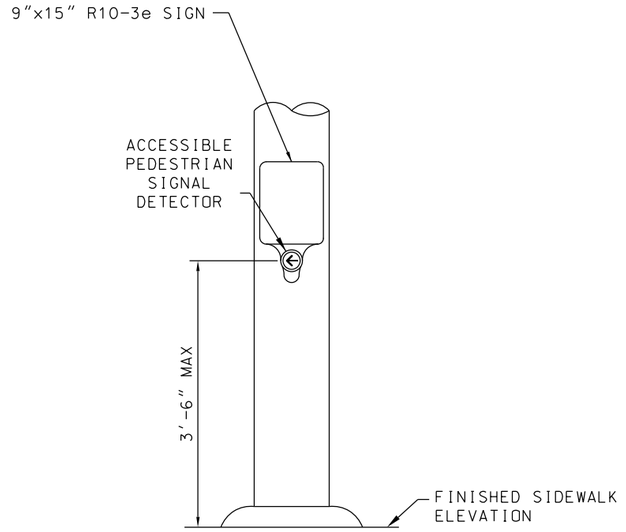
ACCESSIBLE PEDESTRIAN SIGNALS

NEW SHEET

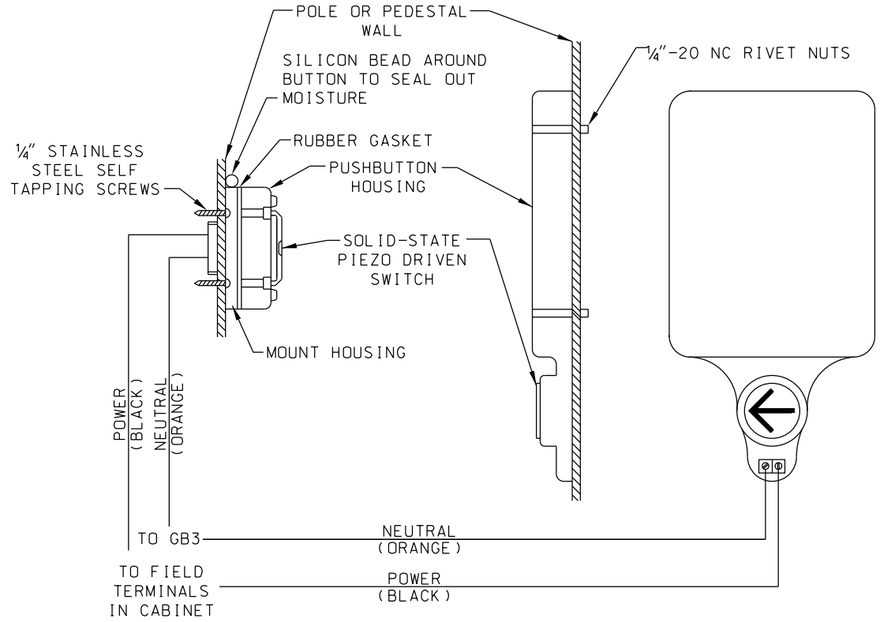
DATE EFFECTIVE: ##/##/####
DATE PREPARED: $DATE$

902.05

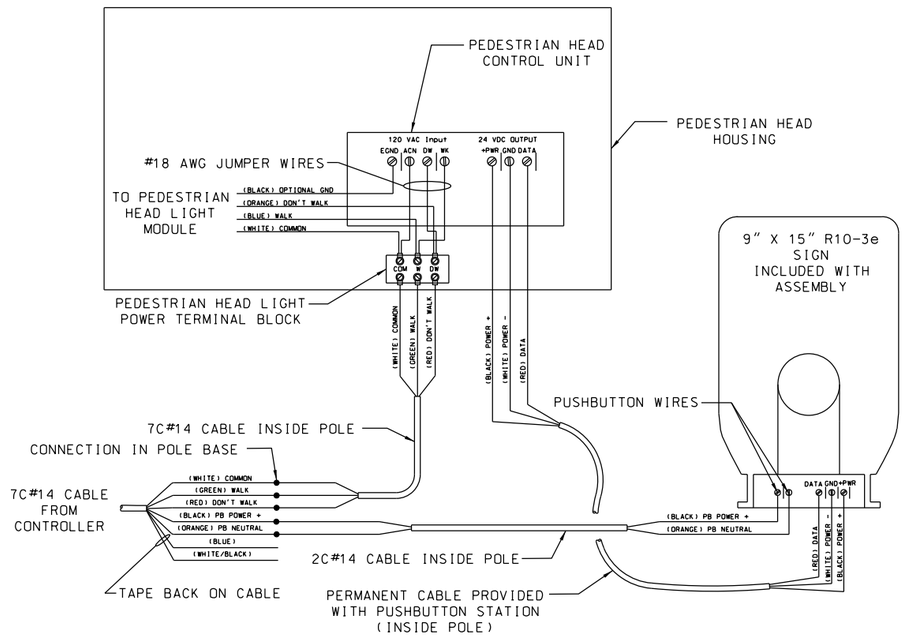
SHEET NO. 1 OF 2



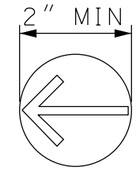
ACCESSIBLE PEDESTRIAN SIGNAL ASSEMBLY



2-WIRE SYSTEM WIRING DETAILS



3-WIRE SYSTEM WIRING DETAILS



ACTUATOR DETAIL

GENERAL NOTES:

ACCESSIBLE PEDESTRIAN SIGNAL ASSEMBLY MAY BE MONOLITHIC OR A SEPARATE ACTUATOR AND SIGN.

THE ACCESSIBLE PEDESTRIAN SIGNAL PUSHBUTTON SHALL BE OF THE PRESSURE-ACTIVATED TYPE WITH ESSENTIALLY NO MOVING PARTS. IT SHALL BE "ADA" COMPLIANT AND WEATHERPROOF.

THE HOUSING SHALL BE BLACK, ROUND IN SHAPE TO FIT THE CURVATURE OF THE POST TO WHICH IT IS ATTACHED AND SHALL PROVIDE A RIGID INSTALLATION. ACCESSIBLE PEDESTRIAN SIGNAL CAN BE MOUNTED TO THE SIGNAL POLE, PEDESTRIAN POLE, OR PEDESTRIAN PEDESTAL POLE. THE BOLT PATTERN OF THE PUSHBUTTON STATION SHALL BE COMPATIBLE WITH OLDER PUSHBUTTONS.

THERE SHALL BE A TACTILE ARROW POINTING IN THE DIRECTION OF PEDESTRIAN TRAVEL CONTROLLED BY THE BUTTON.

THE ACTUATOR SHALL BE A MINIMUM OF 2 INCHES IN DIAMETER, RAISED, CONTRAST VISUALLY WITH THE HOUSING AND MADE OF BRASS OR CORROSION-RESISTANT METAL ALLOY OR NON-METALLIC MATERIAL. A MAXIMUM FORCE OF 3.5 LBS SHALL BE REQUIRED TO ACTIVATE THE SWITCH. SWITCH SHALL BE OF THE SOLID-STATE ELECTRONIC, PIEZO TYPE.

THE ACCESSIBLE PEDESTRIAN SIGNAL SHALL OPERATE AT A VOLTAGE NO GREATER THAN 24 VOLTS. SOME MANUFACTURERS PROVIDE A 2-WIRE ACCESSIBLE PEDESTRIAN SIGNAL SYSTEM THAT USES THE EXISTING WIRING FROM PREVIOUSLY INSTALLED STANDARD PUSHBUTTONS. THE 3-WIRE SYSTEM IS DESIGNED FOR INTERSECTIONS WHERE BUTTON WIRES DO NOT EXIST. THE 3-WIRE SYSTEM PROVIDES WIRELESS CONNECTIVITY FOR BLUETOOTH PROGRAMMING.

THE ACCESSIBLE PEDESTRIAN SIGNAL SHALL BE FULLY OPERATIONAL BETWEEN -30°F TO +165°F (-34°C TO +74°C), SHALL NOT ALLOW ICE TO FORM SUCH TO IMPEDE THE OPERATION OF THE BUTTON, AND SHALL HAVE A WEATHERPROOF SPEAKER.

IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

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ACCESSIBLE PEDESTRIAN SIGNALS

NEW SHEET

DATE EFFECTIVE: ##/##/####	902.05	SHEET NO. 2 OF 2
DATE PREPARED: $DATE$		

~~902.6.9 Accessible Pedestrian Signals and Detectors – General (MUTCD Sections 4E.09 - 4E.13)~~

~~**Standard.** Accessible pedestrian signals and detectors shall be considered upon request and evaluated based on the 2009 MUTCD and collaboration with Central Office Traffic.~~

902.6.9 Accessible Pedestrian Signals and Detectors – General (MUTCD Section 4E.09)

Standard. Accessible pedestrian signals and detectors shall be included as part of the design at new signalized intersections where pedestrians are present and shall be considered at existing intersections being altered or are needing maintenance applications. See EPG 642.4 for additional guidance on the impact of the project category on Americans with Disabilities Act.

Support. Accessible pedestrian signals and detectors provide information in non-visual formats (such as audible tones, speech messages, and/or vibrating surfaces).

The primary technique that pedestrians who have visual disabilities use to cross streets at signalized locations is to initiate their crossing when they hear the traffic in front of them stop and the traffic alongside them begin to move, which often corresponds to the onset of the green interval. The existing environment is often not sufficient to provide the information that pedestrians who have visual disabilities need to cross a roadway at a signalized location.

Standard. When used, accessible pedestrian signals shall be used in combination with pedestrian signal timing. The information provided by an accessible pedestrian signal shall clearly indicate which pedestrian crossing is served by each device.

Under stop-and-go operation, accessible pedestrian signals shall not be limited in operation by the time of day or day of week.

Option. Accessible pedestrian signal detectors may be pushbuttons or passive detection devices. At locations with pretimed traffic control signals or non-actuated approaches, pedestrian pushbuttons may be used to activate the accessible pedestrian signals.

Support. Accessible pedestrian signals are typically integrated into the pedestrian detector (pushbutton), so the audible tones and/or messages come from the pushbutton housing. They have a pushbutton locator tone and tactile arrow. The pushbutton housing can include audible beaconing and other special features.

Option. The name of the street to be crossed may also be provided in accessible format, such as Braille or raised print. Tactile maps of crosswalks may also be provided.

Support. Specifications regarding the use of Braille or raised print for traffic control devices can be found in the “Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG)” (EPG 642.3).

Standard. At accessible pedestrian signal locations where pedestrian pushbuttons are used, each pushbutton shall activate both the walk interval and the accessible pedestrian signals.

902.6.10 Accessible Pedestrian Signals and Detectors – Location (MUTCD Section 4E.10)

Support. Accessible pedestrian signals that are located as close as possible to pedestrians waiting to cross the street provide the clearest and least ambiguous indication of which pedestrian crossing is served by a device.

Guidance. Pushbuttons for accessible pedestrian signals should be located in accordance with the provisions of EPG 902.6.8 and should be located as close as possible to the crosswalk line furthest from the center of the intersection and as close as possible to the curb ramp.

Standard. If the curb ramp is not aligned with the crosswalk, the accessible pedestrian signal assembly shall point in the direction of travel, not in the direction of the curb ramp orientation.

If two accessible pedestrian pushbuttons are placed less than 10 feet apart or on the same pole, each accessible pedestrian pushbutton shall be provided with the following features:

A. A pushbutton locator tone,

B. A tactile arrow,

C. A speech walk message for the WALKING PERSON (symbolizing WALK) indication, and

D. A speech pushbutton information message.

If the pedestrian clearance time is sufficient only to cross from the curb or shoulder to a median of sufficient width for pedestrians to wait and accessible pedestrian detectors are used, an additional accessible pedestrian detector shall be provided in the median.

902.6.11 Accessible Pedestrian Signals and Detectors – Walk Indications (MUTCD Section 4E.11)

Support. Technology that provides different sounds for each non-concurrent signal phase has frequently been found to provide ambiguous information. Research indicates that a rapid tick tone for each crossing coming from accessible pedestrian signal devices on separated poles located close to each crosswalk provides unambiguous information to pedestrians who are visually impaired. Vibrotactile indications provide information to pedestrians who are visually impaired and deaf and are also used by pedestrians who are visually impaired or who have low vision to confirm the walk signal in noisy situations.

Standard. Accessible pedestrian signals shall have both audible and vibrotactile walk indications.

Vibrotactile walk indications shall be provided by a tactile arrow on the pushbutton (see EPG 902.6.12) that vibrates during the walk interval.

Accessible pedestrian signals shall have an audible walk indication during the walk interval only. The audible walk indication shall be audible from the beginning of the associated crosswalk.

The accessible walk indication shall have the same duration as the pedestrian walk signal except when the pedestrian signal rests in walk.

Guidance. If the pedestrian signal rests in walk, the accessible walk indication should be limited to the first 7 seconds of the walk interval. The accessible walk indication should be recalled by a button press during the walk interval provided that the crossing time remaining is greater than the pedestrian change interval.

Standard. Where two accessible pedestrian signals are separated by a distance of at least 10 feet, the audible walk indication shall be a percussive tone. Where two accessible pedestrian

signals on one corner are not separated by a distance of at least 10 feet, the audible walk indication shall be a speech message.

Support. At any given intersection, there may be a combination of speech messages and percussive tones depending on placement of accessible pedestrian pushbuttons at any given curb ramp. Each curb ramp is evaluated individually for the need of the features listed above.

Standard. Audible tone walk indications shall repeat at eight to ten ticks per second. Audible tones used as walk indications shall consist of multiple frequencies with a dominant component at 880 Hz.

The volume of audible walk indications and pushbutton locator tones (see EPG 902.6.12) shall be set to be a maximum of 5 dBA louder than ambient sound, except when audible beaconing is provided in response to an extended pushbutton press.

Automatic volume adjustment in response to ambient traffic sound level shall be provided up to a maximum volume of 100 dBA.

Guidance. The sound level of audible walk indications and pushbutton locator tones should be adjusted to be low enough to avoid misleading pedestrians who have visual disabilities when the following conditions exist:

A. Where there is an island that allows unsignalized right turns across a crosswalk between the island and the sidewalk.

B. Where multi-leg approaches or complex signal phasing require more than two pedestrian phases, such that it might be unclear which crosswalk is served by each audible tone.

C. At intersections where a diagonal pedestrian crossing is allowed, or where one street receives a WALKING PERSON (symbolizing WALK) signal indication simultaneously with another street.

Support. An optional alert tone at the beginning of the walk indication can be particularly useful if the walk tone is not easily audible in some traffic conditions.

Speech walk messages communicate to pedestrians which street has the walk interval. Speech messages might be either directly audible or transmitted, requiring a personal receiver to hear the message. To be a useful system, the words and their meaning need to be correctly understood by all users in the context of the street environment where they are used. Because of this, tones are the preferred means of providing audible walk indications except where two accessible pedestrian signals on one corner are not separated by a distance of at least 10 feet.

If speech walk messages are used, pedestrians have to know the names of the streets that they are crossing in order for the speech walk messages to be unambiguous. In getting directions to travel to a new location, pedestrians with visual disabilities do not always get the name of each street to be crossed. Therefore, it is desirable to give users of accessible pedestrian signals the name of the street controlled by the pushbutton. This can be done by means of a speech pushbutton information message (see EPG 902.5.19) during the flashing or steady UPRAISED HAND intervals, or by raised print and Braille labels on the pushbutton housing.

By combining the information from the pushbutton message or Braille label, the tactile arrow aligned in the direction of travel on the relevant crosswalk, and the speech walk message, pedestrians with visual disabilities are able to correctly respond to speech walk messages even if there are two pushbuttons on the same pole.

Standard. If speech walk messages are used to communicate the walk interval, they shall provide a clear message that the walk interval is in effect, as well as to which crossing it applies. Speech walk messages shall be used only at intersections where it is technically infeasible to install two accessible pedestrian signals in one corner separated by a distance of at least 10 feet.

Speech walk messages that are used at intersections having pedestrian phasing that is concurrent with vehicular phasing shall be patterned after the model: “Broadway. Walk sign is on to cross Broadway.”

Speech walk messages that are used at intersections having exclusive pedestrian phasing shall be patterned after the model: “Walk sign is on for all crossings.”

Speech walk messages shall not contain any additional information, except they shall include designations such as “Street” or “Avenue” where this information is necessary to avoid ambiguity at a particular location.

Guidance. Speech walk messages should not state or imply a command to the pedestrian, such as “Cross Broadway now.” Speech walk messages should not tell pedestrians that it is “safe to cross,” because it is always the pedestrian’s responsibility to check actual traffic conditions.

Standard. A speech walk message is not required at times when the walk interval is not timing, but, if provided:

A. It shall begin with the term “wait.”

B. It need not be repeated for the entire time that the walk interval is not timing.

Option. Accessible pedestrian signals that provide speech walk messages may provide similar messages in languages other than English, if needed, except for the terms “walk sign” and “wait.”

Standard. Following the audible walk indication, accessible pedestrian signals shall revert to the pushbutton locator tone (see EPG 902.6.12) during the pedestrian change interval.

902.6.12 Accessible Pedestrian Signals and Detectors – Tactile Arrows and Locator Tones (MUTCD Section 4E.12)

Standard. To enable pedestrians who have visual disabilities to distinguish and locate the appropriate pushbutton at an accessible pedestrian signal location, pushbuttons shall clearly indicate by means of tactile arrows which crosswalk signal is actuated by each pushbutton. Tactile arrows shall be located on the pushbutton, have high visual contrast (light on dark or dark on light), and shall be aligned parallel to the direction of travel on the associated crosswalk.

An accessible pedestrian pushbutton shall incorporate a locator tone.

Support. A pushbutton locator tone is a repeating sound that informs approaching pedestrians that a pushbutton to actuate pedestrian timing or receive additional information exists, and that enables pedestrians with visual disabilities to locate the pushbutton.

Standard. Pushbutton locator tones shall have a duration of 0.15 seconds or less and shall repeat at 1-second intervals.

Pushbutton locator tones shall be deactivated when the traffic control signal is operating in a flashing mode, or if the pedestrian button/signal indications/phasing are out-of-service due to technical issues or damage. This requirement shall not apply to traffic control signals or pedestrian hybrid beacons that are activated from a flashing or dark mode to a stop-and-go mode by pedestrian actuations.

Pushbutton locator tones shall be intensity-responsive to ambient sound and be audible 6 to 12 feet from the pushbutton, or to the building line, whichever is less.

Support. EPG 902.6.11 contains additional provisions regarding the volume and sound level of pushbutton locator tones.

902.6.13 Accessible Pedestrian Signals and Detectors – Extended Pushbutton Press Features (MUTCD Section 4E.13)

Option. Pedestrians may be provided with additional features such as increased crossing time, audible beaconing, or a speech pushbutton information message as a result of an extended pushbutton press.

Standard. If an extended pushbutton press is used to provide any additional feature(s), a pushbutton press of less than one second shall actuate only the pedestrian timing and any associated accessible walk indication, and a pushbutton press of one second or more shall actuate the pedestrian timing, any associated accessible walk indication, and any additional feature(s).

If additional crossing time is provided by means of an extended pushbutton press, a PUSHBUTTON FOR 2 SECONDS FOR EXTRA CROSSING TIME (R10-32P) plaque (see Figure 2B-26) shall be mounted adjacent to or integral with the pedestrian pushbutton.

