



Florida Department of Transportation

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SECRETARY

January 12, 2022

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **995**
Proposed Specification: **9950100 Traffic Control Signal and Device Materials.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Derek Vollmer from the Traffic Engineer and Operations Office to provide clarification to the language by adding a new Article for Midblock Crosswalk Enhancement Assemblies. The proposed specification change is associated with changes to Section 663, 654, 659, and 665.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to daniel.strickland@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at (850) 414-4130.

Sincerely,

Signature on file

Daniel Strickland, P.E.
State Specifications Engineer

DS/ra

Attachment

cc: Florida Transportation Builders' Assoc.
State Construction Engineer

TRAFFIC CONTROL SIGNAL AND DEVICE MATERIALS (REV 11-10-21)

ARTICLE 995-1 is deleted and the following substituted:

995-1 Description.

This Section governs the requirements for all permanent traffic control signals and devices. All equipment shall be permanently marked with manufacturer name or trademark, part number, and date of manufacture or serial number.

SECTION 995 is expanded by the following new Articles:

995-6 Midblock Crosswalk Enhancement Assemblies.

995-6.1 General: Midblock crosswalk enhancement assemblies shall be listed on the Department's Approved Product List (APL). Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6.

Midblock crosswalk enhancement assemblies are classified as the following types: In-Roadway Light Assemblies and Rectangular Rapid Flashing Beacon Assemblies (RRFB).

995-6.2 In-Roadway Light Assemblies: In-roadway light assemblies must meet the physical and operational requirements of the latest edition of the MUTCD, Chapter 4N.

In-roadway light assemblies can include a passive detector in addition to a pedestrian pushbutton. In-roadway light assemblies must be normally dark and initiate operation upon pedestrian actuation via a pedestrian pushbutton or a passive detector. The In-roadway light assembly will cease operation at a predetermined time after the pedestrian actuation. If a passive detector is used, the In-roadway light assembly may cease operation after the pedestrian clears the crosswalk. The duration of the predetermined period shall be programmable and capable of matching the pedestrian clearance time for pedestrian signals as determined by MUTCD procedures. The timer that controls flashing must automatically reset each time a pedestrian call is received.

In-roadway light assemblies must have a minimum luminance of 101 candelas and a minimum viewing angle of 20 degrees.

995-6.3 Rectangular Rapid Flashing Beacon (RRFB): RRFB must include two rapidly and alternately flashed rectangular yellow indications having LED-array based pulsing light sources. Each rectangular yellow indication must be a minimum of five inches wide by two inches high. RRFB installations shall comply with the use and technical conditions of FHWA MUTCD Interim Approval 21 – Rectangular Rapid-Flashing Beacons at Crosswalks. The two RRFB indications shall be aligned horizontally, with the longer dimension horizontal and with a minimum space between the two indications of approximately 7 inches measured from inside edge of one indication to inside edge of the other indication.

995-6.3.1 Beacon Flashing Requirements: The light intensity of the yellow indications shall meet the minimum specifications of Society of Automotive Engineers (SAE) standard J595 for Class 1 (Directional Flashing Optical Warning Devices for Authorized Emergency, Maintenance, and Service Vehicles) dated January 2005. Ensure RRFB assemblies are capable of automatically dimming to reduce brightness of the LEDs at nighttime.

The flash rate of each individual yellow indication, as applied over the full on-off sequence of a flashing period of the indication, shall not be between 5 and 30 flashes per second. When activated, the two yellow indications in each RRFB shall have a flash rate of 75 flash cycles per minute using the following sequence: left side beacon on for 50 milliseconds (msec), both beacons off for 50 msec, right side beacon on for 50 msec, both beacons off for 50 msec, left side beacon on for 50 msec, both beacons off for 50 msec, right side beacon on for 50 msec, both beacons off for 50 msec, both beacons on for 50 msec, both beacons off for 50 msec, both beacons on for 50 msec, both beacons off for 250 msec. No other flash patterns shall be selectable via hardware or software.

995-6.3.2 RRFB Operation: RRFB can include a passive detector in addition to a pedestrian pushbutton. RRFBs must be normally dark and initiate operation only upon pedestrian actuation via a pedestrian pushbutton, or a passive detector. The RRFB will cease operation at a predetermined time after the pedestrian actuation. If the passive detector is used, the RRFB may cease operation after the pedestrian clears the crosswalk. The duration of the predetermined period shall be programmable and capable of matching the pedestrian clearance time for pedestrian signals as determined by MUTCD procedures. The timer that controls flashing must automatically reset each time a pedestrian call is received.

All RRFBs associated with a single crosswalk (including those with an overhead or advance crossing sign, if used) shall simultaneously commence operation of their alternating rapid flashing indications and shall cease operation simultaneously.

RRFBs must include an instruction sign (FTP-68C-21) mounted adjacent to or integral with each pedestrian pushbutton.

A confirmation light directed at and visible to pedestrians in the crosswalk must be installed integral to the RRFB to give confirmation that the RRFB is in operation.

995-6.3.3 Accessible Pedestrian Pushbutton: If an accessible pedestrian pushbutton is shown in the Plans, the assembly must contain a speaker, audio amplifier, and noise monitoring microphone for auto volume control.

The accessible pedestrian pushbutton detector must meet 995-9.3 for the locator tone feature. The pushbutton must not include a vibrotactile indication or percussive indications. The audible message must be programmable.

995-6.4 Cabinets, Housings, and Hardware: Cabinets used as part of the midblock crosswalk enhancement assembly must meet the applicable criteria of Section 676.

All housings other than approved cabinets must be powder coat painted dull black (FED-STD-595-37038) with a reflectance value not exceeding 25 percent as measured by American Society for Testing and Material E1347. Cabinets and housings must prevent unauthorized access.

Pole-mount assemblies shall allow installation on 4-1/2 inch outer diameter posts.

Ensure all assembly hardware, including nuts, bolts, external screws, and locking washers less than 5/8 inch in diameter, are Type 304 or 316 passivated stainless steel. Stainless steel bolts, screws, and studs must meet ASTM F593. Stainless steel nuts must meet ASTM F594. All assembly hardware greater than or equal to 5/8 inch in diameter must be galvanized. Carbon steel bolts, studs, and threaded rod must meet ASTM A307. Structural bolts must meet ASTM F3125, Grade A325.

995-6.5 Electrical Specifications: Equipment must operate on solar power or a nominal voltage of 120 V alternating current (V_{AC}). If the device requires operating voltages of less than 120 V_{AC}, supply the appropriate voltage converter. Solar powered systems must be designed to

operate for minimum of 100 activations per day and provide 10 days of operation without sunlight. Each activation must be 30 seconds in duration. Solar powered systems must automatically charge batteries and prevent overcharging and over-discharging. Solar powered systems must include a charge indicator.