Support. Audible beaconing is the use of an audible signal in such a way that pedestrians with visual disabilities can identify the signal that is located on the far end of the crosswalk as they cross the street.

Not all crosswalks at an intersection need audible beaconing; audible beaconing can actually cause confusion if used at all crosswalks at some intersections. Audible beaconing is not appropriate at locations with channelized turns or split phasing, because of the possibility of confusion.

Guidance. Audible beaconing should only be considered following an engineering study at:

A. Crosswalks longer than 70 feet, unless they are divided by a median that has another accessible pedestrian signal with a locator tone;

B. Crosswalks that are skewed;

C. Intersections with irregular geometry, such as more than four legs;

D. Crosswalks where audible beaconing is requested by an individual with visual disabilities; or

E. Other locations where a study indicates audible beaconing would be beneficial.

Option. Audible beaconing may be provided in several ways, any of which are initiated by an extended pushbutton press.

Standard. If audible beaconing is used, the volume of the pushbutton locator tone during the pedestrian change interval of the called pedestrian phase shall be increased and operated in one of the following ways:

A. The louder audible walk indication and louder locator tone comes from the far end of the crosswalk, as pedestrians cross the street,

B. The louder locator tone comes from both ends of the crosswalk, or

C. The louder locator tone comes from an additional speaker that is aimed at the center of the crosswalk and that is mounted on a pedestrian signal head.

Option. Speech pushbutton information messages may provide intersection identification (see EPG 902.6.11), as well as information about unusual intersection signalization and geometry, such as notification regarding exclusive pedestrian phasing, leading pedestrian intervals, split phasing, diagonal crosswalks, and medians or islands.

Standard. If speech pushbutton information messages are made available by actuating the accessible pedestrian signal detector, they shall only be actuated when the walk interval is not timing. They shall begin with the term “Wait,” followed by intersection identification information modeled after: “Wait to cross Broadway at Grand.” If information on intersection signalization or geometry is also given, it shall follow the intersection identification information.

Guidance. Speech pushbutton information messages should not be used to provide landmark information or to inform pedestrians with visual disabilities about detours or temporary traffic control situations.

Support. Additional information on the structure and wording of speech pushbutton information messages is included in ITE’s “Electronic Toolbox for Making Intersections More Accessible for Pedestrians Who Are Blind or Visually Impaired,” which is available at ITE’s website.

902.6.14 Accessible Pedestrian Signals and Detectors – Additional Requirements

Additional requirements for accessible pedestrian signals are provided below.

Guidance. The bolt pattern of the pushbutton station should be compatible with older pushbuttons. This will allow equipment to be easily upgraded at existing signalized intersections.

902.6.14.1 Mechanical/Electrical Requirements

Standard. Accessible pedestrian signals shall include the following mechanical and electrical requirements.

Pushbutton station shall be constructed of aluminum. Tactile arrows and actuator shall be made of brass or corrosion-resistant metal alloy or non-metallic material.

The actuator shall be a minimum of 2 inches in diameter, raised, contrast visually with the housing and shall have a solid state, piezo type switch rated at a minimum of 20 million actuations. A maximum force of 3.5 lbs shall be required to activate the switch.

The accessible pedestrian signal shall operate at a voltage no greater than 24 volts.

Support. Accessible pedestrian signal assembly may be monolithic or a separate actuator and sign.

Some manufacturers provide a 2-wire accessible pedestrian signal system that uses the existing wiring from previously installed standard pushbuttons. For installation, a control unit is installed in the controller cabinet. Wiring this device requires correct connection of wires from pedestrian signal heads, particularly where two parallel crosswalks do not operate concurrently to provide accurate messages using two wires.

The 3-wire and 4-wire systems are typically designed for intersections where pushbutton wires do not exist, though they can also be installed on intersections with existing pushbutton wires. For installation, the wires from the accessible pedestrian signal run to a control unit in the pedestrian head. Each system is independent of the others and each accessible pushbutton signal responds to the messaging provided by the pedestrian signal head it is connected to.

Option. Additional features may include Bluetooth or wireless capabilities to allow for programming using a manufacturer developed app on a tablet or cell phone.

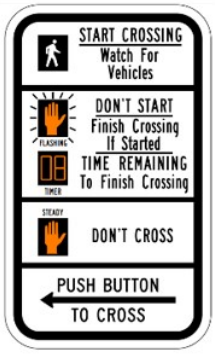
902.6.14.2 Environmental Requirements

Standard. The accessible pedestrian signal shall be fully operational between -30° F to +165°F (-34° C to +74° C), shall not allow ice to form such to impede the operation of the button and shall have a weatherproof speaker.

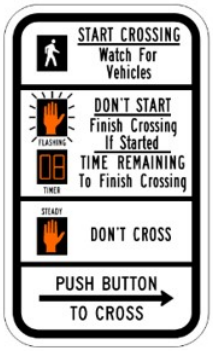
902.6.14.3 Pedestrian Information Sign Requirements

Standard. The accessible pedestrian signal shall include a pedestrian information sign. The pedestrian information sign shall be post mounted or integral to the Pedestrian Pushbutton Station. The sign shall:

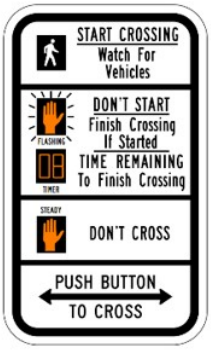
A) Be in accordance with the provisions of EPG 902.6.8,
B) Be a 9''x15" R10-3e,
~~A)~~C) Be fabricated as flat sheet (SH) in accordance with all applicable sections of MoDOT's Standard Specifications for Construction and Standard Plans.



R10-3e (Left)



R10-3e (Right)



R10-3e (Modified)

902.6.15 Post-installation Checklist of Accessible Pedestrian Signals & Maintenance

Standard. Accessible pedestrian signals shall be carefully installed in the field and evaluated after installation to verify they are working properly from an engineering perspective and from the perspective of pedestrians who are visually impaired. During installation, the installer shall program the system as directed by the engineer.

902.6.15.1 ~~Post-installation~~Installation Acceptance & Inspection Checklist of Accessible Pedestrian Signals

~~Guidance~~**Standard.** After installation and programming is complete, the installer sh~~ould~~all perform the following steps (detailed in sections below). A printable checklist sh~~ould~~all be used to provide documentation of proper installation and show continual maintenance to the accessible pedestrian signal.

A) Evaluate and adjust the locator tone volume
B) Evaluate and adjust the WALK indication volume
C) Evaluate and set the sensitivity level of the automatic volume adjustment
D) Confirm proper functioning of the WALK indicators
E) Check height and location of pushbutton
F) Check the tactile arrow
G) Check optional features
H) Check audible beaconing
I) Recheck the functioning at a later time

The following subsections provide guidance for the completion of the evaluation criteria listed in the checklist.

902.6.15.1.1 Locator tone volume

Guidance. Evaluate and adjust locator tone volume:

A) Approach intersection along sidewalk from both directions and note when the pushbutton locator tone is audible. If there are two pushbutton locator tones at the corner, each should be audible. The pushbutton locator tone should be audible when 6 to 12 feet from pushbutton, or at the building line, whichever is closer to the pushbutton.
B) Approach corner from crosswalk and note when the pushbutton locator tone is audible. The pushbutton locator tone should be audible at 6 to 12 feet (or approximately one lane) from pushbutton.
C) Listen through several cycles at times when traffic is noisy and at times when traffic is quiet.
D) Adjust the locator tone volume as necessary.

902.6.15.1.2 WALK indication volume

Guidance. Evaluate and adjust the volume of the WALK indication:

A) Stand at the curb or end of the curb ramp at the crosswalk and listen for the WALK indication. It should be audible from the crossing location.
B) Confirm that the WALK indication for each crosswalk sounds closer than the WALK indication for the perpendicular crosswalk.
C) Listen through several cycles at times when traffic is noisy and at times when traffic is quiet.
D) Adjust the WALK indication volume as necessary.

902.6.15.1.3 Automatic volume adjustment

Guidance. Evaluate and set the sensitivity level of the automatic volume adjustment:

A) If volumes are adequate in quiet conditions, but do not increase enough or quickly enough when ambient noise increases, the microphone sensitivity, or automatic gain control, should be increased.
B) Increase the microphone sensitivity in 10–20% steps until the response is as desired.
C) If necessary, readjust the volume of the locator tone and WALK indications after the microphone is adjusted.

902.6.15.1.4 Confirm proper functioning of the WALK indication

Guidance. Determine if the vibrating surface, speech messages or other features of the WALK indication work properly:

A) Press the button and wait for the WALK indication. The tactile arrow or vibrating surface should vibrate rapidly only during the WALK.
B) The WALK indication (tone or speech message) should sound for the duration of the WALK interval, unless there is a special setting due to a "rest-in-WALK" situation.
C) If the WALK indication is a speech message, confirm that it refers to the correct street and is appropriately worded and understandable.

902.6.15.1.5 Check height and location of the pushbutton

Guidance. Confirm that pushbutton height and location conform to specifications and can be reached by a person in a wheelchair, from a level landing.

902.6.15.1.6 Check tactile arrow

Guidance. Examine the tactile arrow.

A) Check that it is aligned in the direction of travel on the crosswalk.
B) Confirm that it points to the street that is controlled by that pushbutton.

902.6.15.1.7 Check optional features

Guidance. Confirm that optional features, if ordered, are present and functioning correctly.

A) Confirm that Braille dots are raised to the touch, not depressed. If possible, request that a person who reads Braille confirm that it is the correct label.
B) Press the pushbutton for an extended button press and see if the pushbutton information message plays and accurately identifies the crossing controlled by the pushbutton, and that other information, if provided, is accurate.
C) Confirm that a tactile map accurately represents the crossing features.
D) If pushbutton is Bluetooth or Wi-Fi enabled, confirm it is connected, app is installed on phone or tablet, and program is properly working.

902.6.15.1.8 Check audible beaconing

Guidance. If the intersection requires audible beaconing,

A) Press the pushbutton for an extended button press and confirm that the sound is boosted during the following pedestrian phase for the WALK tone and for the locator tone.
B) Walk across the street during the pedestrian phase and evaluate placement and aim of devices to provide sound in the crosswalk area.

902.6.15.1.9 Re-check device functioning at a later time

Guidance. Follow-up during the first few weeks after installation, checking device and volume at different times of day to assure proper functioning.

Designate a person and phone number to call and report malfunctioning devices. Share that information with agencies serving individuals who are visually impaired and organizations of individuals who are visually impaired in the community.

902.6.15.2 Maintenance of Accessible Pedestrian Signals

As with any complex device, an accessible pedestrian signal has many features that could malfunction or fail in the course of its operation. It is important to take steps to ensure correct functioning through the years.

Guidance. MoDOT should conduct an audit or checkup of the accessible pedestrian signal installations on a regular basis. Checkups should be conducted frequently if factors such as

harsh weather may have affected the devices. At the very least, the accessible pedestrian signal should be checked:

A) Every year
B) During signal observations
C) After any repairs to the intersection signals, poles or controller
D) After any field changes to signal timing

With each visit, MoDOT should recheck each of the items on the original post-installation checklist. In addition to the checklist, the most common failures are listed below and should be checked specifically:

A) Vibrating arrow/button: could stop working or have very weak vibration
B) WALK indication: tone or speech message could have stopped working or be delayed in sounding after the WALK interval begins
C) Raised arrow: could be missing or pointing in the wrong direction
D) Pushbutton: could be jammed or malfunctioning
E) Ambient noise response: could be slow to respond or have ceased responding at all

If an accessible pedestrian signal has been damaged or is not working properly, it should be replaced as quickly as possible.

ACCESSIBLE PEDESTRIAN SIGNAL INSTALLATION ACCEPTANCE & INSPECTION CHECKLIST

Installation Date:

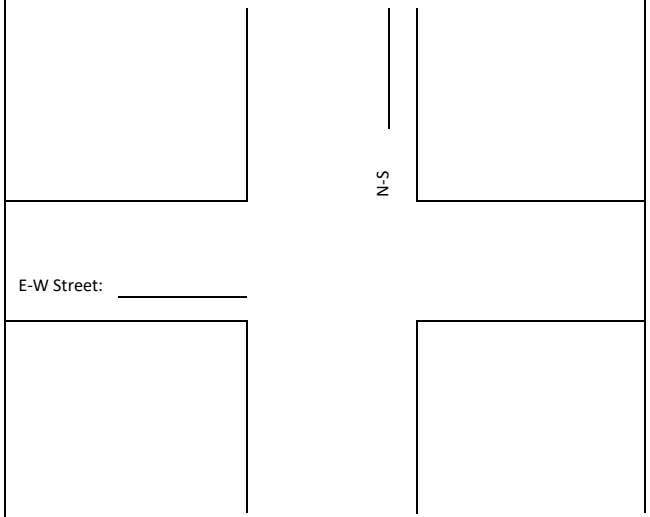
Intersection:

Checker:

Installation Checklist	APS 1	APS 2	APS 3	APS 4	APS 5	APS 6	APS 7	APS 8
Evaluate and adjust locator tone volume (EPG 902.6.11, 902.6.12, 902.15.1.1)								
Evaluate and adjust WALK indication volume (EPG 902.6.11, 902.15.1.2)								
Evaluate and set the sensitivity level of automatic volume adjustment EPG 902.6.15.1.3)								
Confirm proper functioning of WALK indicators (EPG 902.6.15.1.4)								
Check height and location of pushbutton (EPG 902.6.15.1.5)								
Check tactile arrow (EPG 902.6.15.1.6)								
Check audible beaconing (EPG 902.6.15.1.8)								
Check optional features (EPG 902.6.16.1.7)								
(If optional features are installed, document the specific optional feature below and the specific settings utilized for the individual APS installation)								
Feature A:								
Programmed Settings:								
Feature B:								
Programmed Settings:								
Feature C:								
Programmed Settings:								
Recheck Functioning (EPG 902.6.15.1.9)- Date:								

Notes:

Pushbutton Layout Diagram:



Note: Diagram general location of APS equipment and designate as APS1, APS2, …. APS8.

ACCESSIBLE PEDESTRIAN SIGNAL POST-INSTALLATION & MAINTENANCE CHECKLIST

Installation Date:

Checker:

Post - Installation	APS 1	APS 2	APS 3	APS 4	APS 5	APS 6	APS 7	APS 8
Evaluate and adjust locator tone volume								
Evaluate and adjust WALK indication volume								
Evaluate and set the sensitivity level of automatic volume adjustment								
Confirm proper functioning of WALK indicators								
Check height and location of pushbutton								
Check tactile arrow								
Check audible beaconing								
Check optional features								
Feature A:								
Feature B:								
Feature C:								
Recheck Functioning - Date:								
Maintenance								
Date:								
Date:								
Date:								
Date:								
Date:								
Date:								
Date:								

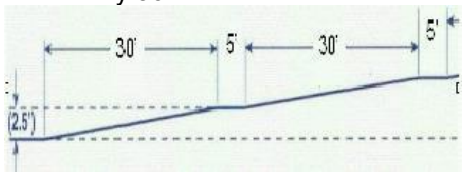
Notes:

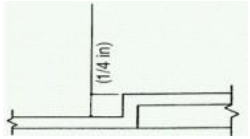
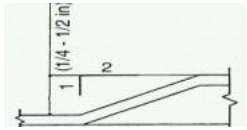
ADA CHECKLIST

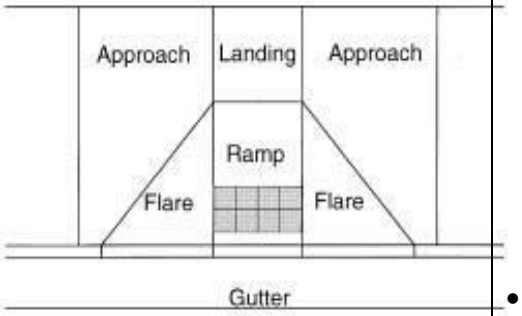
Revised April 22, 2015

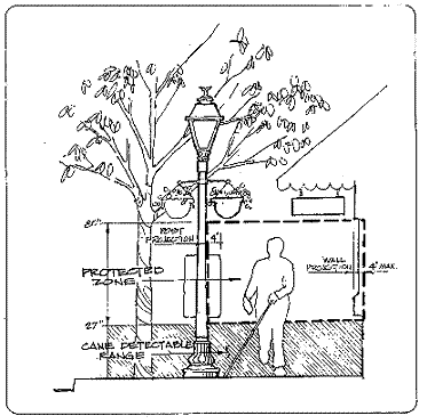
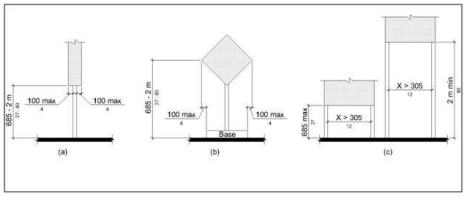
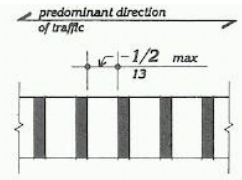
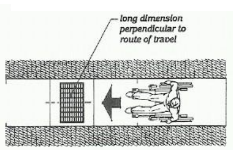
Job No._____ **Route**_____ **County**_____ **Location** _____

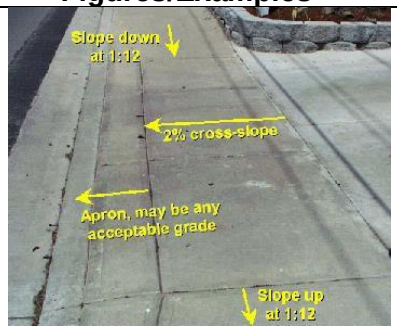
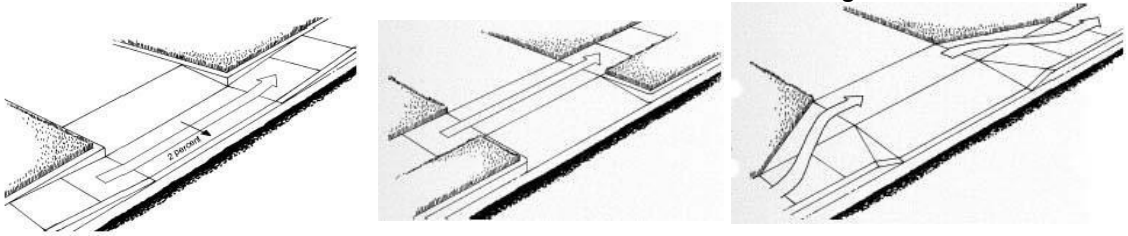
Pedestrian Access Route (PROWAG R204)				
Figures/Examples	**Requirements** [1]	**YES**	**NO**	**NA**
Sidewalk Width 	• The minimum continuous and unobstructed clear width of a pedestrian access route shall be 4.0 feet, exclusive of the width of the curb. • The continuous clear width of pedestrian access routes for medians and pedestrian refuge islands must be 5 feet minimum in order to allow for passing space. • MoDOT Sidewalks shall be 5 feet wide minimum. [2] • MoDOT Sidewalks located within 2 feet of the back of curb are to be constructed 6 feet wide minimum and constructed adjacent to the back of the curb. [2] • Exception: an unaltered, existing sidewalk shall be 3 feet wide minimum and shall provide 5 foot x 5 foot passing spaces at intervals of 200 feet maximum. [2] • Detectable warning surfaces shall be provided, where a curb ramp, landing, or blended transition connects to a street. Where commercial driveways are provided with traffic control devices or otherwise are permitted to operate like public streets, detectable warnings should be provided at the junction between the pedestrian route and the street. • Gratings, access covers, and other appurtenances shall not be located on curb ramps, landings, blended transitions, and gutters within the pedestrian access route. • Grade breaks shall not be permitted on the surface of curb ramps, blended transitions, landings, and gutter areas within the pedestrian access route. Surface slopes that meet at grade breaks shall be flush.			
Passing Spaces	• Walkways in pedestrian access routes that are less than 5 feet in clear width shall provide passing spaces at intervals of 200 feet maximum. • Pedestrian access routes at passing spaces shall be 5 feet wide for a distance of 5 feet.			
Sidewalk Running Slope The grade that is parallel to the direction of travel, expressed as a ratio of rise to run or as a percent.	• The running slope of a pedestrian access route shall be 5 percent maximum. **Roadway Grade Exception**: Where pedestrian access routes are contained within a street or highway right-of-way, the grade of the pedestrian access route is permitted to equal the general grade established for the adjacent street or highway. • Running Slopes shall be measured using a calibrated 2 foot long digital level.			

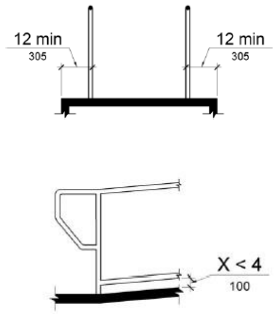
Figures/Examples	Requirements [1]	YES	NO	NA
Sidewalk Cross Slope The grade that is perpendicular to the direction of accessible pedestrian travel, measured perpendicular to the curb line or edge of the street or highway, or measured perpendicular to the running grade.	• The cross slope of the walkway of a pedestrian access route shall be 2 percent maximum. (Roadway Grade Exception may be considered) • 2010 ADA/ABA allows for cross slopes of up to ¼ inch per foot (2.08 percent). • In either case, a cross slope measurement of 2.1percent or greater is not ADA compliant. • Cross Slopes shall be measured using a calibrated 2 foot long digital level.			
Sidewalk Ramps For example, a ramp segment with the maximum allowed running slope of 8.33% would require 5' x 5' landing after every 30' of run.  	• A sidewalk segment (not contained within a street or highway border) with a running grade in excess of 5 percent but less than 8.33 percent is by definition a sidewalk ramp. • The clear width of landings, blended transitions, and curb ramps, excluding flares, shall be 4.0 feet minimum. • Cross slope of ramp runs shall be 2 percent maximum. • The rise for any ramp run shall be 30 inches maximum. • Ramps shall have landings at the top and the bottom of each ramp run. • Ramp runs with a rise greater than 6 inches shall have handrails. • Handrails shall be provided on both sides of stairs and ramps. • Edge protection shall be provided on each side of ramp runs. • Detectable warning surfaces shall be provided, where a curb ramp, landing, or blended transition connects to a street. • Gratings, access covers, and other appurtenances shall not be located on ramps, landings, blended transitions, and gutters within the pedestrian access route. • Grade breaks shall not be permitted on the surface of ramps, blended transitions, landings, and gutter areas within the pedestrian access route. Surface slopes that meet at grade breaks shall be flush.			

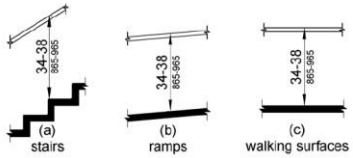
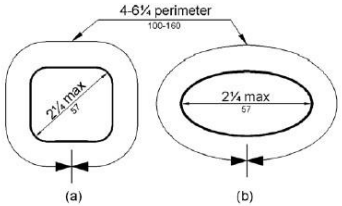
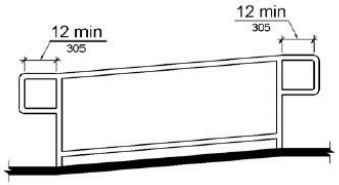
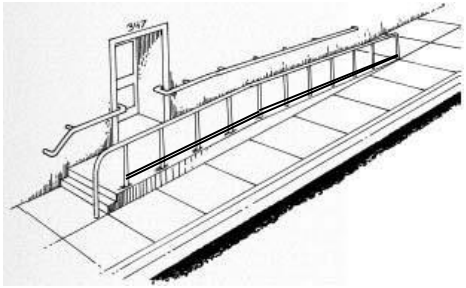
Figures/Examples	Requirements [1]	YES	NO	NA
Vertical Alignment	• Vertical alignment shall be planar within curb ramp runs, blended transitions, landings, and gutter areas within the pedestrian access route, and within clear spaces required for accessible pedestrian signals, street furniture, and operable parts. • Grade breaks shall not be permitted on the surface of curb ramps, blended transitions, landings, and gutter areas within the pedestrian access route. • Grade breaks shall be flush. • Running Slopes and Cross Slopes shall be measured using a calibrated 2 foot long digital level. • Where the pedestrian access route crosses rail tracks at grade, the surface of the pedestrian access route shall be level and flush with the top of the rail at the outer edges of the rail. The surface between the rails shall be aligned with the top of the rail.			
Changes in Level   	• Changes in level at grade breaks shall be flush. • Changes in level of ¼ inch high maximum shall be permitted to be vertical. • Changes in level between ¼ inch high maximum and ½ inch high maximum shall be beveled with a slope not steeper than 1v:2h. • The bevel shall be applied across the entire level change. • Changes in level greater than ½ inch high shall be ramp grade or flatter, a slope of 8.33 percent or less.			

Figures/Examples	Requirements [1]	YES	NO	NA
Landing A required level space required at both ends of a ramp. An area 5' x 5' with no slope greater than 2 percent. This space can be used as a place to rest, turn or pass another user. Landings that are contained within a street or highway border are permitted to use the Roadway Grade Exception for running slopes or cross slopes in the direction of the roadway travel being matched.  	• The landing clear width shall be at least as wide as the widest ramp run leading to the landing. • The clear width of landings, blended transitions, and curb ramps, excluding flares, shall be 4 feet minimum. • The landing clear length shall be 5 feet long minimum. • Landing slopes shall be 2 percent maximum. • Changes in level at grade breaks shall be flush. • Detectable warning surfaces shall be provided, where a curb ramp, landing, or blended transition connects to a street. Detectable warning shall be located on the landing or blended transition at the back of curb. • Gratings, access covers, and other appurtenances shall not be located on curb ramps, landings, blended transitions, and gutters within the pedestrian access route. • Grade breaks shall not be permitted on the surface of curb ramps, blended transitions, landings, and gutter areas within the pedestrian access route. Surface slopes that meet at grade breaks shall be flush. **Roadway Grade Exception**: The grade of pedestrian access routes within sidewalks is permitted to equal the general grade established for the adjacent street or highway. The cross slope of curb ramps, blended transitions, landings, and turning spaces at pedestrian street crossings without yield or stop control where vehicles can proceed through the intersection without slowing or stopping, and at midblock pedestrian street crossings are permitted to equal the street or highway grade. • Running Slopes and Cross Slopes shall be measured using a calibrated 2 foot long digital level.			

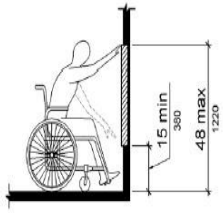
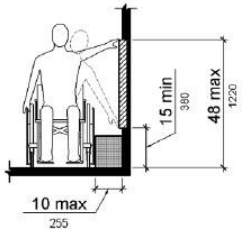
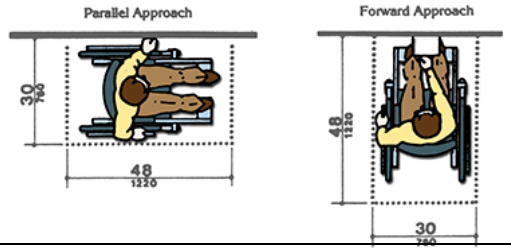
Figures/Examples	Requirements [1]	YES	NO	NA
 	• Protruding objects on sidewalks and other pedestrian circulation paths shall not reduce the clear width required for pedestrian accessible routes. • Objects with leading edges more than 27 inches and not more than 80 inches above the finish floor or ground shall protrude 4 inches maximum horizontally into the circulation path. • Free-standing objects mounted on posts or pylons shall overhang circulation paths 4 inches maximum measured horizontally from the post or pylon base when located 27 inches minimum and 80 inches maximum above the finish floor or ground. The base dimension shall be 2.5 inches thick minimum. (2011 PROWAG R402.3) • Where a sign or other obstruction is mounted between posts or pylons and the clear distance between the posts or pylons is greater than 12 inches, the lowest edge of such sign or obstruction shall be 27 inches maximum or 80 inches minimum above the finish floor or ground. • Vertical clearance shall be 80 inches high minimum. Guardrails or other barriers shall be provided where the vertical clearance is less than 80 inches high. The leading edge of such guardrail or barrier shall be located 27 inches maximum above the finish floor or ground. • Guardrails or other barriers shall be provided where the vertical clearance is less than 80 inches high. The leading edge of such guardrail or barrier shall be located 27 inches maximum above the finish surface or ground.			
    Wrong Installation	• Openings in floor and ground surfaces shall not allow passage of a sphere more than ½ inch diameter. Elongated openings shall be placed so that the long dimension is perpendicular to the dominant direction of travel. • Gratings, access covers, and other appurtenances shall not be located on curb ramps, landings, blended transitions, and gutters within the pedestrian access route. • Lift holes for manhole/utility covers shall not have an opening greater than ½ inch. Plugging of holes greater than ½ inch with a material approved by the engineer is acceptable as long as it complies with the changes in level requirements.			

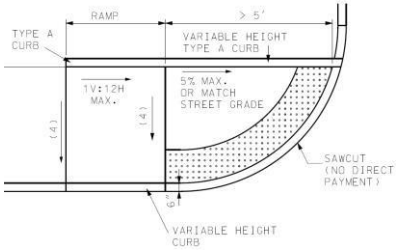
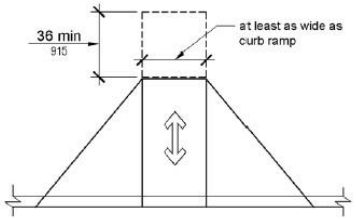
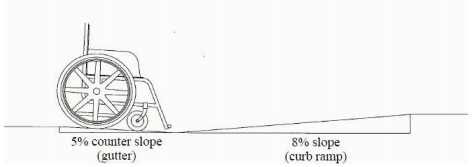
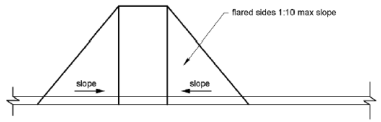
ENTRANCES (PROWAG R301)				
Figures/Examples	**Requirements [1]**	**YES**	**NO**	**NA**
	• The minimum continuous and unobstructed clear width of a pedestrian access route provided across commercial and residential entrances shall be 4 feet minimum. • Cross slope shall be 2 percent maximum. • Be cautious with the transition from the driveway to the roadway to avoid grade combinations that will cause vehicles to bottom out when driving over the transition. [2] 			

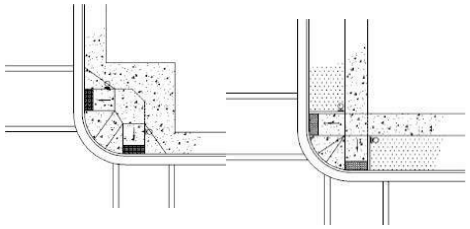
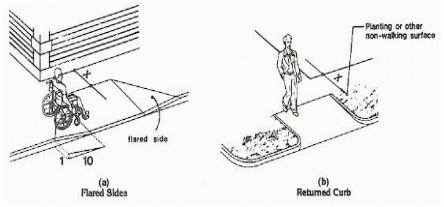
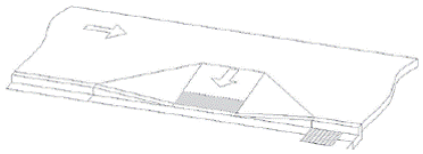
EDGE PROTECTION (PROWAG R406.8)				
Figures/Examples	**Requirements [1]**	**YES**	**NO**	**NA**
	• Edge protection shall be provided on each side of ramp runs and at each side of ramp landings. • A curb or barrier shall be provided that prevents the passage of a 4 inch diameter sphere, where any portion of the sphere is within 4 inches of the finish floor or ground surface. • Edge-protection shall not be required when the floor or ground surface of the ramp run or landing extends 12 inches minimum beyond the inside face of a handrail. • Edge protection shall not be required on curb ramps and their landings. • Edge protection shall not be required on ramps that are not required to have handrails and have flares not steeper than 1:10. • Edge protection shall not be required on the sides of ramp landings having a vertical drop-off of ½ inch maximum within 10 inches horizontally of the minimum landing area.			

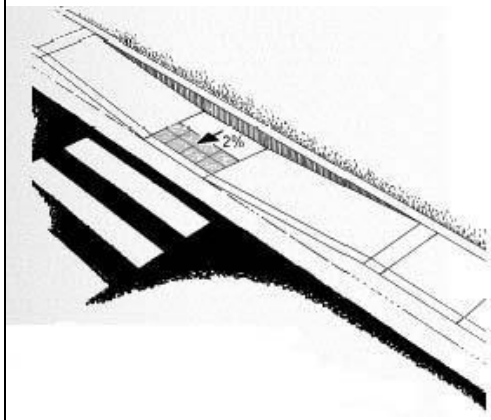
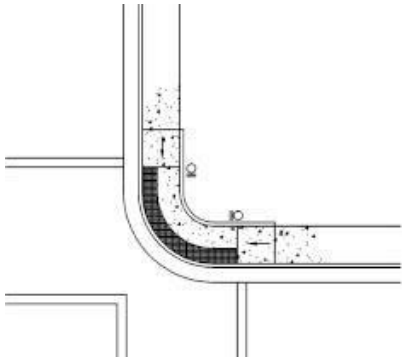
HANDRAIL AND PEDESTRIAN GUARDRAIL (PROWAG R408)				
Figures/Examples	**Requirements** [1]	**YES**	**NO**	**NA**
   	• The clear width of walking surfaces shall be 4.0 feet minimum. • Handrails are required on ramp runs with a rise greater than 6 inches and on certain stairways. Handrails are not required on walking surfaces with running slopes less than 1:20. Where required, handrails shall be provided on both sides of stairs and ramps. • Handrails shall be continuous within the full length of each stair flight or ramp run. Inside handrails on switchback or dogleg stairs and ramps shall be continuous between flights or runs. • Top of gripping surfaces of handrails shall be 34 inches minimum and 38 inches maximum vertically above walking surfaces, stair nosings, and ramp surfaces. Handrails shall be at a consistent height above walking surfaces, stair nosings, and ramp surfaces. • Clearance between handrail gripping surfaces and adjacent surfaces shall be 1 1/2 inches minimum. • Handrail gripping surfaces with a circular cross section shall have an outside diameter of 1 1/4 inches minimum and 2 inches maximum. • Handrail gripping surfaces with a non-circular cross section shall have a perimeter dimension of 4 inches minimum and 6 1/4 inches maximum, and a cross-section dimension of 2 1/4 inches maximum. • Handrail gripping surfaces and any surfaces adjacent to them shall be free of sharp or abrasive elements and shall have rounded edges. • Handrails shall not rotate within their fittings. • Ramp handrails shall extend horizontally above the landing for 12 inches minimum beyond the top and bottom of ramp runs. Extensions shall return to a wall, guard, or the landing surface, or shall be continuous to the handrail of an adjacent ramp run. • At the top of a stair flight, handrails shall extend horizontally above the landing for 12 inches minimum beginning directly above the first riser nosing. Extensions shall return to a wall, guard, or the landing surface, or shall be continuous to the handrail of an adjacent stair flight. • At the bottom of a stair flight, handrails shall extend at the slope of the stair flight for a horizontal distance at least equal to one tread depth beyond the last riser nosing. Extension shall return to a wall, guard, or the landing surface, or shall be continuous to the handrail of an adjacent stair flight. • See Edge Protection section above (also PROWAG 406.8) for additional details.			

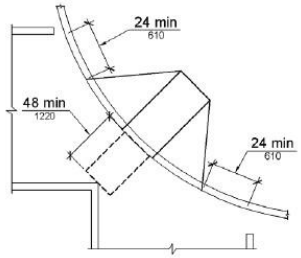
STAIRWAYS (PROWAG R407)				
Figures/Examples	**Requirements** [1]	**YES**	**NO**	**NA**
	• All steps on a flight of stairs shall have uniform riser heights and uniform tread depths. Risers shall be 4 inches high minimum and 7 inches high maximum. Treads shall be 11 inches deep minimum. • Open risers are not permitted. • The radius of curvature at the leading edge of the tread shall be 1/2 inch maximum. Nosings that project beyond risers shall have the underside of the leading edge curved or beveled. Risers shall be permitted to slope under the tread at an angle of 30 degrees maximum from vertical. The permitted projection of the nosing shall extend 1 1/2 inches maximum over the tread below. • Stairs shall have handrails complying with PROWAG 2005 R408.			