995-6.6 Environmental Specifications: All electronic assemblies shall operate as specified during and after being subjected to the transients, temperature, voltage, humidity, vibration, and shock tests described in National Electrical Manufacturers Association (NEMA) TS2, 2.2.7, 2.2.8, and 2.2.9. Electronics must meet Federal Communications Commission (FCC) Title 47, Subpart B, Section 15. The optical portion of the housing shall be sealed to provide an IP 67 rating.

995-7 Mast Arm, Span Wire, and Pole Mounting Assemblies.

995-7.1 General: Mast arm, span wire, and pole mounting assemblies shall be listed on the Department's Approved Product List (APL) and meet the requirements of Section 603. Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6.

Fastening hardware such as bolts, nuts, washers, set screws, studs, u-bolts, cable and cable swags, must be provided by the mounting assembly manufacturer, must be SAE Type 316 or 304 stainless steel. Hardware (studs, bolts and u-bolts) must be a minimum of 5/16 inch diameter unless otherwise specified in this Section. SAE Grade 8 bolts and nuts are also acceptable. Metallic mounting assemblies must meet ASTM B117 for corrosion resistance.

Connections that provide an entrance to the interior of a traffic device must be weather-resistant.

All assemblies must be constructed to support the weight of any combination of signal indications with all accessories such as back plates and visors.

Connections between signal, disconnect and disconnect hanging hardware must be of the tri-stud design unless otherwise specified in this Section. Tri-stud washers must be a minimum 0.090 inches thick unless otherwise specified in this Section.

Connections must be designed to mate with a standard traffic signal's two inch I.D. opening and must be capable of providing positive positioning and alignment of the traffic device. Connection type may be a 72 tooth serrated edge or other connection type as long as all other specifications are met. For 72 tooth serrated edge connections, the teeth must be clean, sharp, and at least 1/8 inch wide and 3/64 inch deep. All connection types must be weather resistant.

All mounting assemblies must be capable of providing adjustment in multiple directions for proper alignment of the attached traffic device and to prevent rotation around the vertical axis or misalignment after installation.

Use studs that are either cast directly into the aluminum during the casting process or tapped and locked with a locking material. In each case, a pull-out force must be provided. Messenger wire clamps must be extruded aluminum six inches long or cast U-bolt type.

Torque specifications must be included for all fastening hardware with the assembly installation instructions.

995-7.2 Product Identification: Mounting assemblies must be permanently marked with the name or trademark of the manufacturer, part number and date of manufacture. Identification must be cast into, or metal-marked on, the assembly in a legible manner. When the assembly is made up of multiple components, each component must be identified with the manufacturer's name or trademark.

995-7.3 Finish: Unless otherwise specified, mounting assemblies and components must be supplied with a natural finish with mill scale removed in accordance with Military Standard MIL-PRF-24712A or AAMA 2603-02 and must meet the requirements of ASTM 3359 and ASTM D3363. Disconnect (interior and exterior) and disconnect hub must be powder-coat painted dull black (Federal Standard 595A-37038) with a reflectance value not exceeding 25 percent as measured by ASTM E97. All finished surfaces must have a smooth finish free from cracks, blow-holes, shrinks, excessive material, and other flaws.

995-7.4 Mast Arm Mounting Assemblies: Mast arm mounting assemblies must include the following components: mast arm saddle, swivel, attachment cables (with cable clamp mechanism) or bands. Unless the assembly uses a free swinging mounting method, mast arm mounting assemblies must include the support tube, and top and bottom support arms. Mast arm mounting assemblies must be designed to be attached to a mast arm by cables or bands. All connections must be designed to prevent movement when 250 pounds of downward force is applied to the completed vehicular traffic signal assembly.

995-7.4.1 Saddle: Saddles must be aluminum or stainless steel and must have a minimum yield strength of 16 ksi and a minimum ultimate tensile strength of 23 ksi in accordance with ASTM B26, ASTM B108, ASTM B85 or ASTM A240.

995-7.4.2 Swivel: Swivels must be aluminum or stainless steel and must have a minimum yield strength of 16 ksi and a minimum ultimate tensile strength of 23 ksi in accordance with ASTM B26, ASTM B108, ASTM B85 or ASTM A240. The swivel must provide at least two connection devices to secure the support tube to the swivel and be configured to permit the support tube to provide adjustment in multiple directions in a plane parallel to the mast arm. Any castings used to attach the support tube to the swivel must be manufactured from the same alloy as the swivel.

995-7.4.3 Saddle Attachment Cables and Bands: Mast arm saddle attachment cables must be 3/16 inch minimum diameter, Type 316 or 304 stainless steel aircraft type wire strand cable. The swage at the ends of the cable (used to tighten the cable against the saddle) must be Type 316 or 304 stainless steel with a minimum 3/8 inch diameter thread. The swage must permit use of a wrench to prevent rotation while tightening the nut at the end of the swage. If the attachment cable does not have swaged clamp screws at each end (double-ended), the unclamped end of the cable must be sintered, welded, or otherwise secured without adhesives to prevent unraveling of the cable. Banding must use two Type 304 or 201 series stainless steel 3/4 inch wide bands and Type 316 stainless steel buckles (clamp screws). De-burr the edges of the bands.

995-7.4.4 Cable Clamp Mechanism: Mast arm mount components used to secure the cable to the saddle must be aluminum or stainless steel and must have a minimum yield strength of 23 ksi and a minimum ultimate tensile strength of 30 ksi in accordance with ASTM B26, ASTM B221, ASTM B85 or ASTM A240.

995-7.4.5 Support Tube: Support tubes used in mast arm mounting assemblies must be aluminum or stainless steel and must have a minimum yield strength of 25 ksi and a minimum ultimate tensile strength of 30 ksi in accordance with ASTM B221 or ASTM A240. A gusseted hollow design may be used to provide for the routing of necessary wiring. The tube cross-sectional area's principal moments of inertia must average; at a minimum, that of a 1-1/2 inch standard aluminum Schedule 40 pipe and the cross-sectional metal area must not be less than that of a 1-1/2 inch Schedule 40 pipe. The bottom portion of the tube that supports the vertical load of the hanging device must be threaded using National Pipe Thread Taper (NPT).