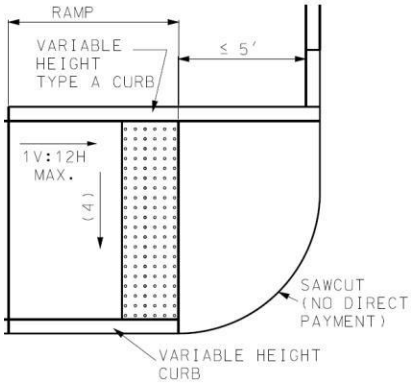
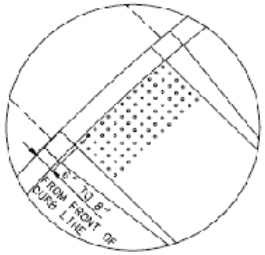
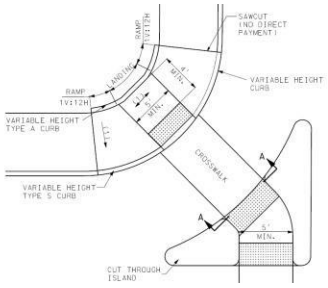
UNOBSTRUCTED REACH RANGES (PROWAG R4064)				
Figures/Examples	**Requirements** [1]	**YES**	**NO**	**NA**
 	Forward Reach • Where a forward reach is unobstructed, the high forward reach shall be 48 inches maximum and the low forward reach shall be 15 inches minimum above the finish floor or ground. Side Reach • Where a clear floor or ground space allows a parallel approach to an element and the side reach is unobstructed, the high side reach shall be 48 inches maximum and the low side reach shall be 15 inches minimum above the finish floor or ground. • EXCEPTION: An obstruction shall be permitted between the clear floor or ground space and the element where the depth of the obstruction is 10 inches maximum. (2011 PROWAG R406.3) 			

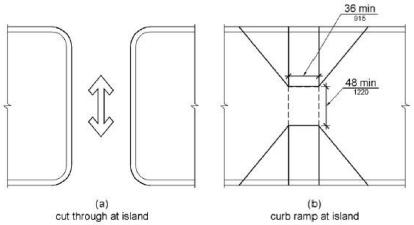
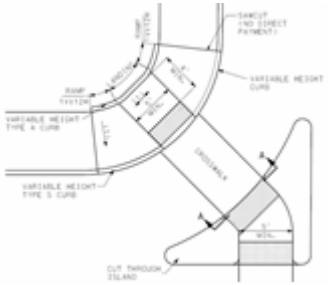
CURB RAMPS (PROWAG R303)				
Figures/Examples	**Requirements** [1]	**YES**	**NO**	**NA**
A curb ramp, blended transition, or a combination of curb ramps and blended transitions shall connect the pedestrian access routes at each pedestrian street crossing.     **15 Foot Rule:** For a compliant curb ramp to exceed 8.33 percent running grade, its constructed length must exceed 15.0 feet.	• The clear width of ramps, excluding the flares, shall be 4.0 feet minimum. • Ramp runs shall have a running slope between 5 percent minimum and 8.33 percent maximum but shall not require the ramp length to exceed 15.0 feet. **Exception: 15 Foot Rule:** The running slope for a curb ramp is not limited to 8.33 percent maximum if the constructed curb ramp length exceeds 15 feet in length. • Cross slope of ramp runs shall be 2 percent maximum. (Roadway Grade Exception may be considered) • The cross slope at midblock crossings shall be permitted to be warped to meet street or highway grade. • Ramps shall have landings at the top and the bottom of each ramp run. - The landing clear width shall be at least as wide as the widest ramp run leading to the landing. - The landing clear length shall be 5.0 feet long minimum. - Ramps that change direction between runs at landings shall have a clear landing 5.0 feet minimum by 5.0 feet minimum. • Handrails and Edge protection shall not be required on curb ramps and their landings. • Curb height = 0 inches within curb ramp spaces. 2 • Curb ramps must be flush with street. • The counter slope of the gutter or street at the foot of a curb ramp, landing, or blended transition shall be 5 percent maximum. (R303.3.5) • The adjacent surfaces at transitions at curb ramps to walks, gutters, and streets shall be at the same level. • Flared sides with a slope of 10 percent maximum, measured parallel to the curb line, shall be provided where a pedestrian circulation path crosses the curb ramp. - In alterations, where there is no landing at the top of curb ramps, curb ramp flares shall be provided and shall not be steeper than 1:12. • Detectable warning surfaces shall be provided, where a curb ramp, landing, or blended transition connects to a street. • Gratings, access covers, and other appurtenances shall not be located on curb ramps, landings, blended transitions, and gutters within the pedestrian access route. • Grade breaks shall not be permitted on the surface of curb ramps, blended transitions, landings, and gutter areas within the pedestrian access route. Surface slopes that meet at grade breaks shall be flush. • Grade Breaks at the top and bottom of curb ramp runs shall be perpendicular to the direction of the ramp run.			

Figures/Examples	Requirements [1]	YES	NO	NA
 Perpendicular Ramps  X = 4'Min. Flared Sides in Pathway Flared Sides Not in Pathway **Roadway Grade Exception:** Where curb ramps, landings and blended transitions are contained within a street or highway right-of-way, the grade of the pedestrian access route is permitted to be modified to equal the general grade established for the adjacent street or highway. 	• Perpendicular curb **ramps** shall have a running slope that cuts through or is built up to the curb at right angles or meets the gutter grade break at right angles. • The clear width of landings, blended transitions, and curb ramps, excluding flares, shall be 4.0 feet minimum. • The running slope shall be 5 percent minimum and 8.33 percent maximum but shall not require the ramp length to exceed 15.0 feet. • The cross slope at intersections shall be 2 percent maximum. (Roadway Grade Exception may be considered) • The cross slope at midblock crossings shall be permitted to be warped to meet street or highway grade. **Roadway Grade Exception**: The grade of pedestrian access routes within sidewalks is permitted to equal the general grade established for the adjacent street or highway. The cross slope of curb ramps, blended transitions, landings, and turning spaces at pedestrian street crossings without yield or stop control where vehicles can proceed through the intersection without slowing or stopping, and at midblock pedestrian street crossings are permitted to equal the street or highway grade. • A landing 4.0 feet minimum by 4.0 feet minimum shall be provided at the top of the curb ramp and shall be permitted to overlap other landings and clear space. • Flared sides with a slope of 10 percent maximum, measured parallel to the curb line, shall be provided where a pedestrian circulation path crosses the curb ramp. • If the flared sides are not in the pathway (grass next to ramp), then there is no maximum slope and can be vertical curbs. (See adjacent figure for further explanation.) • Detectable warning surfaces shall be provided, where a curb ramp, landing, or blended transition connects to a street. • Gratings, access covers, and other appurtenances shall not be located on curb ramps, landings, blended transitions, and gutters within the pedestrian access route. • Grade breaks at the top and bottom of perpendicular curb ramps shall be perpendicular to the direction of ramp run. At least one end of the bottom grade break shall be at the back of curb. • Grade breaks shall not be permitted on the surface of curb ramps, blended transitions, landings, and gutter areas within the pedestrian access route. Surface slopes that meet at grade breaks shall be flush. • Where both ends of the bottom grade break are 5.0 feet or less from the back of curb, the detectable warning shall be located on the ramp surface at the bottom grade break. Where either end of the bottom grade break is more than 5.0 feet from the back of curb, the detectable warning shall be located on the lower landing.			

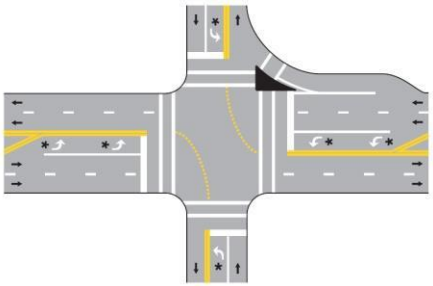
Figures/Examples	Requirements [1]	YES	NO	NA
 Curb Ramps and landings that are contained within a street or highway border may use the Roadway Grade Exception for slopes or cross slopes in the direction of the roadway travel being matched.	• **Parallel curb ramps** shall have a running slope that is in-line with the direction of sidewalk travel. • The clear width of landings, blended transitions, and curb ramps, excluding flares, shall be 4.0 feet minimum. • The running slope shall be 5 percent minimum and 8.33 percent maximum but shall not require the ramp length to exceed 15.0 feet. • The cross slope shall be 2 percent maximum. (Roadway Grade Exception may be considered) **Roadway Grade Exception**: The grade of pedestrian access routes within sidewalks is permitted to equal the general grade established for the adjacent street or highway. The cross slope of curb ramps, blended transitions, landings, and turning spaces at pedestrian street crossings without yield or stop control where vehicles can proceed through the intersection without slowing or stopping, and at midblock pedestrian street crossings are permitted to equal the street or highway grade. • A landing 4.0 feet minimum by 4.0 feet minimum shall be provided at the bottom of the ramp run and shall be permitted to overlap other landings and clear floor or ground space. • Where a parallel curb ramp does not occupy the entire width of a sidewalk, drop-offs at diverging segments shall be protected. • Detectable warning surfaces shall be provided, where a curb ramp, landing, or blended transition connects to a street. • Gratings, access covers, and other appurtenances shall not be located on curb ramps, landings, blended transitions, and gutters within the pedestrian access route. • Grade breaks shall not be permitted on the surface of curb ramps, blended transitions, landings, and gutter areas within the pedestrian access route. Surface slopes that meet at grade breaks shall be flush.			
	• **Blended Transitions** shall have a running slope of 5 percent maximum and cross slope shall be 2 percent maximum. • The clear width blended transitions, excluding flares, shall be 4.0 feet minimum. • Detectable warning surfaces shall be provided where a blended transition connects to a street. • Gratings, access covers, and other appurtenances shall not be located on blended transitions within the pedestrian access route. • Grade breaks at the top and bottom of perpendicular curb ramps shall be perpendicular to the direction of ramp run. At least one end of the bottom grade break shall be at the back of curb. Grade breaks shall not be permitted on the surface of blended transitions and gutter areas within the pedestrian access route. Surface slopes that meet at grade breaks shall be flush.			

Figures/Examples	Requirements [1]	YES	NO	NA
 	• **Diagonal Curb Ramps or corner type curb ramps are no longer preferred design types. A design that provides individual ramps for each crossing direction is recommended by the US Access Board.** • Diagonal Curb Ramps or corner type curb ramps with returned curbs or other well-defined edges shall have the edges parallel to the direction of pedestrian flow. • The bottom of diagonal curb ramps shall have a clear space 48 inches minimum outside active traffic lanes of the roadway. • Diagonal curb ramps provided at marked crossings shall provide the 48 inches minimum clear space within the markings. • Diagonal curb ramps with flared sides shall have a segment of curb 24 inches long minimum located on each side of the curb ramp and within the marked crossing. **Roadway Grade Exception**: The grade of pedestrian access routes within sidewalks is permitted to equal the general grade established for the adjacent street or highway. The cross slope of curb ramps, blended transitions, landings, and turning spaces at pedestrian street crossings without yield or stop control where vehicles can proceed through the intersection without slowing or stopping, and at midblock pedestrian street crossings are permitted to equal the street or highway grade. • Detectable warning surfaces shall be provided, where a curb ramp, landing, or blended transition connects to a street. • Gratings, access covers, and other appurtenances shall not be located on curb ramps, landings, blended transitions, and gutters within the pedestrian access route. • Grade breaks shall not be permitted on the surface of curb ramps, blended transitions, landings, and gutter areas within the pedestrian access route. Surface slopes that meet at grade breaks shall be flush. • Running and cross slope at midblock crossings shall be permitted to be warped to meet street or highway grade.			

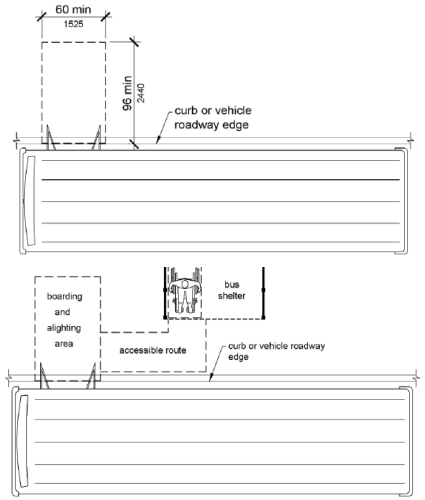
DETECTABLE WARNINGS DEVICES (TRUNCATED DOMES) (PROWAG R304)				
Figures/Examples	**Requirements [1]**	**YES**	**NO**	**NA**
A surface feature of truncated dome material built in or applied to the walking surface to advise of an upcoming change from pedestrian to vehicular way.    	• Detectable warnings shall consist of a surface of truncated domes aligned in a square or radial grid pattern complying with 2010 ADA Standards. Detectable warning surfaces shall contrast visually with adjacent gutter, street or highway, or walkway surfaces, either light-on-dark or dark-on-light. • Detectable warning surfaces shall extend 24 inches minimum in the direction of travel and the full width of the curb ramp (exclusive of flares), the landing, or the blended transition. Detectable warning surfaces are required where curb ramps, blended transitions, or landings provide a flush pedestrian connection to the street. • Sidewalk crossings of residential driveways should not generally be provided with detectable warnings, since the pedestrian right-of-way continues across most driveway aprons and overuse of detectable warning surfaces should be avoided in the interests of message clarity. However, where commercial driveways are provided with traffic control devices or otherwise are permitted to operate like public streets, detectable warnings should be provided at the junction between the pedestrian route and the street. • Perpendicular Curb Ramps: Where both ends of the bottom grade break are 5 feet or less from the back of curb, the detectable warning shall be located on the ramp surface at the bottom grade break. Where either end of the bottom grade break is more than 5 feet from the back of curb, the detectable warning shall be located on the lower landing. • Landings and Blended Transitions: The detectable warning shall be located on the landing or blended transition at the back of curb. • Rail Crossings: The detectable warning surface shall be located so that the edge nearest the rail crossing is 6 feet minimum and 15 feet maximum from the centerline of the nearest rail. The rows of truncated domes in a detectable warning surface shall be aligned to be parallel with the direction of wheelchair travel. • Detectable warnings at cut-through islands shall be located at the curb line in-line with the face of curb and shall be separated by a 2.0 foot minimum length of walkway without detectable warnings. Where the island has no curb, the detectable warning shall be located at the edge of roadway. • Exception, when detectable warnings are required by a manufacturer's installation specifications to be embedded into concrete with a surrounding edge, domes may be installed at less than the required full width. Under this exception, the detectable warning surface shall never be more than 2 inches from the edge of the curb ramp, the landing, or the blended transition. [2] • Detectable warnings shall not be stamped into concrete.			

ISLANDS AND MEDIANS (PROWAG R305.4)				
Figures/Examples	**Requirements** [1]	**YES**	**NO**	**NA**
  	• Medians and pedestrian refuge islands in crosswalks shall contain a pedestrian access route, including passing space and connecting to each crosswalk. • Raised islands in crossings shall be cut through level with the street or have curb ramps and required landings at both sides. • All median island passage spaces shall provide a clear width of 5 feet minimum. [2] • Medians and pedestrian refuge islands shall be 6.0 feet minimum in length in the direction of pedestrian travel. **<u>Roadway Grade Exception</u>**: The grade of pedestrian access routes within sidewalks is permitted to equal the general grade established for the adjacent street or highway. The cross slope of curb ramps, blended transitions, landings, and turning spaces at pedestrian street crossings without yield or stop control where vehicles can proceed through the intersection without slowing or stopping, and at midblock pedestrian street crossings are permitted to equal the street or highway grade. • Each curb ramp shall have a level area 48 inches long minimum by 36 inches wide minimum at the top of the curb ramp in the part of the island intersected by the crossings. • Each 48 inch minimum by 36 inch minimum area shall be oriented so that the 48 inch minimum length is in the direction of the running slope of the curb ramp it serves. The 48 inch minimum by 36 inch minimum areas and the accessible route shall be permitted to overlap. • Detectable warning surfaces shall be provided, where a curb ramp, landing, or blended transition connects to a street. Medians and pedestrian refuge islands shall have detectable warnings at curb ramps and blended transitions. • Detectable warnings at cut-through islands shall be located at the curb line in-line with the face of curb and shall be separated by a 2.0 foot minimum length of walkway without detectable warnings. Where the island has no curb, the detectable warning shall be located at the edge of roadway. • Gratings, access covers, and other appurtenances shall not be located on curb ramps, landings, blended transitions, and gutters within the pedestrian access route. • Grade breaks shall not be permitted on the surface of curb ramps, blended transitions, landings, and gutter areas within the pedestrian access route. Surface slopes that meet at grade breaks shall be flush.			

ACCESSIBLE PEDESTRIAN SIGNALS (PUSHBUTTONS) (PROWAG R306 and EPG 902.6.1 – EPG 902.6.15)				
Figures/Examples	**Requirements** [1]	**YES**	**NO**	**NA**
    	• Each crosswalk with pedestrian signal indication shall have an accessible pedestrian signal which includes audible and vibrotactile indications of the WALK interval at new signalized intersections and shall be considered at existing intersections being altered or are needing maintenance applications. Where a pedestrian pushbutton is provided, it shall be integrated into the accessible pedestrian signal. ~~← ON HOLD waiting for MoDOT Specs and APL~~ • Accessible pedestrian signals shall be located so that the vibrotactile feature can be contacted from the level landing serving a curb ramp, if provided, or from a clear floor or ground space that is in line with the crosswalk line adjacent to the vehicle stop line. • Accessible pedestrian pushbuttons shall be located within a reach range complying with ~~PROWAG 2005 R404~~EPG 642. • A clear floor or ground space shall be provided at the pushbutton and shall connect to or overlap the pedestrian access route. **Roadway Grade Exception**: Clear spaces required at accessible pedestrian signals and pedestrian pushbuttons and at other accessible elements are permitted to have a running slope or cross slope consistent with the grade of the adjacent pedestrian access route. • Pedestrian signals shall comply with PROWAG 2005 R306 and EPG 902.6.1 through 902.6.15. - Pushbuttons are a minimum 2 inches across in one dimension, raised (not recessed), contrast visually with the housing or mounting, and have a maximum force of 3.5~~5~~ pounds to activate operable parts. - The control face of the pushbuttons is installed parallel to the direction of the crosswalk it serves. - The location of pushbuttons for new construction ~~are~~ within a longitudinal distance of 5 feet maximum from the crosswalk line, and 18~~30~~ inches minimum to 6 feet maximum from the curb line. - For audible pedestrian signal devices only, pushbuttons are a minimum 10 feet apart ~~at crossings and a minimum 5 feet apart at islands or medians. This minimum distance may be waived for audible pushbuttons in medians and islands with the use of voice commands~~. - Pushbuttons are located at a height of approximately 42 inches, but no higher than 48~~2~~ inches from the ground and within 10 inch reach from a level paved landing with minimum dimensions of 48 inches x 30 inches positioned for a parallel approach to the pushbutton. For a forward approach space (30 x 48			

PEDESTRIAN STREET CROSSINGS (PROWAG R305 and EPG 642)				
Figures/Examples	**Requirements** [1]	**YES**	**NO**	**NA**
 	• Crosswalks shall contain a pedestrian access route that connects to departure and arrival walkways through any median or pedestrian refuge island. • Marked crosswalks shall be 6 feet wide minimum. • The grade of the pedestrian access route is permitted to equal the general grade established for the adjacent street or highway, except that where pedestrian access routes are contained within pedestrian street crossings a maximum grade of 5 percent is required. • A 5 percent maximum cross slope is specified for pedestrian access routes contained within pedestrian street crossings without yield or stop control. • Crossings with Stop Control: The cross slope shall be 2 percent maximum. • The cross slope at midblock crossings shall be permitted to be warped to meet street or highway grade. • The running slope shall be 5 percent maximum, measured parallel to the direction of pedestrian travel in the crosswalk. • Accessible pedestrian signals and pedestrian pushbuttons provided at pedestrian crossings with pedestrian signals (See EPG 642 for applicability) shall comply with EPG 902.6.8 through 902.6.15. Operable parts shall comply with EPG 902.6.9 – 902.6.15. ~~Where pedestrian signals are provided at pedestrian street crossings, they shall include accessible pedestrian signals and pedestrian pushbuttons complying with sections 4E.08 through 4E.13 of the MUTCD. Operable parts shall comply with R403. (2011 PROWAG R209.1) ← ON HOLD waiting for MoDOT Specs and APL~~ • Crosswalk pavement marking is 6 inches wide white. • Stop bar is at minimum 4 feet from the crosswalk. • Curb ramps at marked crossings shall be wholly contained within the markings, excluding any flared sides. • Gratings, access covers, and other appurtenances shall not be located on curb ramps, landings, blended transitions, and gutters within the pedestrian access route. • Grade breaks shall not be permitted on the surface of curb ramps, blended transitions, landings, and gutter areas within the pedestrian access route. Surface slopes that meet at grade breaks shall be flush.			

ALTERNATE CIRCULATION PATH (PROWAG R302)				
Figures/Examples	**Requirements [1]**	**YES**	**NO**	**NA**
	• Alternate circulation paths shall contain a pedestrian access route. • To the maximum extent feasible, the alternate circulation path shall be provided on the same side of the street as the disrupted route. • Where the alternate circulation path is exposed to adjacent construction, excavation drop-offs, traffic, or other hazards, it shall be protected with a pedestrian barricade or channelizing device complying with MUTCD 6F-58, 6F-63, and 6F-66. • Pedestrian barricades and channelizing devices shall be continuous, stable, and non-flexible and shall consist of a wall, fence, or enclosures specified in section 6F-58, 6F-63, and 6F-66 of the MUTCD (incorporated by reference; see PROWAG 2005 R104.2.4). • A detectable continuous bottom edge shall be provided 2 inches maximum above the ground or walkway surface. • Devices shall provide a continuous surface or upper rail at 3.0 feet minimum above the ground or walkway surface. • Support members shall not protrude into the alternate circulation path.			

BUS BOARDING AND ALIGHTING AREAS (PROWAG R410)				
Figures/Examples	**Requirements [1]**	**YES**	**NO**	**NA**
	• Bus stop boarding and alighting areas shall have a firm, stable surface. • Bus stop boarding and alighting areas shall provide a clear length of 8 feet minimum, measured perpendicular to the curb or vehicle roadway edge, and a clear width of 5 feet minimum, measured parallel to the vehicle roadway. • Bus stop boarding and alighting areas shall be connected to streets, sidewalks, or pedestrian paths by an accessible route. • Parallel to the roadway, the slope of the bus stop boarding and alighting area shall be the same as the roadway, to the maximum extent practicable. Perpendicular to the roadway, the slope of the bus stop boarding and alighting area shall not be steeper than2 percent. • Bus shelters shall provide a minimum 30 inch by 48 inch clear floor or ground space entirely within the shelter. • Bus shelters shall be connected by an accessible route to a boarding and alighting area.			

[1] Any “NO” answer means that location is ADA non-compliant and needs to be corrected before final acceptance of the work, except as follows. Although exceptions listed in the above requirements may not meet MoDOT current policy standards, work that does meet the minimum ADA standards will be accepted as ADA compliant. Where it is technically infeasible to correct deficiencies as part of the current work, those locations will be labeled as non-compliant and marked “NO”. These items will be added to the Transition Plan Inventory for correction at a later date. (Guidance is provided in ADA documents and in the EPG on what may be considered as technically infeasible.)

[2] A MoDOT requirement.

Unless otherwise noted, all notes on this form are direct ADA requirements as published in either the PROWAG dated November 23, 2005 or ADA/ABA Standards from 2010.

All exceptions and technically infeasible locations should be discussed with the project manager and/or area engineer prior to acceptance of the work. All exceptions and technically infeasible locations will need to be thoroughly documented by the engineer, and that documentation will be attached to this form and retained as part of the final acceptance records.

All slope and grade measurements for ADA compliance will be made using a calibrated 2 foot long digital level.

US Access Board PROWAG

R202.3.1 Prohibited Reduction in Required Access. An alteration shall not decrease or have the effect of decreasing the accessibility of a facility or an accessible connection to an adjacent building or site below the requirements for new construction in effect at the time of the alteration.

Inspector Name: _____ **Inspector Signature:** _____	**Date:**
Resident Engineer or Area Engineer Name: _____ **Resident Engineer or Area Engineer Signature:**	**Date:**
Distribution: ❑ **Project Office** ❑ **District Permit Office**	

SAMPLE

ADA EXCEPTIONS DOCUMENTATION

Job No._____ **Route**_____ **County**_____ **Location**_____

Item	Location	Standard	As Built	Discussion
Sidewalk Width	Third Street Sta 3+00 to 7+00 RT	5' wide	Exist 3' wide	Required 5' x 5' Passing Space added at 5+00
Curb Ramp Grade	SE Quad of Main & First	8.33%	11.2%	As-built Curb Ramp is 16.0' long
Parallel Ramp Landing running grade	Sta 35+20 to 35+25 Rt Rte 14 (turning space)	2.00%	2.6%	Landing running grade matches existing roadway grade
Sidewalk Grade	Sta 23+45 to 23+52	5.0%	8.4%	Match existing floor at two exist doorways, Straight grade between fixed elevations

Inspector Name: _____ **Inspector Signature:** _____	**Date:**
Resident Engineer or Area Engineer Name: _____ **Resident Engineer or Area Engineer Signature:**	**Date:**
Distribution: ❑ **Project Office** ❑ **District Permit Office**	

902.12 Flashing Beacons (MUTCD Chapter 4L)

From Engineering Policy Guide
Jump to: navigation, search

Contents

[hide]

902.12.1 General Design and Operation of Flashing Beacons (MUTCD Section 4L.01)

Support. A Flashing Beacon is a highway traffic signal with one or more signal sections that operates in a flashing mode. It can provide traffic control when used as an intersection control beacon (see EPG 902.12.2) or it can provide warning when used in other applications (see EPG 902.12.3 through EPG 902.12.5).

When used with good judgment, the installation of a flashing beacon can be an extremely effective traffic control device. However, indiscriminate use degrades their effectiveness and affects the usefulness of other flasher installations. Flashing beacons can be installed by MoDOT or by outside parties. An engineering study is to be performed to determine the need for them.

Flashing beacons can be used in a number of different applications. The installation of flashing beacons at any location on the State Highway System is to be approved by the District Engineer. Likewise, the removal of any flashing beacons installed by MoDOT over any roadway shall also have prior approval from the District Engineer.

A number of flashing beacons present on state highways were installed and are operated by others. No concerted attempt to have them removed is to be engaged in except when such a flasher is considered a potential safety problem to the motoring public, or conditions have changed so a flasher is no longer needed. If these conditions occur, the organization operating the flasher is to be encouraged to remove it. However, if its operation is considered to be important to traveler safety, consideration is to be given for MoDOT to assume responsibility for operating and maintaining the flasher.

Standard. Flashing Beacon units and their mountings shall comply with the provisions of EPG 902.5, except as otherwise provided in this article.

Beacons shall be flashed at a rate of not less than 50 or more than 60 times per minute. The illuminated period of each flash shall be a minimum of 1/2 and a maximum of 2/3 of the total cycle.

A beacon shall not be included within the border of a sign except for SCHOOL SPEED LIMIT sign beacons (see EPG 902.12.4 and MUTCD Section 7B.15).

Guidance. If used to supplement a warning or regulatory sign, the edge of the beacon signal housing should normally be located no closer than 12 in. outside of the nearest edge of the sign.

Option. An automatic dimming device may be used to reduce the brilliance of flashing yellow signal indications during night operation.

902.12.2 Intersection Control Beacon (MUTCD Section 4L.02)

Standard. An Intersection Control Beacon shall consist of one or more signal faces directed toward each approach to an intersection. Each signal face shall consist of one or more signal sections of a standard traffic signal face, with flashing CIRCULAR YELLOW or CIRCULAR RED signal indications in each signal face. They shall be installed and used only at an intersection to control two or more directions of travel.

Application of Intersection Control Beacon signal indications shall be limited to the following:

A. Yellow on one route (normally the major street) and red for the remaining approaches, and
B. Red for all approaches (if the warrant described in EPG 903.5.4.3 for a multi-way stop is satisfied).

Flashing yellow signal indications shall not face conflicting vehicular approaches.

A STOP sign shall be used on approaches to which a flashing red signal indication is displayed on an Intersection Control Beacon (see MUTCD Section 2B.04).

If two horizontally aligned red signal indications are used on an approach for an Intersection Control Beacon, they shall be flashed simultaneously to avoid being confused with grade crossing flashing-light signals. If two vertically aligned red signal indications are used on an approach for an Intersection Control Beacon, they shall be flashed alternately.

All intersection control beacons shall be installed and/or maintained to provide a clearance over the roadway of 16 ft. to 19 feet.

A pole on state right of way owned by others shall not be used to support a span wire flasher. If an adjustment of the location for a department installed pole cannot be made, the existing pole shall be moved at the expense of the owner.

Hybrid beacons (pedestrian and emergency) are not considered an intersection control beacon and are not subject to provisions stated in the section. Refer to EPG 902.6 and EPG 902.7 for provisions for pedestrian and emergency hybrid beacons, respectively.

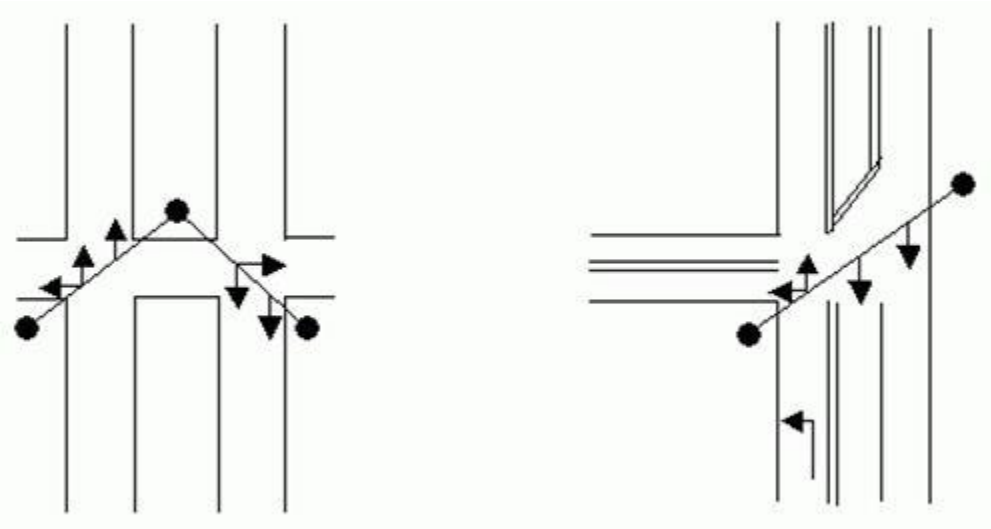
Guidance. An Intersection Control Beacon should not be mounted on a pedestal in the roadway unless the pedestal is within the confines of a traffic or pedestrian island.

Option. Where there are two or more approach lanes, it is desirable to center a head over each lane; however, one head per approach is acceptable.

Guidance. Conditions for which intersection beacons should be considered are:

- A required stop after a long period of uninterrupted speed,
- A required stop on a long tangent section of roadway where cross-street traffic may have trouble judging the distance and speed of an oncoming vehicle,
- A stop condition not readily visible to the approaching driver,
- A situation where traffic on the major roadway may not be aware of cross-street traffic.

Standard. When an overhead flasher is authorized for installation at an intersection, the support pole shall be placed in accordance with the AASHTO *Roadside Design Guide* clear zone guidelines.



Typical Flasher Layouts

Option. Supplemental signal indications may be used on one or more approaches in order to provide adequate visibility to approaching road users.

Intersection Control Beacons may be used at intersections where traffic or physical conditions do not justify conventional traffic control signals but crash rates indicate the possibility of a special need.

An Intersection Control Beacon is generally located over the center of an intersection; however, it may be used at other suitable locations.

902.12.3 Warning Beacon (MUTCD Section 4L.03)

Support. Typical applications of Warning Beacons include the following:

- A. At obstructions in or immediately adjacent to the roadway;
- B. As supplemental emphasis to warning signs;
- C. As emphasis for midblock crosswalks;
- D. As supplemental emphasis to regulatory signs, except STOP, DO NOT ENTER, WRONG WAY and SPEED LIMIT signs (see EPG 902.12.4 Speed Limit Sign Beacons) ; and
- E. In conjunction with a regulatory or warning sign that includes the phrase WHEN FLASHING in its legend to indicate that the regulation is in effect or that the condition is present only at certain times.

Standard. A Warning Beacon shall consist of one or more signal sections of a standard traffic signal face with a flashing CIRCULAR YELLOW signal indication in each signal section. A Warning Beacon shall be used only to supplement an appropriate warning or regulatory sign or marker.

Warning Beacons, if used at intersections, shall not face conflicting vehicular approaches.

If a Warning Beacon is suspended over the roadway, the clearance above the pavement shall be a minimum of 16 ft. and a maximum of 19 feet.

Guidance. The condition or regulation justifying Warning Beacons should largely govern their location with respect to the roadway.

If an obstruction is in or adjacent to the roadway, illumination of the lower portion or the beginning of the obstruction or a sign on or in front of the obstruction, in addition to the beacon, should be considered.

Warning Beacons should be operated only during those periods or times when the condition or regulation exists.

Option. Warning Beacons that are actuated by pedestrians, bicyclists, or other road users may be used as appropriate to provide additional warning to vehicles approaching a crossing or other location.

If Warning Beacons have more than one signal section, they may be flashed either alternately or simultaneously.

A flashing yellow beacon interconnected with a traffic signal controller assembly may be used with a traffic signal warning sign (see MUTCD Section 2C.36).

Warning beacons may be installed in conjunction with school advance signing or in conjunction with a school speed limit assembly at the request of the school district and at their cost.

Warning beacons may be installed in conjunction with emergency vehicle advance signing at the request of the emergency vehicle service district and at their cost.

Standard. School warning beacons only operate when there is activity at the school or school crossing. When school speed limit signing is installed, beacons shall be installed with the school speed limit signing. The beacons are only activated at times when the school speed limit applies.

Emergency vehicle warning beacons are set up to operate only when emergency vehicles are exiting the station or garage on a duly authorized emergency run. As with the school beacons, these beacons enhance the meaning of the advanced signing by only flashing when emergency activity is occurring.

See EPG 902.12.7 Procedures For Advance Beacon Installations by Outside Parties for additional information regarding school and emergency vehicle warning beacons.

902.12.4 Speed Limit Sign Beacon (MUTCD Section 4L.04)

Standard. A Speed Limit Sign Beacon shall be used only to supplement a Speed Limit sign.

A Speed Limit Sign Beacon shall consist of one or more signal sections of a standard traffic control signal face, with a flashing CIRCULAR YELLOW signal indication in each signal section. The signal indications shall have a nominal diameter of not less than 12 inches. If two signal indications are used, they shall be vertically aligned. If two signal indications are used, they shall be alternately flashed.

If used, the phrase WHEN FLASHING is required to be in the legend or on a supplemental plaque.

Option. A Speed Limit Sign Beacon may be used with a fixed or variable Speed Limit sign. If applicable, a flashing Speed Limit Sign Beacon (with an appropriate accompanying sign) may be used to indicate that the displayed speed limit is in effect.

A Speed Limit Sign Beacon may be included within the border of a School Speed Limit (S5-1) sign (see MUTCD Section 7B.15).

902.12.5 Stop Beacon (MUTCD Section 4L.05)

Standard. A Stop Beacon shall be used only to supplement a STOP sign, a DO NOT ENTER sign, or a WRONG WAY sign.

A Stop Beacon shall consist of one or more signal sections of a standard traffic signal face with a flashing CIRCULAR RED signal indication in each signal section. If two horizontally aligned signal indications are used for a Stop Beacon, they shall be flashed simultaneously to avoid being confused with grade crossing flashing-light signals. If two vertically aligned signal indications on the same structure are used for a Stop Beacon, they shall be flashed alternately.

If mounted above a STOP sign, a DO NOT ENTER sign, or a WRONG WAY sign the bottom of the signal housing of a Stop Beacon shall be not less than 12 in. or more than 24 in. above the top of the sign. If mounted below a STOP sign, a DO NOT ENTER sign, or a WRONG WAY sign the top of the signal housing of a Stop Beacon shall be not less than 12 in. or more than 24 in. (only used when an additional sign is used below, i.e. Divided Highway, All Way, etc.) below the bottom of the sign.

902.12.6 Interactive Flashing Beacons

Option. Types of interactive flashing beacons may be any of the previously mentioned types of beacons. These beacons may be accompanied with signs that reinforce the message. Examples include: beacons activated by approaching traffic or excessive speed, beacons used to give advance warning of a yellow change interval at a signalized intersection or beacons used to notify motorists of traffic stopped ahead. Beacons activated by approaching traffic may be used where sight distance is limited and cross-street traffic may have trouble judging the distance and speed of approaching traffic. Beacons activated when motorists exceed a posted speed may be used where conditions require a reduction in traffic speed. Examples of this use include low speed curves or where drivers regularly exceed the posted speed limit. Beacons activated a few seconds before (or at the start of) the yellow change interval at a signalized intersection may be used to give high speed traffic advance warning of the signal changing from green to yellow.

Standard. Interactive flashing beacons shall be activated only when required.

902.12.7 Procedures fFor Advance Beacon Installations by Outside Parties

Standard. Advance beacons such as: school warning, school speed limit, and emergency vehicle warning beacons are installed under contract. The district will obtain appropriate signed contracts and will follow execution guidelines in EPG 153.20.~~to be sent to Central Office Traffic for further handling~~. These contracts deal with the installation and transfer of ownership of the installation from the outside party to the Commission.

Support. The following standard contracts are available:

- TR8 - Installation of Roadside Flashers for School Operation
- TR26 - Installation of Roadside Flashers for Emergency Vehicle Operation

See EPG 902.17 Execution of Contracts for Signal or Flasher Installation for additional information on execution of contracts.

Standard. Plans for installation shall be the responsibility of the outside party and shall conform to the latest standards of MoDOT.

Once the contract is executed, a permit to work on MoDOT's right-of-way shall be obtained by the outside party. Once issued, the outside party may proceed to install the beacons. A contractor or the outside party shall complete the installation; however, a licensed electrician shall supervise the installation. The outside party needs to coordinate with MoDOT prior to installation of the flasher to have MoDOT personnel verify hardware and equipment is acceptable for use on the state highway system. Upon completion of installation, MoDOT personnel shall verify correct installation prior to release of the permit and acceptance of the flasher

General ~~L~~layouts are illustrated in Fig. 902.11 Advanced Flasher Figures and equipment listed in Appendix. School speed limit flasher specific information is listed in School Flasher Packet.

All costs shall be the responsibility of the outside party. This includes but is not limited to installation and power. All specifications shall be met to ensure the proper signing and installation is in place.

Beacons shall be active only during those times when the conditions of the advance signing are applicable or when the enhancement of the signed message is needed. The times of operation, timing, and method of operation are approved by MoDOT.

The contract shall establish responsibility for future maintenance, power costs, programming ownership, and replacement equipment.

Flashing beacons shall only be installed on advanced signing or on school speed limit signing.

Only one flasher shall be permitted per approach.

Parts List and Specifications
Advance Flasher Assembly Installed by Outside Party

1. One, twelve (12) inch black signal head with post mount hardware and 12" LED indicatoin, five (5) inch black back plate, tunnel visor and hardware.

2. One, four and one-half (4-1/2) inch outside diameter pedestal post and pedestal base. Length of post is to be determined as needed to meet dimensions on the attached drawing. The horizontal distance of the post from the pavement shall be as per the attached drawings.

3. One Type C concrete base.

4. Minimum two inch (2") rigid conduit.

5. Signs and mounting brackets supplied by the Missouri Highway and Transportation Commission. Installation of signs is the responsibility of the outside party. Signs shall be installed using stainless steel straps and sign bracket.

6. One fused slip connector assembly required on each control or power cable conductor in the base of the post. If control enclosure is on the post, the fuse shall be 15 amps, if the control enclosure is remote, the fuse shall be 3 amps.

7. Wiring shall be as follows (120 Volt Systems):

Control Wires From Control Equipment to Beacon

Max. Length of Wire Run	Min. Cable Size
1100 Feet	#12 AWG
1850 Feet	#10 AWG
2830 Feet	#8 AWG

Power Cables From Power Source to Control Enclosure

Max. Length of Wire Run	Min. Cable Size
1220 Feet	#8 AWG
1950 Feet	#6 AWG

8. One NEMA 4 aluminum or stainless steel enclosure that contains the necessary equipment to operate the beacon as shown on the attached wiring diagram specified by the Commission. The enclosure shall be of sufficient size to house all specified equipment. The control enclosure shall be mounted on the control pedestal or on the sign post as specified by the Commission. If the control enclosure is mounted on the sign post, it shall be located directly behind the warning sign.