National Pipe Thread Straight (NPS), non-threaded U-bolt secured, or a continuous arm support tube. Threaded support tubes that are fully slotted must have an aluminum insert in the 3/4 inch slot extending a minimum of 1/2 inch beyond the threaded section. To provide easy installation of wiring, the tube must have a minimum 0.562 inch wire entrance slot running the full length of the tube, or either stopping a minimum of 8 inches above the threaded or U-bolt secured end. Edges of slot must be supported with internal gusseting. The tube interior and slot must be free of sharp edges that may damage wiring. Provide an easily installed and removable UV stabilized seal to completely fill the wire entrance slot after installation.

995-7.4.6 Top Support Arm: The top support arm of the mounting assembly must be of one-piece solid construction, or continuous arm with support tube, and capable of holding the signal head firmly in place. Top support arms must be aluminum with a minimum ultimate tensile strength of 30 ksi and minimum yield strength of 18 ksi in accordance with ASTM B26, or be die cast with a minimum ultimate tensile strength of 27 ksi and a minimum yield strength of 24 ksi.

A one or two piece top arm is acceptable. For a one piece top arm, use at least two 1/4 inch minimum diameter Type 316 or 304 stainless steel set screws to secure its position on the support tube. When a two-piece top arm is used, hardware required to connect components of the top arm must be 3/8 inch minimum diameter, Type 316 or 304 stainless steel.

The top support arm must have three 1/4 inch - 20 UNC-2B threaded holes to accept bolts for a tri-stud washer and gasket, or at least one imbedded or tapped and locked 5/16 inch - 18 threaded stud within the industry's standard 72 tooth serrated circular design that facilitates 5 degree increment positioning. Provide 0.090 inch thick (minimum) Type 316 or 304 stainless steel washers, nuts, and lock washers for attaching signal heads. A rubber washer, with dimensions similar to the large stainless steel washer, must be provided for traffic signals. When mast arm clamps are used to support illuminated signs with tri-stud arrangements, a rubber washer with dimensions similar to the steel washer must also be used.

995-7.4.7 Bottom Support Arm: The bottom support arm, when not continuous arm with support tube, must be hollow to allow the routing and enclosing of all signal wiring. Bottom support arms must be aluminum with a minimum ultimate tensile strength of 30 ksi and minimum yield strength of 18 ksi in accordance with ASTM B26, or be die cast with a minimum ultimate tensile strength of 27 ksi and a minimum yield strength of 24 ksi. Plastic bottom arm covers must be constructed of ABS with a UV inhibitor and be strong enough to contain the signal cable in the bottom arm cavity without bending during installation and warping over time.

The end of the bottom support arm that attaches to the support tube must have a 1-1/2 inch steel coupling imbedded and cast directly into the part during the solidification of the aluminum, or a 1-1/2 inch NPT or NPS pipe thread cut directly into the casting. For non-threaded versions, the arm must allow the support tube to sit a minimum of 2 inches into an arm pocket and be secured to the arm with minimum 5/16 full U-shape U-bolt to distribute the load evenly to the lower arm casting.

The end of the bottom support arm that connects to the signal must have either three equally spaced and plumb imbedded 5/16 inch Type 316 or 304 stainless steel threaded studs located in the center of the 72 tooth serrated circular design, or three 1/4 inch – 20 UNC-2B tapped holes to accept bolts for a tri-stud washer.

995-7.4.7.1 Arms with Steel Coupling: If a threaded steel coupling is imbedded into the casting, the bottom arm must be aluminum alloy 535.0-F in accordance with ASTM B26, with a minimum ultimate tensile strength of 23 ksi, meeting all standards listed in

ASTM B26, including chemical composition listed in Table 1 and material mechanical properties listed in Table 2. The end of the bottom support arm must have at least two 1/4 inch diameter Type 316 or 304 stainless steel set screws to secure its position on the support tube.

995-7.4.7.2 Threaded Arms: If threads are cut directly into the casting, the bottom arm must be aluminum alloy 535.0-F in accordance with ASTM B26, with a minimum ultimate tensile strength of 35 ksi and elongation of 9.0% in a two inch section, meeting all standards listed in ASTM B26, including chemical composition listed in Table 1 and material mechanical properties listed in Table 2. As an alternative, the arm can be die cast in aluminum with a minimum ultimate tensile strength of 27 ksi and a minimum yield strength of 24 ksi. The end of the bottom arm must have at least two 1/4 inch minimum diameter Type 316 or 304 stainless steel set screws to secure its position on the support tube.

995-7.4.7.3 Non-threaded Arms: Lower arm must be aluminum 356 having a minimum ultimate tensile strength of 30 ksi and meeting all standards listed in ASTM B26, including chemical composition listed in Table 1 and material mechanical properties listed in Table 2. The arm must have a locator tab to receive the support tube and be secured by a U-bolt.

995-7.4.7.4 Continuous Arm Support Tube: The continuous arm support tube must be of single form construction to support the weight of any combination of signal indicators with all accessories such as backplates and visors. Continuous support tubes must be Type 316 or 304 stainless steel with a minimum ultimate tensile strength of 75 ksi and a minimum yield strength of 30 ksi in accordance with ASTM A554, or aluminum with a minimum yield strength of 25 ksi and a minimum ultimate tensile strength of 30 ksi in accordance with ASTM B221.

The continuous arm support tube attachment to the signal head must have a minimum of two 5/16-18 Type 316 or 304 stainless steel bolts, nuts and washers. A rubber seal must be provided between the support tube and signal head.

995-7.5 Span Wire Mounting Assemblies: Span wire mounting assemblies must include a span wire clamp, a hanging device such as a drop pipe, adjustable hanger, or adjustable pivotal hanger with extension bar, messenger clamp, disconnect hanger, and multi-brackets.

995-7.5.1 Span Wire Clamp: Span wire clamps must be aluminum or stainless steel and must have a minimum ultimate tensile strength of 32 ksi and minimum yield strength of 22 ksi in accordance with ASTM B28, ASTM B108, ASTM B85, or ASTM A240.

995-7.5.2 Drop Pipe: Drop pipe hangers must be galvanized 1-1/2 inch steel aluminum having a minimum yield strength of 35 ksi and a minimum ultimate tensile strength of 42 ksi in accordance with ASTM B221 and have NPT on each end for assembly.

995-7.5.3 Aluminum Adjustable Hanger: Aluminum adjustable hangers must be aluminum alloy 535.0-F in accordance with ASTM B26 with a minimum ultimate tensile strength of 35 ksi and elongation of 9.0% in a two inch section, meeting the chemical composition listed in Table 1 and material mechanical properties listed in Table 2 in ASTM B26.

995-7.5.4 Stainless Steel Adjustable Hanger: Stainless steel adjustable hangers must be Type 316 or 304 stainless steel with a minimum ultimate tensile strength of 75 ksi and a minimum yield strength of 30 ksi in accordance with ASTM A276.