If a special event is needed, contact MoDOT representative for approval and who could program the event.

9. The power will be provided by the outside party, by a separate power drop to the control pedestal with the meter installed on the control pedestal as approved by the Commission or a 12 Volt DC solar system.

   - For 120 Volt power sources, a separate disconnect enclosure shall be provided on the control pedestal. The control pedestal shall be located as close to the right-of-way as possible or, if the power source is on the right-of-way, as close to the power source as possible. Also the meter and power disconnect breaker box shall not be located on the flasher post. The power disconnect breaker shall be located within the right of way as close to the right of way line as possible.

   - For 12 Volt DC solar systems, an 85W (Watt) or greater solar panel and a 100ah (amp hour) or greater battery is required.

10. All applicable equipment shall conform to the Missouri Department of Transportation applicable Standard Specifications and Standard Plans.

    An equipment list of proposed items to be used and a layout of the entire installation shall be submitted to the engineer for approval before ordering equipment. All equipment to be maintained by the Commission shall be located on the right-of-way.

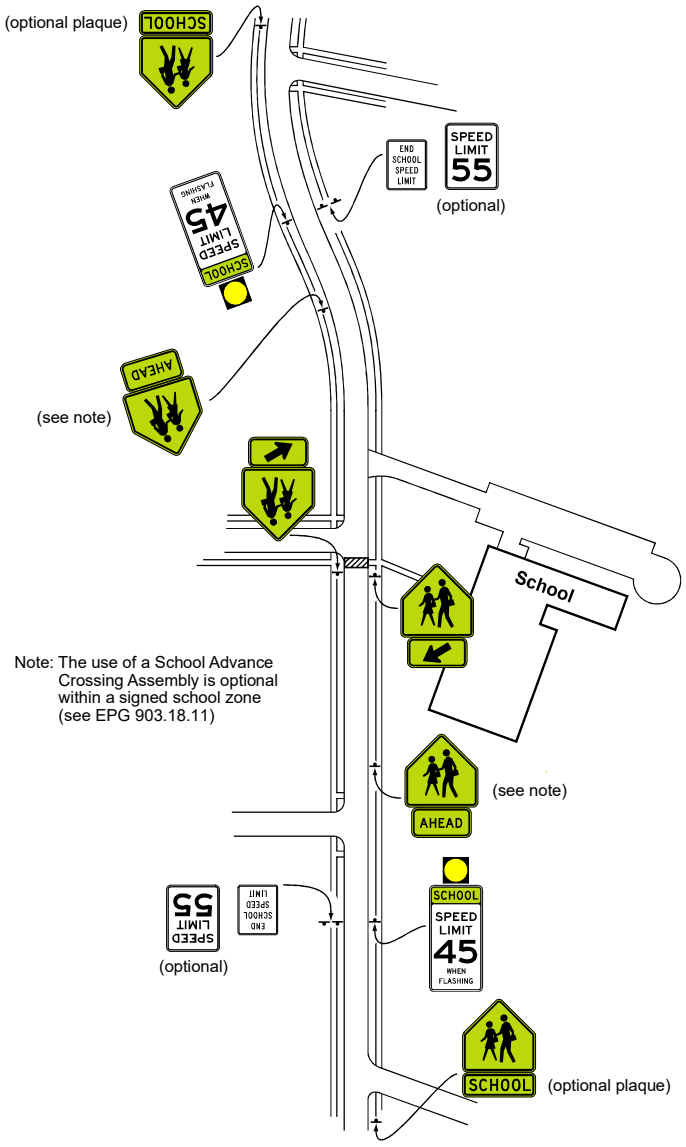


Figure 1: EPG Fig. 903.18.14.1, Example of Signing for a School Zone with a School Speed Limit and a School Crossing

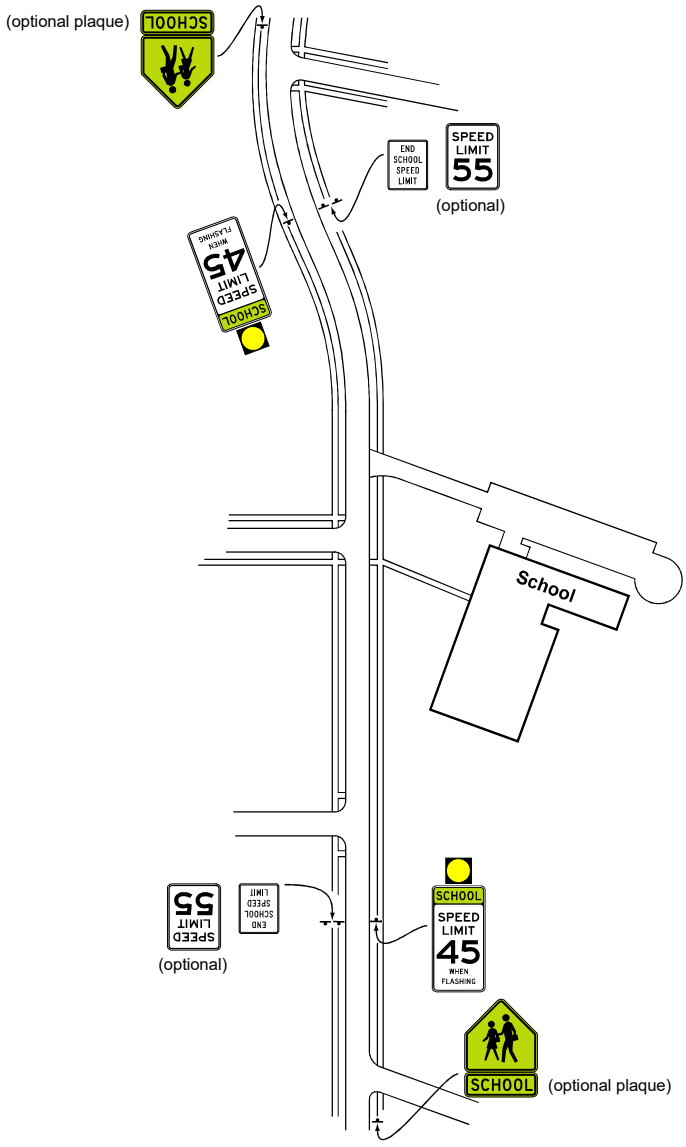


Figure 2: EPG Fig. 903.18.14.2, Example of School Zone with Signing for a School Speed Limit without a School Crossing

Note: Location of school flasher and school signing is to be determined by MoDOT personnel as per EPG 903.18 Signing for School Areas

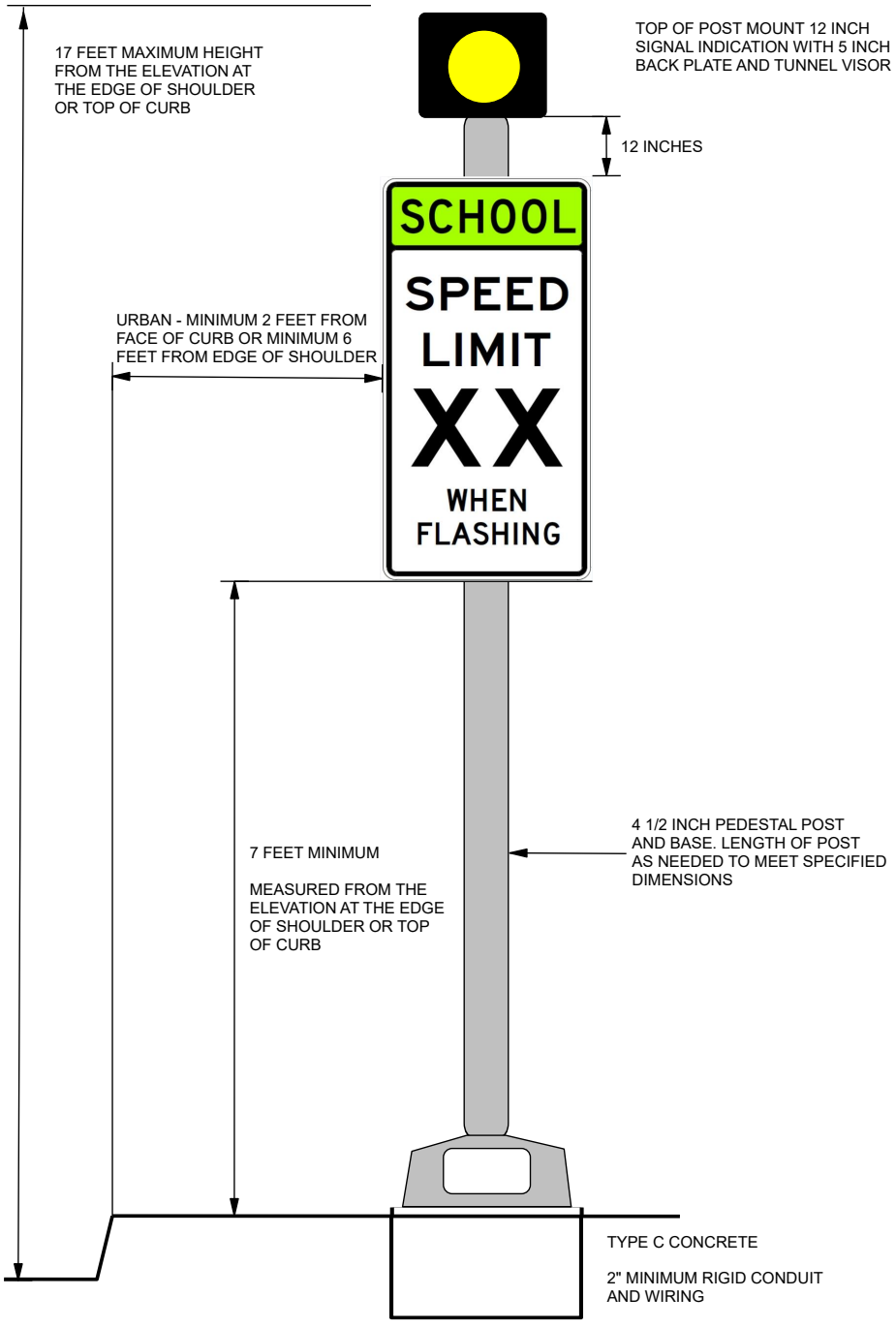
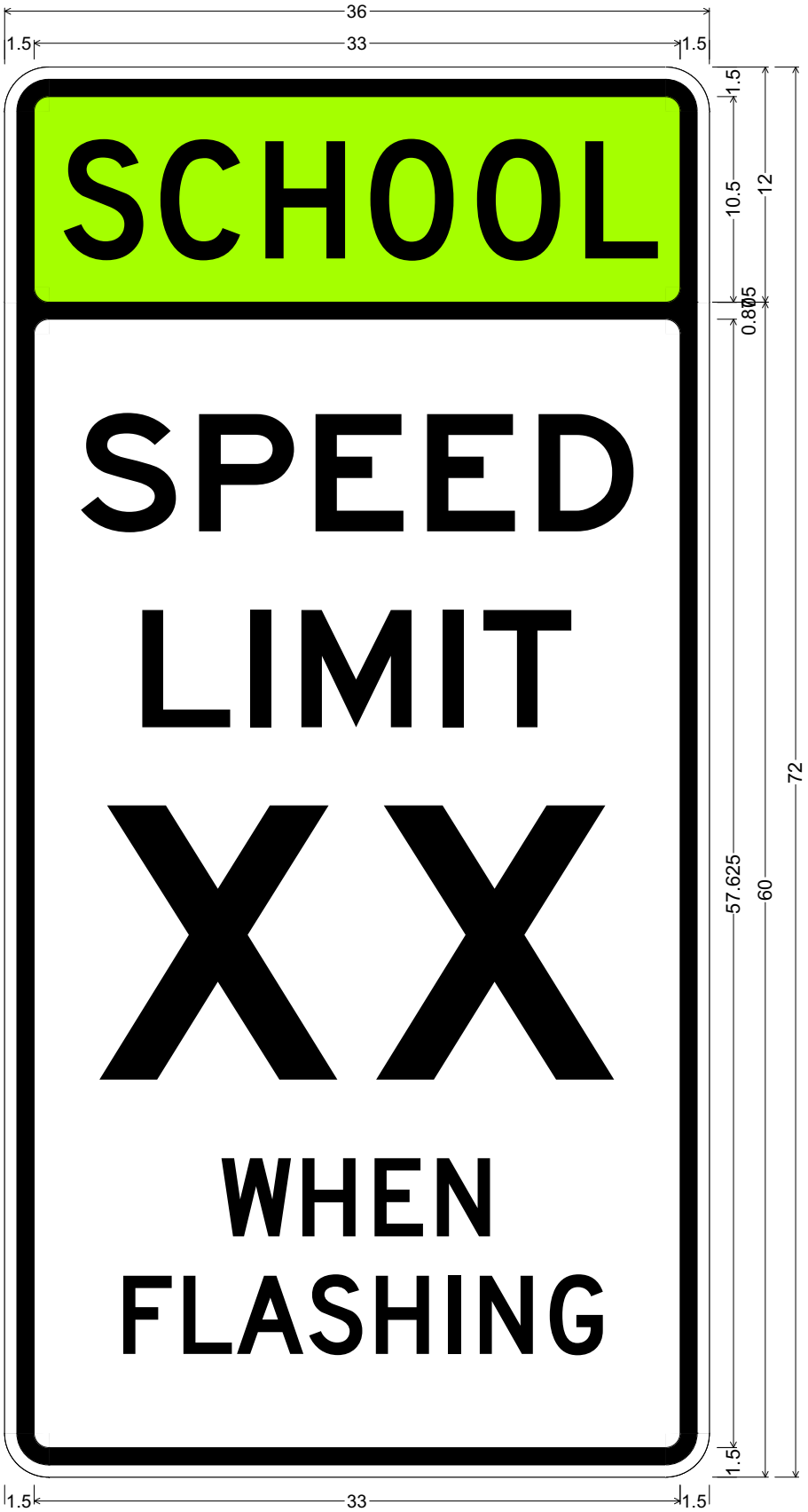
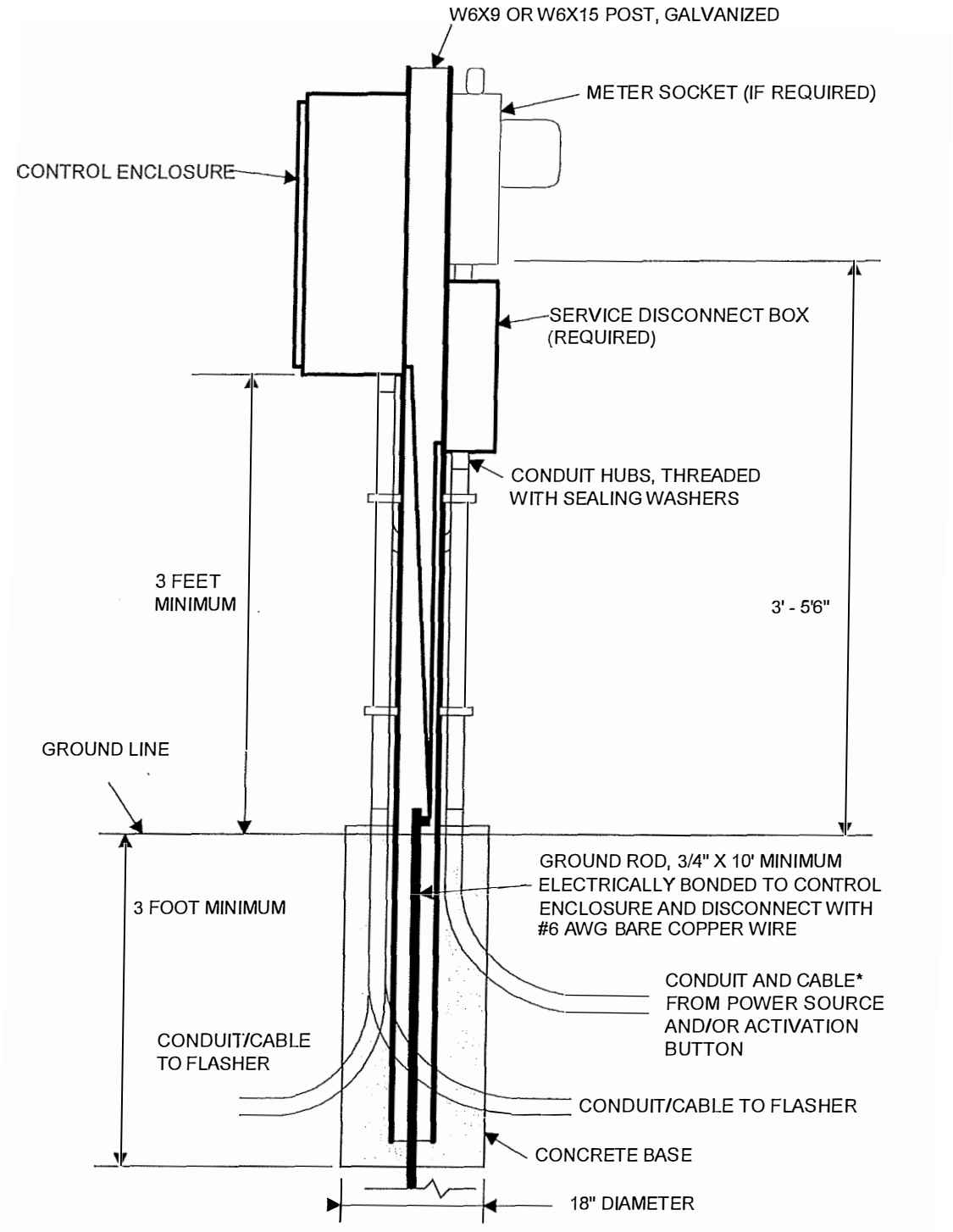


Figure 3: ADVANCE FLASHER WITH WARNING SIGN OR SPEED LIMIT



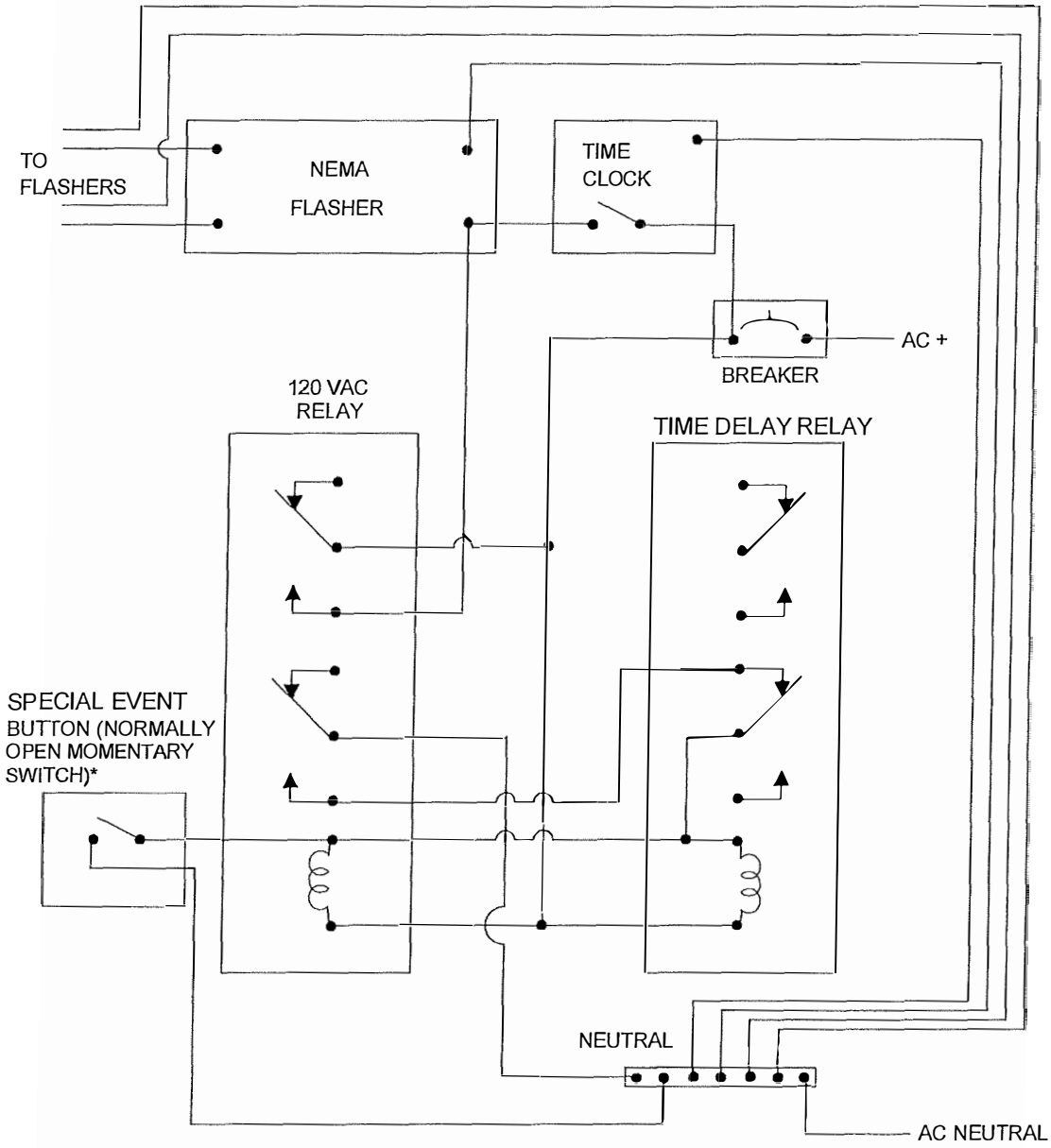
S5-1 SH-FLAT SHEET;
2.250" Radius, 0.625" Border, White on Black;
Rounded Rectangle 0.750" Radius Bright yellow green;
2.250" Radius, 0.625" Border, White on Black;
Rounded Rectangle 0.750" Radius;

Figure 4: Speed Limit Sign Specifications



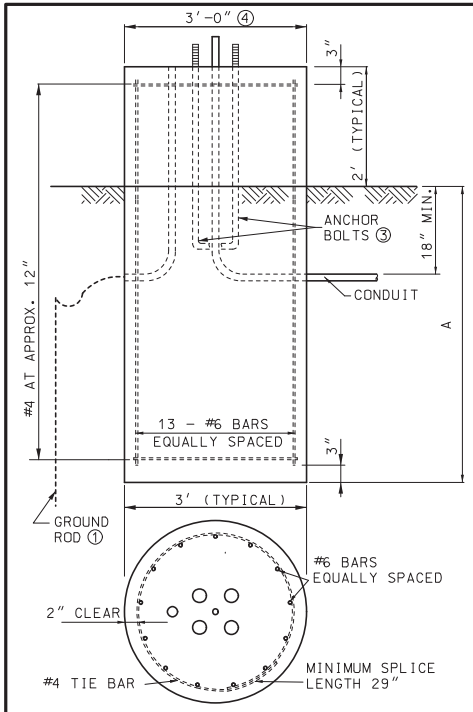
* IF POWER SOURCE IS THE UTILITY COMPANY, MINIMUM 2" RIGID STEEL CONDUIT

CONTROL PEDESTAL FOR ADVANCE FLASHER

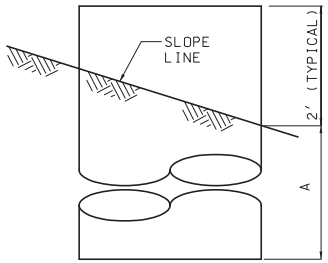


RELAYS - 8 PIN OCTAL BASE WITH MINIMUM 5 AMP CONTACTS
TIME DELAY RELAY - SSAC INC. TUD 120VAC OR EQUIVALENT
ALL WIRING SHALL BE #12 AWG MINIMUM
BREAKER - 15 AMP
TIME CLOCK SHALL CONFORM TO APPLICABLE STANDARD SPECIFICATIONS AND THE APPROVED PRODUCTS LIST

WIRING DIAGRAM FOR ADVANCE FLASHER -TIME CLOCK ACTIVATION

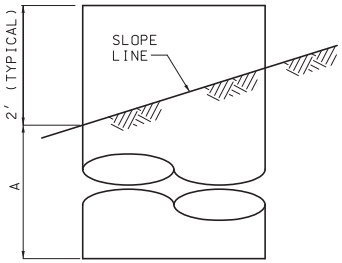


TYPE A (FLAT GROUND)



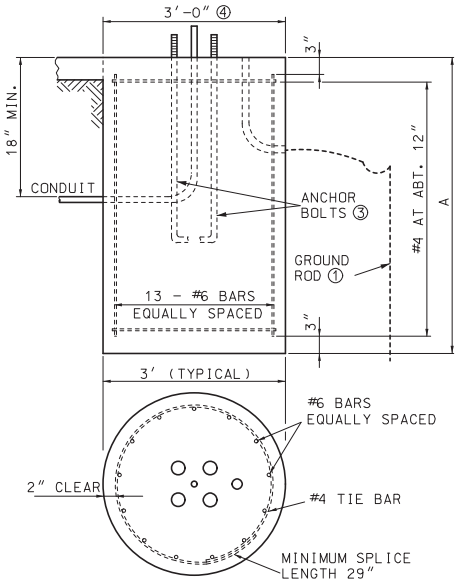
TYPE A (FILL)

(FOR ADDITIONAL DETAILS SEE TYPE A FLAT GROUND)

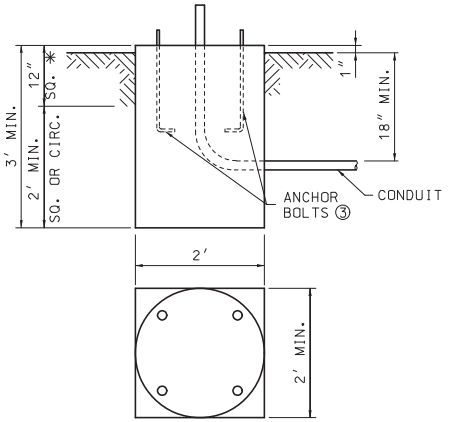


TYPE A (CUT)

(FOR ADDITIONAL DETAILS SEE TYPE A FLAT GROUND)



TYPE F



✳ SURFACE OF BASE TO BE CONSTRUCTED SQUARE FOR A DEPTH OF 12″.

TYPE C

POST BASES

POST BASES		
POST TYPE	ARM LENGTH (FEET) ⑤	BASE TYPE ⑥
C OR CL	15 – 25	A-9 OR F-9
C OR CL	30 – 35	A-9.5 OR F-9.5
C OR CL	40 – 55	A-10.5 OR F-10.5
B OR BL	15 – 25	A-10 OR F-10
B OR BL	30 – 35	A-11 OR F-11
B OR BL	40 – 55	A-12 OR F-12

STEEL AND CONCRETE REQUIREMENTS FOR POST BASES ⑨				
BASES		#6 STEEL BAR		CONC. C.Y.
TYPE	A ⑦	LENGTH	WEIGHT LBS. ⑧	
A-9	9′-0″	10′-6″	300	2.88
A-9.5	9′-6″	11′-0″	310	3.01
A-10	10′-0″	11′-6″	320	3.14
A-10.5	10′-6″	12′-0″	330	3.27
A-11	11′-0″	12′-6″	350	3.40
A-12	12′-0″	13′-6″	380	3.67
F-9	9′-0″	8′-6″	240	2.36
F-9.5	9′-6″	9′-0″	250	2.49
F-10	10′-0″	9′-6″	270	2.62
F-10.5	10′-6″	10′-0″	280	2.75
F-11	11′-0″	10′-6″	300	2.88
F-12	12′-0″	11′-6″	320	3.14
C✳				0.44

✳ SURFACE OF BASE TO BE CONSTRUCTED SQUARE FOR A DEPTH OF 12″.

BASE EMBEDMENT IN SOLID ROCK	
SOLID ROCK ENCOUNTER POINT	REQUIRED EMBEDMENT FOR BASE TYPE A-10 F-10
AT SURFACE	4′-9″
AT ONE-FOURTH NORMAL DEPTH	4′-0″
AT ONE-HALF NORMAL DEPTH	3′-3″
AT THREE-FOURTHS NORMAL DEPTH	1′-3″

1. REQUIRED EMBEDMENT DEPTHS CAN BE INTERPOLATED BETWEEN ENCOUNTER POINTS FOR OTHER SOLID ROCK ENCOUNTER DEPTHS.
2. NORMAL LENGTHS FOR ANCHOR BOLTS AND REINFORCING STEEL WILL BE REQUIRED.
3. CORE DRILL HOLES FOR ANCHOR BOLTS AND REINFORCING STEEL IN SOLID ROCK SHALL BE PROVIDED. CORE DRILL HOLES SHALL BE TWICE THE DIAMETER OF THE ANCHOR BOLT AND REINFORCING STEEL DIAMETER AND TO WITHIN 3 INCHES OF THE NORMAL BASE DEPTH.
4. IF SOIL, SHALE, GRAVEL, FRACTURED ROCK, OR VOIDS ARE ENCOUNTERED DURING CORE DRILLING, THE ROCK SHALL BE REMOVED TO THE POINT OF ENCOUNTER.
5. ANCHOR BOLTS AND REINFORCING STEEL SHALL BE GROUTED IN THE CORE DRILL HOLES WITH NON-SHRINK GROUT HAVING A MINIMUM STRENGTH OF 9,000 POUNDS IN 24 HOURS.
6. STRAIGHT ANCHOR BOLTS OF THE LENGTH SHOWN IN THE ANCHOR BOLT TABLE UNDER THE COLUMN "BOLT LENGTH" ARE ADEQUATE FOR USE IN GROUTED CORE DRILLED HOLES.

① APPLICABLE ONLY WHERE CONTROLLER IS MOUNTED TO A SIGNAL POLE.

② BASE PLATE SHALL STAY WITHIN THE TOP OF THE POST BASE DIAMETER.

③ ANCHOR BOLT DIMENSIONS ARE SHOWN ON THE MANUFACTURER'S APPROVED DRAWINGS.

④ MAXIMUM BOLT CIRCLE DIAMETER IS 26″. BASE PLATE SHALL STAY WITHIN THE TOP OF THE POST BASE DIAMETER.

⑤ ARM LENGTH DETERMINED BY LENGTH OF LONGEST ARM FOR TYPE B & BL SIGNAL POSTS.

⑥ BASE TYPE A OR F DETERMINED BY LOCATION OF POST BASE.

⑦ SOIL DEPTH, NO ROCK.

⑧ WEIGHT INCLUDES #4 TIE BARS.

⑨ WHEN CONCRETE BASE IS LOCATED WITHIN 8″ CONCRETE DIVISIONAL ISLAND, EMBEDMENT LENGTH MAY BE REDUCED BY ½ DIAMETER OF THE DRILLED SHAFT.

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

STATE OF MISSOURI NICOLE A. KOLB HOOD NUMBER PE-2001018754 PROFESSIONAL ENGINEER
THIS SHEET HAS BEEN SIGNED, SEALED AND DATED ELECTRONICALLY.

TRAFFIC SIGNALS

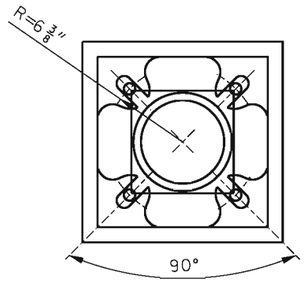
POST BASES

DATE EFFECTIVE: 07/01/2019
DATE PREPARED: 5/20/2019

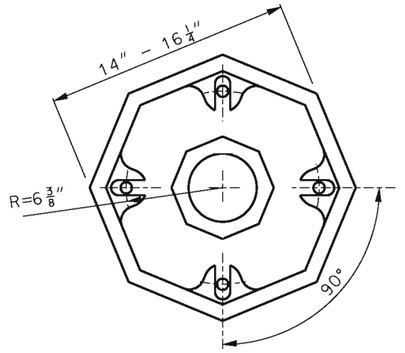
902.30P

SHEET NO. 1 OF 2

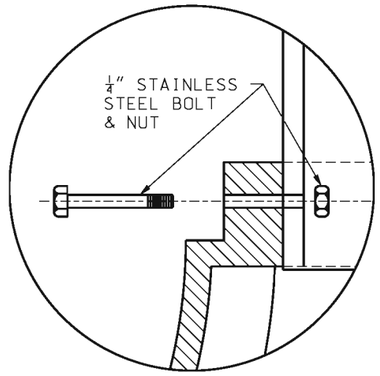
IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.



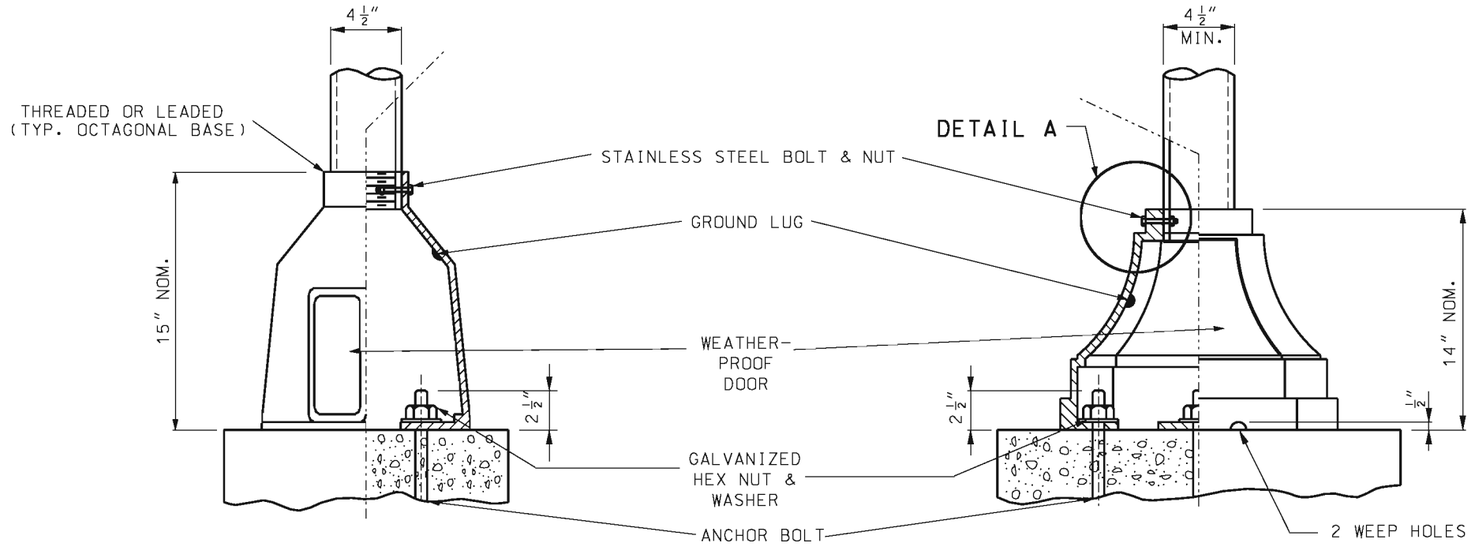
BOLT CIRCLE



BOLT CIRCLE



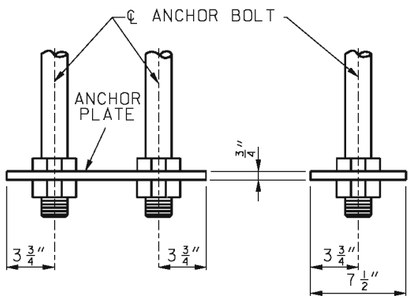
DETAIL A



SQUARE

OCTAGONAL

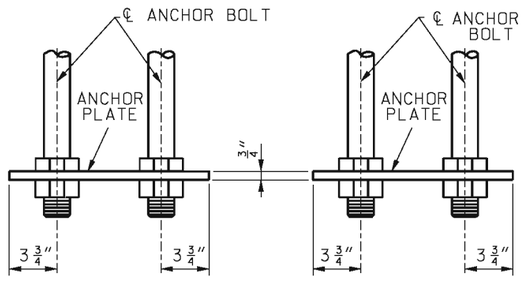
CAST BASE



SIDE VIEW END VIEW

TWO BOLTS PER PLATE

HEX NUT OR 5/16" FILLET WELD ALL AROUND BOTH SIDES

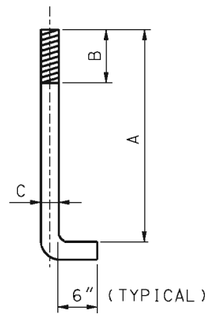


SIDE VIEW END VIEW

FOUR BOLTS PER PLATE

HEX NUT OR 5/16" FILLET WELD ALL AROUND BOTH SIDES

OPTIONAL STEEL PLATE FOR ANCHOR BOLTS



ANCHOR BOLT

NOTE:
ALL ANCHOR BOLTS SHALL BE FULLY GALVANIZED.

BOLT LENGTH	VERT. HT. A	THREAD LEN. B	DIA. C
INCHES	INCHES	INCHES	INCHES
19	17	1.50	0.625
57	51	7.00	1.250
79	73	7.50	1.500
94	88	8.00	1.750
121	115	8.50	2.000
120	114	9.00	2.250
146	140	9.50	2.500

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

STATE OF MISSOURI
KATHRYN PHILLIPS HARVEY
NUMBER PE-23751
PROFESSIONAL ENGINEER
THIS SHEET HAS BEEN SIGNED, SEALED AND DATED ELECTRONICALLY.

TRAFFIC SIGNALS

POST BASES

DATE EFFECTIVE: 02/01/2008
DATE PREPARED: 8/26/2009

902.30P

SHEET NO. 2 OF 2

903.19 Signing for School Areas

903.19.1 Size of School Signs (MUTCD Section 7B.01)

Standard. The sizes of signs and plaques to be used on conventional roadways in school areas shall be as shown in Table 903.19.1.

Option. Signs and plaques larger than those shown in Table 903.19.1 may be used at other locations that require increased emphasis, improved recognition, or increased legibility.

Table 903.19.1 School Area Sign and Plaque Sizes

Sign or Plaque	Sign Designation	EPG Article	Conventional Road (in. x in.)			Freeway/Expressway (in. x in.)
			Single Lane	Multi-Lane	Oversized	Mainline and Ramps
School	S1-1	903.19.8	36 X 36	36 X 36	-	-
School (plaque)	S4-3P	903.19.9	36 X 12	36 X 12	-	-
School Bus Stop Ahead	S3-1	903.19.13	36 X 36	36 X 36	-	-
When Flashing (plaque)	S4-4P	903.19.14	36 X 18	36 X 18	-	-
End School Speed Limit	S5-3	903.19.14	24 X 30	24 X 30	-	-
Diagonal Downward Arrow (plaque)	W16-7P	903.19.12	30 X 18	30 X 18	-	-
Ahead	W16-9P	903.19.11	30 X 18	30 X 18	-	-

903.19.2 Illumination and Reflectorization (MUTCD Section 7B.02)

Standard. The signs used for school area traffic control shall be retroreflectorized only.