995-7.5.5 Aluminum Adjustable Pivotal Hanger: Aluminum pivotal hangers must be aluminum alloy 535.0-F in accordance with ASTM B26 with a minimum ultimate tensile strength of 35 ksi and elongation of 9.0% in a two inch section, meeting the chemical composition listed in Table 1 and material mechanical properties listed in Table 2 in ASTM B26.

995-7.5.6 Stainless Steel Adjustable Pivotal Hanger: Stainless steel pivotal hangers must be either Type 316 or 304 stainless steel with a minimum ultimate tensile strength of 75 ksi and a minimum yield strength of 30 ksi in accordance with ASTM A276.

995-7.5.7 Aluminum Extension Bar: Extension bars used to extend the length of the adjustable hanger must be T6061-T6 extrusion aluminum having a minimum yield strength of 35 ksi and a minimum ultimate tensile strength of 42 ksi in accordance with ASTM B221.

995-7.5.8 Stainless Steel Extension Bar: Stainless steel extension bar used to extend the length of adjustable hangers must be Type 316 or 304 stainless steel with a minimum ultimate tensile strength of 75 ksi and a minimum yield strength of 30 ksi in accordance with ASTM A276.

995-7.5.9 Disconnect Hanger: The disconnect hanger must be supplied with the following as a minimum:

1. Wired screw type/compression terminal block and wiring rated at 600 V_{AC} Root Mean Square (rms) with 12 or 18 circuits. The terminal block must be easily accessible for connection of the field wiring. Attach the terminal block to the disconnect with Type 316 or 304 stainless steel or brass fastening hardware.

2. Weather resistant grommets in each signal cable entrance of the disconnect hanger to prevent insect and animal access and to protect the signal cable from chafing.

3. A two inch opening in the top of the disconnect hanger with an integral serrated area (or 1-1/2 inch NPT threaded top section) to interface with the hanger method employed above it.

4. A securable door that allows access to all areas of the interior. The door securing device must be Type 316 or 304 stainless steel and captive. Hinge or groove pins for the door must be Type 316, 304, 303, or 302 stainless steel.

995-7.5.10 Multi-Brackets: Top and bottom (multi) brackets used in the assembly of span wire mounted multi-directional signals must be constructed of aluminum having a minimum yield strength of 13 ksi and a minimum ultimate tensile strength of 23 ksi per ASTM B26.

Top brackets must be of one-piece hollow design, with a cross-sectional diameter of at least 1-1/2 inch I.D. for receiving signal wires. The wall thickness must be at least 3/16 inch. Each top bracket (2- way, 3-way, and 4-way) must have a two inch diameter hole (with integral serrated boss as specified above) in the top side of the bracket for receiving a 1-1/2 inch entrance fitting. The underside of the top bracket must have a covered hole of at least three inches in diameter for the installation of the signal wires.

Bottom brackets must be of one-piece solid construction and must hold the signal heads firmly in place.

For the five section cluster configuration, provide 3/8 inch thick Type 316 or 304 stainless steel tri-stud washers and nylock nuts with lock washers to secure the top and lower signal sections of the cluster to the top multi bracket. Washer distortion must not occur after assembly of the five section cluster. Multi-brackets must include all fastening hardware necessary to attach to the signal.

995-7.6 Pole (Pedestal and Post) Mounting Assemblies: All trunnions, brackets, and suspensions used in mounting vehicular and pedestrian signals to concrete, steel, aluminum, or wood poles must be an aluminum alloy cast fitting, pipe or equivalent as approved by the

Engineer. The aluminum alloy must have a minimum ultimate tensile strength of 35 ksi in accordance with ASTM B221, ASTM B85, or ASTM B26.

Pole side-mount brackets used for pedestrian signals may be constructed of polycarbonate material.

995-7.7 Mounting Assemblies for Signs, Cameras, Detectors, and Other Traffic Control Devices: Mounting assemblies or assembly components used for signs, cameras, detectors, and other traffic control devices must be constructed of the same material, and meet the same mechanical and chemical properties as mounting assemblies for signals.

995-7.8 Miscellaneous Mounting Components: Miscellaneous mast arm, span wire, and pole mounting components and accessories included with assemblies must meet the mechanical properties for its associated main assembly components or be listed separately on the APL. Mounting assemblies not approved with a specific primary device (such as a camera, detector, etc.), must be approved and listed separately on the APL.

995-8 Signal Priority and Preemption Systems.

995-8.1 General: Signal priority and preemption system equipment shall be listed on the Department's Approved Product List (APL). Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6.

Signal priority and preemption system equipment may utilize optical, GPS, and radio frequency based technologies.

995-8.2 Functional Requirements: Ensure that in-vehicle equipment operates without requiring any action from the vehicle operator or occupants once power is applied.

995-8.2.1 Security: The system must include features that secure the system and restrict its configuration and operation to authorized users and vehicles only.

995-8.2.2 Vehicle Identification: The system must be able to assign a unique identifier for each authorized vehicle. The system must be able to associate the identifier with vehicle information such as vehicle classification (e.g., fire, police, rescue, transit), owner/operator, and priority level.

995-8.2.3 Configuration and Management: The system must allow authorized local and remote users to set and read all user-programmable features and retrieve data collected by the system. The manufacturer must provide computer software required to configure, operate, and maintain the system at no additional cost to the Department.

995-8.2.4 Logging: The system installed in the field cabinet must store a record of events, including time, vehicle ID, class, priority level, and approaching direction for all vehicles detected. The log must operate on a first-in, first out (FIFO) principle with a minimum capacity of 5,000 events.

995-8.2.5 Detection Range and Accuracy: The priority and preemption system must be capable of detecting and identifying multiple authorized vehicles at various ranges up to 2,500 feet. The system must be able to determine the approaching direction of authorized vehicles. The detection range and programming of emergency (high priority) and transit signal (low priority) preemption shall be adjustable from within the traffic signal cabinet. High priority calls must override low priority calls.

The system must service preemption calls having equal priority on a first-come, first-served basis.

995-8.3 Preemption System Cabinet Electronics: The priority and preemption system must be compatible with NEMA TS 1, NEMA TS 2, Type 170, and Type 2070 traffic signal controllers and their respective cabinets.

The system must be able to provide calls to the controller via input file and detector rack. The system must include two channel or four channel detector card units compatible with NEMA TS 2-2003 v02.06. The system must include a shelf mount option.

The system must be able to provide emergency preemption (high priority) and transit signal (low priority) preemption calls to the controller. Detectors must include programmable timers that allow the operator to configure detector call extension as well as limit the length of channel output calls.

Channel outputs must deliver a constant signal while emergency vehicles are detected for high priority preemption activation. Channel outputs must deliver a pulsed output for low priority preemption activation. Inputs and outputs must be optically isolated.

995-8.3.1 Serial Interface: Ensure that the serial ports support data rates up to 115 kbps; error detection procedures utilizing parity bits (i.e., none, even, and odd); and stop bits (1 or 2). Serial interface ports may utilize RJ-45 connectors, D-sub connectors, or screw terminals.

995-8.3.2 Network Interface: Ensure that local area network (LAN) connections support the requirements detailed in the Institute of Electrical and Electronics Engineers (IEEE) IEEE 802.3 Standard for 10/100 Ethernet connections. Ensure that the connector complies with applicable Electronic Industries Alliance (EIA) and Telecommunications Industry Association (TIA) requirements.

995-8.4 Optical Preemption Detectors: Optical preemption detectors must respond to light impulses generated from a visible or infrared light source.

995-8.5 Intersection Radio/GPS Modules: Radio/GPS preemption systems must include radio/GPS modules that transmit a beacon signal and receive data transmitted by Radio/GPS vehicle equipment.

995-8.6 Mechanical Specifications: Ensure equipment is permanently marked with manufacturer name or trademark, part number, and date of manufacture or serial number.

Ensure that every conductive contact surface or pin is gold-plated or made of a noncorrosive, conductive metal. Do not use self-tapping screws on the exterior of the assembly.

All external parts must be made of corrosion-resistant materials, such as plastic, stainless steel, anodized aluminum, brass, or gold-plated metal.

Detector cards must include indicators for power and vehicle detection. Detector cards must include a test switch that can be used to manually generate detector calls that the system provides during normal operations.

995-8.7 Electrical Specifications: Provide equipment that operates on a nominal voltage of 120 volts alternating current (V_{AC}). If the device requires operating voltages of less than 120 V_{AC}, supply the appropriate voltage converter.

995-8.8 Environmental Specifications: Ensure system electronics perform all required functions during and after being subjected to the environmental testing procedures described in NEMA TS 2, Sections 2.2.7, 2.2.8, and 2.2.9. Detectors and detector connections that are exposed to the elements must be weatherproof and designed for outdoor use.

995-9 Pedestrian Detection System.

995-9.1 General: Pedestrian detection system equipment shall be listed on the Department's Approved Product List (APL). Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6.

Pedestrian detection systems are classified into three categories: Standard Pedestrian Pushbutton Detectors, Accessible (Audible/Tactile) Pedestrian Pushbutton Detectors,

and Passive Detectors. The components of the pedestrian detection system include pushbuttons, pedestrian actuation signs, electronics, wiring, and mounting hardware.

995-9.2 Standard Pedestrian Pushbutton Detector: Pushbuttons must be raised from or flush with their housings and be a minimum of 2 inches in the smallest dimension. The pushbutton must require no more than 5 pounds of force to activate. The detector must be weather-tight and tamper resistant.

995-9.2.1 Housing: The housing must be a two piece unit consisting of a base housing and a removable cover. The housing must be cast aluminum meeting the physical characteristics and chemical content established in ASTM B26 for alloys S5A and CS72A.

The housing or adapter (saddle) must conform to the shape of a pole and provide a flush, secure fit. Saddles must be of the same material and construction as the housing. Pushbuttons for wood pole mounting must have threaded holes for 1/2 inch conduit provided in the housing top or bottom. A 3/4 inch hole with an insulated bushing shall be provided through the back of the housing. Unused openings shall be closed with a weatherproof closure and painted to match the housing.

The housing must have a powder-coat finish and painted in accordance with Military Standard MIL-PRF-24712A. The housing must be permanently marked with manufacturer name or trademark, part number, date of manufacture, and serial number.

995-9.2.2 Pushbutton: The pushbutton must include a normally open, mechanical phenolic enclosed, positive-acting, spring-loaded, audible (i.e., click) snap-action switch with single pole, single throw contacts, or a Piezo driven solid state switch rated for a minimum of 50 V. The Piezo driven solid state switch, when activated, must give an audible (i.e., two-tone chirp) indication of actuation. A visual indication of actuation is optional. The visual indication must remain illuminated until the pedestrian's WALKING PERSON (symbolizing WALK) signal indication is displayed. Switch connections inside the housing must allow wiring and installation without binding. The switch must have a design life of one million operations (minimum) at rated load.

995-9.2.3 Electrical Requirements: The wiring must be No. 18 AWG stranded (minimum) with 600 V outdoor insulation rating.

995-9.3 Accessible (Audible/Tactile) Pedestrian Pushbutton Detector: The accessible pedestrian pushbutton detector must consist of all electronic control equipment, wiring, mounting hardware, pushbuttons, and pedestrian actuation signs designed to provide both a pushbutton with a raised, vibrating tactile arrow on the button as well as a variety of audible indications for differing pedestrian signal functions.

995-9.3.1 Electronic Control Equipment: The accessible pedestrian pushbutton detector must include electronic control equipment that is programmable and adjustable using a laptop computer or vendor supplied programmer. Electronic control equipment must be able to be installed within a traffic controller cabinet or within a pedestrian signal housing. Electronic control equipment installed within a traffic controller cabinet must allow the use of up to 16 pushbuttons (4 maximum per channel) with a single traffic controller cabinet. The accessible pedestrian pushbutton detector must receive timing from Walk and Don't Walk signals.

995-9.3.1.1 Audible Messages: Audible messages must be programmable. All audible messages and tones must emanate from the accessible pedestrian pushbutton housing. The accessible pedestrian pushbutton detector must utilize digital audio technology. The system shall have, at a minimum, three programmable locator tones. The accessible pedestrian pushbutton detector must have independent minimum and maximum

volume limits for the Locator Tone, Walk, and Audible Beacons features. The Wait message must only announce once per actuation.

995-9.3.1.2 Pushbutton locator tone: The accessible pedestrian pushbutton detector must provide independent ambient sound adjustment for the locator tone feature. The accessible pedestrian pushbutton detector must allow the locator tone to be deactivated.

995-9.3.1.3 Vibrating Pushbutton (VPB): The accessible pedestrian pushbutton detector must include a Vibrating Pushbutton (VPB). The VPB must be a single assembly containing an ADA compliant, vibro-tactile, directional arrow button, weatherproof audible speaker and pedestrian actuation sign with optional placard Braille messages. The VPB tactile arrow must be 2 inches in length, be field adjustable to two directions, and require no more than 5 pounds of applied force to activate.