903.19.3 Position of Signs (MUTCD Section 7B.03)

Support. EPG 903.2.26 and EPG 903.4.1 contain provisions regarding the placements and locations of signs.

EPG 903.3.2 contains provisions regarding the lateral offsets of signs.

Option. In-roadway signs for school traffic control areas may be used consistent with the requirements of EPG 903.19.8 and EPG 903.19.12.

903.19.4 Height of Signs (MUTCD Section 7B.04)

Support. EPG 903.3.3 contains provisions regarding the mounting height of signs.

903.19.5 Installation of Signs (MUTCD Section 7B.05)

Support. EPG 903.2.26 contains provisions regarding the installation of signs.

903.19.5.1 School Assembly Installation Contracts

Standard. Before a School Crossing and/or Advanced School Crossing sign(s) are installed a TR11 School Crossing contract shall be executed. All requests shall be reviewed in the district. A competent adult crossing guard acting for the school district shall supervise the operation of the crosswalk and the crossing of the students during hours of operation.

Before a School Flasher is ~~is~~ installed above a School Warning sign or School Zone sign, a TR08 Roadside Flashers for School Operations contract shall be executed.

Before a School Speed Limit is installed, a TR08 Roadside Flashers for School Operations contract shall be executed. All School Speed Limit assemblies shall use a flasher to indicate when the school speed limit is active.

903.19.6 Lettering (MUTCD Section 7B.06)

Support. EPG 900.1.11 Relation to Other Publications contains information regarding sign lettering.

903.19.7 Sign Color for School Warning Signs (MUTCD Section 7B.07)

Standard. School warning signs, including the “SCHOOL” portion of the School Speed Limit (S5-1) sign and including any supplemental plaques used in association with these warning signs, shall have a fluorescent yellow-green background with a black legend and border unless otherwise specified.

903.19.8 School Sign (S1-1) and Plaques (S4-3p, W16-9P and W16-7P) (MUTCD Section 7B.08)

Support. Many local jurisdictions find it beneficial to advise road users that they are approaching a school that is adjacent to a highway, where additional care is needed, even though no school crossing is involved and the speed limit remains unchanged. Additionally, some jurisdictions designate school zones that have a unique legal standing where special

enforcement techniques such as photo radar systems are used (refer to EPG 950 Automated Traffic Enforcement). It is important and sometimes legally necessary to mark the beginning and end points of these designated school zones so that the road user is given proper notice.

The School (S1-1) sign has the following four applications:

A. School Area – the S1-1 sign can be used to warn road users that they are approaching a school area that might include school buildings or grounds, a school crossing, or school related activity adjacent to the highway.

B. School Zone – the S1-1 sign can be used to identify the location of the beginning of a designated school zone.

C. School Advance Crossing – if combined with an AHEAD (W16-9P) plaque to comprise the School Advance Crossing assembly, the S1-1 sign can be used to warn road users that they are approaching a crossing where schoolchildren cross the roadway.

D. School Crossing – if combined with a diagonal downward pointing arrow (W16-7P) plaque to comprise the School Crossing assembly, the S1-1 sign can be used to warn approaching road users of the location of a crossing where schoolchildren cross the roadway.

Option. If added emphasis is determined to be required for a School Area assembly, an amber flasher may be used to supplement the assembly. See EPG 903.19.5.1 School Assembly Installation Contracts for contract requirements.

If a school area, school zone, or school crosswalk is located on a cross street in close proximity to the intersection, a School (S1-1) sign with a supplemental arrow (W16-6P) plaque may be installed on each approach of the street or highway to warn road users making a turn onto the cross street that they will encounter a school area soon after making the turn.

903.19.9 School Zone Sign (S1-1) and Plaques (S4-3P) and END SCHOOL ZONE Sign (S5-2) (MUTCD Section 7B.09)

Standard. If a school zone has been designated under Missouri or local statute, a School (S1-1) sign shall be installed to identify the beginning point(s) of the designated school zone, See Fig. 903.19.9.

Option. A School Zone (S1-1) sign may be supplemented with a SCHOOL (S4-3P) plaque.

If added emphasis is determined to be required for a School Zone assembly, an amber flasher may be used to supplement the assembly. See EPG 903.19.5.1 School Assembly Installation Contracts for contract requirements.

The downstream end of a designated school zone may be identified with an END SCHOOL ZONE (S5-2) sign.

903.19.10 Higher Fines Zone Signs (R2-10, R2-11) and Plaques (MUTCD Section 7B.10)

Standard. Not used by MoDOT. Fines in school zones cannot be raised above statutory limits by MoDOT or local jurisdictions so these signs and plaques cannot be used in this state.

903.19.11 School Advance Crossing Assembly (MUTCD Section 7B.11)

Standard. The School Advance Crossing assembly shall consist of a School (S1-1) sign supplemented with an AHEAD (W16-9P) plaque.

Except as provided in the option below, a School Advance Crossing assembly shall be used in advance (see Table 903.6.6 for advance placement guidelines) of the first School Crossing assembly that is encountered in each direction as traffic approaches a school crosswalk, see Fig. 903.19.11.

A School Crossing contract shall be required prior to the installation of these signs. See EPG 903.19.5.1 School Assembly Installation Contracts for contract requirements.

Option. The School Advance Crossing assembly may be omitted (see Fig. 903.19.14.1) where a School Zone (S1-1) sign is installed to identify the beginning of a school zone in advance of the School Crossing assembly if the distance is reasonably close or determined by engineering judgment.

903.19.12 School Crossing Assembly (MUTCD Section 7B.12)

Standard. If used, the School Crossing assembly shall be installed at the school crossing, or as close to it as possible, and shall consist of a School (S1-1) sign supplemented with a diagonal downward pointing arrow (W16-7P) plaque to show the location of the crossing.

The School Crossing assembly shall not be used at crossings other than those adjacent to schools and those on established school pedestrian routes.

The School Crossing assembly shall not be installed on approaches controlled by a STOP or YIELD sign.

A School Crossing contract shall be required prior to the installation of these signs. See EPG 903.19.5.1 School Assembly Installation Contracts for contract requirements.

903.19.13 School Bus Stop Ahead Sign (S3-1) (MUTCD Section 7B.13)

Guidance. The School Bus Stop Ahead (S3-1) sign should be installed in advance of locations where a school bus stops to pick up or discharge passengers and the sight distance of the bus available to other drivers is greater than the minimum sight distance and less than the maximum sight distance shown in Table 903.19.13. All attempts should be made to relocate the school bus stop to improve available sight distance and eliminate the need for the School Bus Stop Ahead (S3-1) sign.

Table 903.19.13 Sight Distance Requirements for use of the S3-1 sign

Posted Speed (mph)	Minimum Sight Distance (ft.)	Maximum Sight Distance (ft.)
30	300	500
35	300	500
40	300	500
45	300	500
50	300	510
55	300	560
60	300	625
65	500	700
70	500	740

Support. Section 304.050, RSMo, paragraph 4, defines, by state statute the minimum allowable sight distance a school bus stop must have. The statute states "…nor shall any passengers be taken on or discharged while the vehicle is upon the road or highway proper unless the vehicle

so stopped is plainly visible for at least five hundred feet in each direction to drivers of other vehicles in the case of a highway with no shoulder and a speed limit greater than 60 miles per hour and at least three hundred feet in each direction to drivers of other vehicles upon other highways". While shoulder is not defined in state statutes, for this purpose it will mean a shoulder of sufficient width and strength for a school bus to be able to safely and completely leave the traveled portion of the roadway. At those locations not meeting the requirements above, a school bus stop is not allowed.

It is not intended that these signs be used everywhere a school bus stops to pick up or discharge passengers, but for use where terrain and roadway features limit the approach sight distance and where there is no opportunity to relocate the stop to another location with adequate sight distance.

Standard. The requirements to use the School Bus Stop Ahead signs are:

A. For this policy, the school bus stop shall be defined as the location where passengers wait to be picked up or are discharged.

B. The sight distance shall be determined using a 3.5 ft. eye height and an 8 ft. object height.

C. Each approach to the school bus stop shall be considered independently of each other, i.e. it may not be necessary to sign both approaches to the school bus stop.

D. Placement will be as per Table 903.6.6 Guidelines for Advance Placement of Warning Signs.

The location of school bus stops may change from year to year. It is therefore, imperative the district keep track of all School Bus Stop Ahead signs. The school districts shall provide confirmation to the district office when the school bus stops are active. This shall be done prior to the fall session. Also, whenever the school districts are aware of a school bus stop location change, they shall advise the district office as soon as possible.

Option. If a location has more than the minimum sight distance required by statute, as described above, but less than the values in Table 903.19.13, placement of the SCHOOL BUS STOP AHEAD sign may be allowed.

903.19.14 School Speed Limit Flasher Assembly (~~S4-3P, R2-1, S4-4P~~S5-1) and END SCHOOL SPEED LIMIT Sign (S5-3) (MUTCD Section 7B.15)

Standard. A School Speed Limit Flasher assembly shall be used to indicate the speed limit where a reduced speed zone for a school area has been established (~~in accordance with law~~ based upon an engineering study) or where a speed limit is specified for such areas by statute.

The School Speed Limit Flasher assembly shall be placed at or as near as practical to the point where the reduced speed zone begins.

If a reduced school speed limit zone has been established, a School (S1-1) sign shall be installed in advance (see Table 903.6.6 ~~F~~for advance placement guidelines) of the first School Speed Limit Flasher sign assembly that is encountered in each direction as traffic approaches the reduced school speed limit zone. See Fig. 903.19.14.1.

The downstream end of an authorized and posted reduced school speed limit zone shall be identified with an END SCHOOL SPEED LIMIT (S5-3) sign. See Fig. 903.19.14.2.

Before a School Speed Limit is installed a TR08 Roadside Flashers for School Operations contract shall be executed. See EPG 903.19.5.1 School Assembly Installation Contracts for contract requirements.

Guidance. The reduced speed zone should begin either at a point 200 ft. from the crosswalk, or at a point 100 ft. from the school property line, based on whichever is encountered first as traffic approaches the school.

If a school speed limit flasher is installed, no other school flasher should be permitted.

Standard. The fixed-message School Speed Limit assembly shall consist of a School Speed Limit XX When Flashing sing (S5-1).~~top plaque (S4-3P) with the legend SCHOOL, a Speed Limit (R2-1) sign, and a bottom plaque (S4-4P) with the legend WHEN FLASHING.~~

School speed limits are in effect only when the flasher is operational.

903.19.13.1 Stop for School Bus Loading or Unloading Children State Law (Special R0-1), ALL Lanes (Special W0-1) signing

Support. The Stop for School Bus sign was originally used as a place holder on posts for School Bus Stop Ahead signs when they were removed for the summer. Many of these original 24 inch x 24 inch signs remained in place and are on the Do Not Replace List.

With the advent of the Alternating Passing lanes, which are not addressed in state law for yielding to school buses, the Stop for School Bus sign was resurrected, but in a larger version for legibility.

Standard. If used, the Stop for School Bus Loading or Unloading Children State Law (Special R0-1), with the ALL LANES warning plaque (Special W0-1) installed at the bottom of the assembly, shall only be used on Alternating passing lanes to notify drivers that they must stop for school buses that are stopped in the opposing direction. If used, one sign assembly should be installed in advance of the first school bus stop in each direction.

The Stop for School Bus Loading or Unloading Children State Law (Special R0-1) shall only be used on routes which have active school bus stops, when the school bus stops are no longer active, the Stop for School Bus Loading or Unloading Children State Law (Special R0-1) shall be removed.

Option. When engineering judgement determine the need, the Stop for School Bus Loading or Unloading Children State Law (Special R0-1) and the ALL LANES warning plaque (Special W0-1) may be installed on 3 lane and 5 lane roadways.

903.19.14.1 School Speed Limits

Standard. Upon receipt of a school speed limit request, the district shall perform a speed study for the corridor, a crash study and a site investigation. If after these analyses the reduced speed limit is determined to be warranted and justified school speed limit assembly shall be installed and the school speed limit set. If the reduced speed limit is determined to not be warranted and justified the school speed limit assembly shall not be installed and the speed limit will not be reduced. If the reduced speed is justified ~~T~~the school speed limit shall be 10 mph below ~~either~~ the posted speed limit ~~or the 85th percentile speed, whichever is higher,~~ as determined by the speed study. In no case shall a school speed limit of less than 25 mph be allowed.

In addition to determining if the reduced speed would be justified, if in the course of the speed study it is determined that the posted speed for the corridor is not proper the posted speed shall be reevaluated and changed as necessary following EPG 949.2 Speed Limit Guidelines.

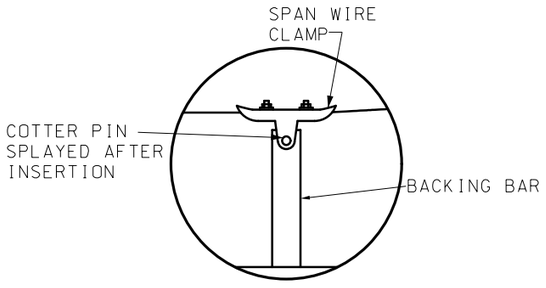
~~**Support.** See EPG 902.4 Signal Installations and Equipment for more information.~~

903.19.15 Parking and Stopping Signs (R7 and R8 Series) (MUTCD Section 7B.17)

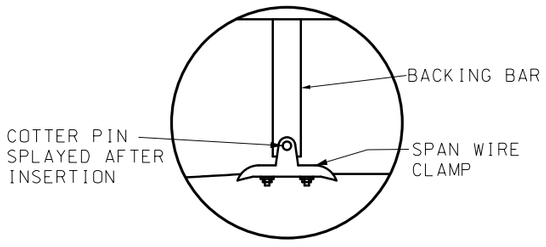
Option. Parking and stopping regulatory signs may be used to prevent parked or waiting vehicles from blocking pedestrians' views and drivers' views of pedestrians and to control vehicles as a part of the school traffic plan.

Support. Parking signs and other signs governing the stopping and standing of vehicles in a school area cover a wide variety of regulations.

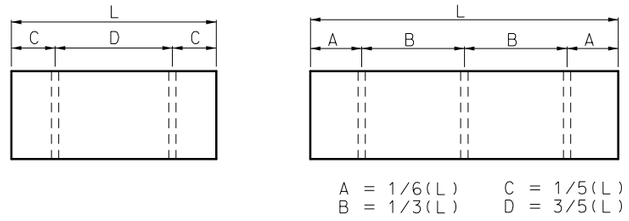
EPG 903.5.26 contains information regarding the signing of parking regulations in school zone areas.



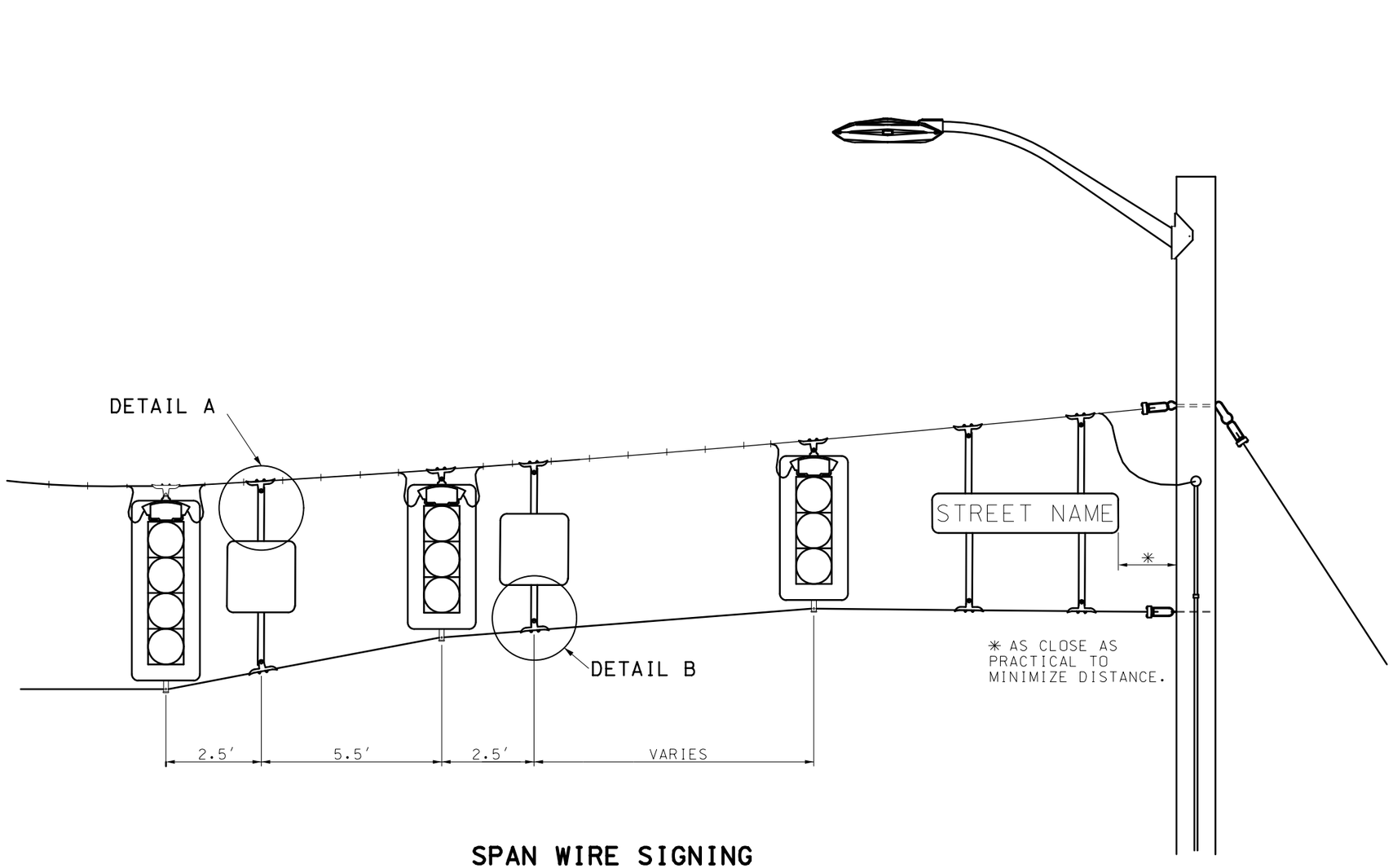
DETAIL A



DETAIL B



BACKING BAR PLACEMENT



SPAN WIRE SIGNING

GENERAL NOTES:

SIGNS UP TO 30" IN WIDTH SHALL BE INSTALLED ON ONE VERTICAL BACKING BAR. SIGNS 30" TO 60" IN WIDTH SHALL BE INSTALLED ON TWO VERTICAL BACKING BARS. SIGNS WIDER THAN 60" SHALL BE INSTALLED ON THREE VERTICAL BACKING BARS.

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

NEW SHEET

TRAFFIC SIGNALS

RIGID SPAN WIRE
SIGN DETAILS

DATE EFFECTIVE: 04/01/2021
DATE PREPARED: 12/21/2020

902.70Q

SHEET NO.
3 OF 3