995-9.3.1.4 Conflict Monitoring: The accessible pedestrian pushbutton detector must monitor the Walk condition for conflict operation. The accessible pedestrian detector system must disable the Walk functionality if a conflict is detected.

995-9.3.1.5 Cabinet Control Unit (CCU): The accessible pedestrian pushbutton detector may include a CCU for interfacing and connecting the system. The CCU shall have labeled LED indicators for each channel operation. The CCU must reset upon loss of internal communication.

995-9.3.2 Inputs and Outputs: All inputs and outputs must use Mil-Spec Multi-pin connectors.

995-9.3.2.1 Inputs: Walk and Don't Walk inputs must be optically isolated 80-150 volts AC/DC, 5mA max. General purpose inputs must be optically isolated 10-36 volts AC/DC, 10mA max.

995-9.3.2.2 Outputs: Outputs must be optically isolated 36 volts AC/DC peak, 300mA solid state fused contact closures. CCUs must include a normally open relay contact fault output.

995-9.3.3 Communication: The CCU must include an Ethernet interface. The CCU must have an integral web server that provides information on audible/tactile pedestrian-pushbutton detector status, access to event logs, and provides for remote Configuration of accessible pedestrian pushbutton detector system options. VPBs must include an Ethernet, serial, USB, or Bluetooth programming interface.

995-9.4 Passive Detectors: The passive detector must consist of all electronic control equipment, wiring, and mounting hardware.

995-9.4.1 General: A passive detector system uses one or more sensors and analytics hardware and software to detect the presence and direction of pedestrians and activate the traffic control device without any required action by the pedestrian.

995-9.4.2 Configuration and Management: Ensure that the passive detector is provided with software that allows local and remote configuration and monitoring. Ensure that the system can display detection zones and detection activations overlaid on live passive detector inputs. Ensure that the passive detector allows a user to edit previously defined configuration parameters, including size, placement, and sensitivity of detection zones.

Ensure that the passive detector retains its programming in nonvolatile memory. Ensure that the detection system configuration data can be saved to a computer and restored from a saved file. Ensure that all communication addresses are user programmable.

995-9.4.3: Solid State Detection Outputs: Ensure outputs meet the requirements of NEMA TS2-2016, 6.5.2.26.

995-9.4.4: Electrical Requirements: Ensure the system operates using a nominal input voltage of 120V of alternating current (V_{AC}). Ensure that the system will operate with an input voltage ranging from 89 to 135 V_{AC} . If a system device requires operating voltages other than 120 V_{AC} , supply a voltage converter.

995-9.5 Electrical: All wiring must meet applicable NEC requirements. The accessible pedestrian pushbutton detector must operate using a nominal input voltage of 120 V alternating current (V_{AC}). If any device requires nominal input voltage of less than 120 V_{AC} , furnish the appropriate voltage converter.

Accessible pedestrian pushbutton detector control electronics that are mounted in a pedestrian signal head must be able to receive power from the Walk and Don't Walk circuits of the signal head. Control electronics shall not require more than four wires for each pushbutton connection, and no more than two wires for each controller pedestrian input. Voltage at the pushbutton shall not exceed 24 V_{AC} .

995-9.6 Mechanical: Equipment must be permanently marked with manufacturer name or trademark, part number, date of manufacture, and serial number. Do not use self-tapping screws on the exterior of the assembly.

Ensure that all parts are made of corrosion-resistant materials, such as plastic, stainless steel, anodized aluminum, brass, or gold-plated metal. Ensure that all assembly hardware, including nuts, bolts, external screws and locking washers less than 5/8 inch in diameter, are Type 304 or 316 passivated stainless steel. Stainless steel bolts, screws and studs must meet ASTM F593. Nuts must meet ASTM F594. All assembly hardware greater than or equal to 5/8 inch in diameter must be galvanized. Bolts, studs, and threaded rod must meet ASTM A307. Structural bolts must meet ASTM F3125, Grade A325.

Enclosures must have a NEMA 4X rating. Pushbutton housings for intersections must be black.

995-9.7 Environmental: Ensure equipment performs all required functions during and after being subjected to the environmental testing procedures described in NEMA TS2-2016, Sections 2.2.7, 2.2.8, and 2.2.9.

TRAFFIC CONTROL SIGNAL AND DEVICE MATERIALS (REV 11-10-21)

ARTICLE 995-1 is deleted and the following substituted:

995-1 Description.

This Section governs the requirements for all permanent traffic control signals and devices. All equipment shall be permanently marked with manufacturer name or trademark, part number, and date of manufacture or serial number.

SECTION 995 is expanded by the following new Articles:

995-6 Midblock Crosswalk Enhancement Assemblies.

995-6.1 General: Midblock crosswalk enhancement assemblies shall be listed on the Department's Approved Product List (APL). Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6.

Midblock crosswalk enhancement assemblies are classified as the following types: In-Roadway Light Assemblies and Rectangular Rapid Flashing Beacon Assemblies (RRFB).

995-6.2 In-Roadway Light Assemblies: In-roadway light assemblies must meet the physical and operational requirements of the latest edition of the MUTCD, Chapter 4N.

In-roadway light assemblies can include a passive detector in addition to a pedestrian pushbutton. In-roadway light assemblies must be normally dark and initiate operation upon pedestrian actuation via a pedestrian pushbutton or a passive detector. The In-roadway light assembly will cease operation at a predetermined time after the pedestrian actuation. If a passive detector is used, the In-roadway light assembly may cease operation after the pedestrian clears the crosswalk. The duration of the predetermined period shall be programmable and capable of matching the pedestrian clearance time for pedestrian signals as determined by MUTCD procedures. The timer that controls flashing must automatically reset each time a pedestrian call is received.

In-roadway light assemblies must have a minimum luminance of 101 candelas and a minimum viewing angle of 20 degrees.

995-6.3 Rectangular Rapid Flashing Beacon (RRFB): RRFB must include two rapidly and alternately flashed rectangular yellow indications having LED-array based pulsing light sources. Each rectangular yellow indication must be a minimum of five inches wide by two inches high. RRFB installations shall comply with the use and technical conditions of FHWA MUTCD Interim Approval 21 – Rectangular Rapid-Flashing Beacons at Crosswalks. The two RRFB indications shall be aligned horizontally, with the longer dimension horizontal and with a minimum space between the two indications of approximately 7 inches measured from inside edge of one indication to inside edge of the other indication.

995-6.3.1 Beacon Flashing Requirements: The light intensity of the yellow indications shall meet the minimum specifications of Society of Automotive Engineers (SAE) standard J595 for Class 1 (Directional Flashing Optical Warning Devices for Authorized Emergency, Maintenance, and Service Vehicles) dated January 2005. Ensure RRFB assemblies are capable of automatically dimming to reduce brightness of the LEDs at nighttime.

The flash rate of each individual yellow indication, as applied over the full on-off sequence of a flashing period of the indication, shall not be between 5 and 30 flashes per second. When activated, the two yellow indications in each RRFB shall have a flash rate of 75 flash cycles per minute using the following sequence: left side beacon on for 50 milliseconds (msec), both beacons off for 50 msec, right side beacon on for 50 msec, both beacons off for 50 msec, left side beacon on for 50 msec, both beacons off for 50 msec, right side beacon on for 50 msec, both beacons off for 50 msec, both beacons on for 50 msec, both beacons off for 50 msec, both beacons on for 50 msec, both beacons off for 250 msec. No other flash patterns shall be selectable via hardware or software.

995-6.3.2 RRFB Operation: RRFB can include a passive detector in addition to a pedestrian pushbutton. RRFBs must be normally dark and initiate operation only upon pedestrian actuation via a pedestrian pushbutton, or a passive detector. The RRFB will cease operation at a predetermined time after the pedestrian actuation. If the passive detector is used, the RRFB may cease operation after the pedestrian clears the crosswalk. The duration of the predetermined period shall be programmable and capable of matching the pedestrian clearance time for pedestrian signals as determined by MUTCD procedures. The timer that controls flashing must automatically reset each time a pedestrian call is received.

All RRFBs associated with a single crosswalk (including those with an overhead or advance crossing sign, if used) shall simultaneously commence operation of their alternating rapid flashing indications and shall cease operation simultaneously.

RRFBs must include an instruction sign (FTP-68C-21) mounted adjacent to or integral with each pedestrian pushbutton.

A confirmation light directed at and visible to pedestrians in the crosswalk must be installed integral to the RRFB to give confirmation that the RRFB is in operation.

995-6.3.3 Accessible Pedestrian Pushbutton: If an accessible pedestrian pushbutton is shown in the Plans, the assembly must contain a speaker, audio amplifier, and noise monitoring microphone for auto volume control.

The accessible pedestrian pushbutton detector must meet 995-9.3 for the locator tone feature. The pushbutton must not include a vibrotactile indication or percussive indications. The audible message must be programmable.

995-6.4 Cabinets, Housings, and Hardware: Cabinets used as part of the midblock crosswalk enhancement assembly must meet the applicable criteria of Section 676.

All housings other than approved cabinets must be powder coat painted dull black (FED-STD-595-37038) with a reflectance value not exceeding 25 percent as measured by American Society for Testing and Material E1347. Cabinets and housings must prevent unauthorized access.

Pole-mount assemblies shall allow installation on 4-1/2 inch outer diameter posts.

Ensure all assembly hardware, including nuts, bolts, external screws, and locking washers less than 5/8 inch in diameter, are Type 304 or 316 passivated stainless steel. Stainless steel bolts, screws, and studs must meet ASTM F593. Stainless steel nuts must meet ASTM F594. All assembly hardware greater than or equal to 5/8 inch in diameter must be galvanized. Carbon steel bolts, studs, and threaded rod must meet ASTM A307. Structural bolts must meet ASTM F3125, Grade A325.

995-6.5 Electrical Specifications: Equipment must operate on solar power or a nominal voltage of 120 V alternating current (V_{AC}). If the device requires operating voltages of less than 120 V_{AC}, supply the appropriate voltage converter. Solar powered systems must be designed to

operate for minimum of 100 activations per day and provide 10 days of operation without sunlight. Each activation must be 30 seconds in duration. Solar powered systems must automatically charge batteries and prevent overcharging and over-discharging. Solar powered systems must include a charge indicator.

995-6.6 Environmental Specifications: All electronic assemblies shall operate as specified during and after being subjected to the transients, temperature, voltage, humidity, vibration, and shock tests described in National Electrical Manufacturers Association (NEMA) TS2, 2.2.7, 2.2.8, and 2.2.9. Electronics must meet Federal Communications Commission (FCC) Title 47, Subpart B, Section 15. The optical portion of the housing shall be sealed to provide an IP 67 rating.

995-7 Mast Arm, Span Wire, and Pole Mounting Assemblies.

995-7.1 General: Mast arm, span wire, and pole mounting assemblies shall be listed on the Department's Approved Product List (APL) and meet the requirements of Section 603. Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6.

Fastening hardware such as bolts, nuts, washers, set screws, studs, u-bolts, cable and cable swags, must be provided by the mounting assembly manufacturer, must be SAE Type 316 or 304 stainless steel. Hardware (studs, bolts and u-bolts) must be a minimum of 5/16 inch diameter unless otherwise specified in this Section. SAE Grade 8 bolts and nuts are also acceptable. Metallic mounting assemblies must meet ASTM B117 for corrosion resistance.

Connections that provide an entrance to the interior of a traffic device must be weather-resistant.

All assemblies must be constructed to support the weight of any combination of signal indications with all accessories such as back plates and visors.

Connections between signal, disconnect and disconnect hanging hardware must be of the tri-stud design unless otherwise specified in this Section. Tri-stud washers must be a minimum 0.090 inches thick unless otherwise specified in this Section.

Connections must be designed to mate with a standard traffic signal's two inch I.D. opening and must be capable of providing positive positioning and alignment of the traffic device. Connection type may be a 72 tooth serrated edge or other connection type as long as all other specifications are met. For 72 tooth serrated edge connections, the teeth must be clean, sharp, and at least 1/8 inch wide and 3/64 inch deep. All connection types must be weather resistant.

All mounting assemblies must be capable of providing adjustment in multiple directions for proper alignment of the attached traffic device and to prevent rotation around the vertical axis or misalignment after installation.

Use studs that are either cast directly into the aluminum during the casting process or tapped and locked with a locking material. In each case, a pull-out force must be provided. Messenger wire clamps must be extruded aluminum six inches long or cast U-bolt type.

Torque specifications must be included for all fastening hardware with the assembly installation instructions.

995-7.2 Product Identification: Mounting assemblies must be permanently marked with the name or trademark of the manufacturer, part number and date of manufacture. Identification must be cast into, or metal-marked on, the assembly in a legible manner. When the assembly is made up of multiple components, each component must be identified with the manufacturer's name or trademark.

995-7.3 Finish: Unless otherwise specified, mounting assemblies and components must be supplied with a natural finish with mill scale removed in accordance with Military Standard MIL-PRF-24712A or AAMA 2603-02 and must meet the requirements of ASTM 3359 and ASTM D3363. Disconnect (interior and exterior) and disconnect hub must be powder-coat painted dull black (Federal Standard 595A-37038) with a reflectance value not exceeding 25 percent as measured by ASTM E97. All finished surfaces must have a smooth finish free from cracks, blow-holes, shrinks, excessive material, and other flaws.

995-7.4 Mast Arm Mounting Assemblies: Mast arm mounting assemblies must include the following components: mast arm saddle, swivel, attachment cables (with cable clamp mechanism) or bands. Unless the assembly uses a free swinging mounting method, mast arm mounting assemblies must include the support tube, and top and bottom support arms. Mast arm mounting assemblies must be designed to be attached to a mast arm by cables or bands. All connections must be designed to prevent movement when 250 pounds of downward force is applied to the completed vehicular traffic signal assembly.

995-7.4.1 Saddle: Saddles must be aluminum or stainless steel and must have a minimum yield strength of 16 ksi and a minimum ultimate tensile strength of 23 ksi in accordance with ASTM B26, ASTM B108, ASTM B85 or ASTM A240.

995-7.4.2 Swivel: Swivels must be aluminum or stainless steel and must have a minimum yield strength of 16 ksi and a minimum ultimate tensile strength of 23 ksi in accordance with ASTM B26, ASTM B108, ASTM B85 or ASTM A240. The swivel must provide at least two connection devices to secure the support tube to the swivel and be configured to permit the support tube to provide adjustment in multiple directions in a plane parallel to the mast arm. Any castings used to attach the support tube to the swivel must be manufactured from the same alloy as the swivel.

995-7.4.3 Saddle Attachment Cables and Bands: Mast arm saddle attachment cables must be 3/16 inch minimum diameter, Type 316 or 304 stainless steel aircraft type wire strand cable. The swage at the ends of the cable (used to tighten the cable against the saddle) must be Type 316 or 304 stainless steel with a minimum 3/8 inch diameter thread. The swage must permit use of a wrench to prevent rotation while tightening the nut at the end of the swage. If the attachment cable does not have swaged clamp screws at each end (double-ended), the unclamped end of the cable must be sintered, welded, or otherwise secured without adhesives to prevent unraveling of the cable. Banding must use two Type 304 or 201 series stainless steel 3/4 inch wide bands and Type 316 stainless steel buckles (clamp screws). De-burr the edges of the bands.

995-7.4.4 Cable Clamp Mechanism: Mast arm mount components used to secure the cable to the saddle must be aluminum or stainless steel and must have a minimum yield strength of 23 ksi and a minimum ultimate tensile strength of 30 ksi in accordance with ASTM B26, ASTM B221, ASTM B85 or ASTM A240.

995-7.4.5 Support Tube: Support tubes used in mast arm mounting assemblies must be aluminum or stainless steel and must have a minimum yield strength of 25 ksi and a minimum ultimate tensile strength of 30 ksi in accordance with ASTM B221 or ASTM A240. A gusseted hollow design may be used to provide for the routing of necessary wiring. The tube cross-sectional area's principal moments of inertia must average; at a minimum, that of a 1-1/2 inch standard aluminum Schedule 40 pipe and the cross-sectional metal area must not be less than that of a 1-1/2 inch Schedule 40 pipe. The bottom portion of the tube that supports the vertical load of the hanging device must be threaded using National Pipe Thread Taper (NPT),

National Pipe Thread Straight (NPS), non-threaded U-bolt secured, or a continuous arm support tube. Threaded support tubes that are fully slotted must have an aluminum insert in the 3/4 inch slot extending a minimum of 1/2 inch beyond the threaded section. To provide easy installation of wiring, the tube must have a minimum 0.562 inch wire entrance slot running the full length of the tube, or either stopping a minimum of 8 inches above the threaded or U-bolt secured end. Edges of slot must be supported with internal gusseting. The tube interior and slot must be free of sharp edges that may damage wiring. Provide an easily installed and removable UV stabilized seal to completely fill the wire entrance slot after installation.

995-7.4.6 Top Support Arm: The top support arm of the mounting assembly must be of one-piece solid construction, or continuous arm with support tube, and capable of holding the signal head firmly in place. Top support arms must be aluminum with a minimum ultimate tensile strength of 30 ksi and minimum yield strength of 18 ksi in accordance with ASTM B26, or be die cast with a minimum ultimate tensile strength of 27 ksi and a minimum yield strength of 24 ksi.

A one or two piece top arm is acceptable. For a one piece top arm, use at least two 1/4 inch minimum diameter Type 316 or 304 stainless steel set screws to secure its position on the support tube. When a two-piece top arm is used, hardware required to connect components of the top arm must be 3/8 inch minimum diameter, Type 316 or 304 stainless steel.

The top support arm must have three 1/4 inch - 20 UNC-2B threaded holes to accept bolts for a tri-stud washer and gasket, or at least one imbedded or tapped and locked 5/16 inch - 18 threaded stud within the industry's standard 72 tooth serrated circular design that facilitates 5 degree increment positioning. Provide 0.090 inch thick (minimum) Type 316 or 304 stainless steel washers, nuts, and lock washers for attaching signal heads. A rubber washer, with dimensions similar to the large stainless steel washer, must be provided for traffic signals. When mast arm clamps are used to support illuminated signs with tri-stud arrangements, a rubber washer with dimensions similar to the steel washer must also be used.

995-7.4.7 Bottom Support Arm: The bottom support arm, when not continuous arm with support tube, must be hollow to allow the routing and enclosing of all signal wiring. Bottom support arms must be aluminum with a minimum ultimate tensile strength of 30 ksi and minimum yield strength of 18 ksi in accordance with ASTM B26, or be die cast with a minimum ultimate tensile strength of 27 ksi and a minimum yield strength of 24 ksi. Plastic bottom arm covers must be constructed of ABS with a UV inhibitor and be strong enough to contain the signal cable in the bottom arm cavity without bending during installation and warping over time.

The end of the bottom support arm that attaches to the support tube must have a 1-1/2 inch steel coupling imbedded and cast directly into the part during the solidification of the aluminum, or a 1-1/2 inch NPT or NPS pipe thread cut directly into the casting. For non-threaded versions, the arm must allow the support tube to sit a minimum of 2 inches into an arm pocket and be secured to the arm with minimum 5/16 full U-shape U-bolt to distribute the load evenly to the lower arm casting.

The end of the bottom support arm that connects to the signal must have either three equally spaced and plumb imbedded 5/16 inch Type 316 or 304 stainless steel threaded studs located in the center of the 72 tooth serrated circular design, or three 1/4 inch - 20 UNC-2B tapped holes to accept bolts for a tri-stud washer.

995-7.4.7.1 Arms with Steel Coupling: If a threaded steel coupling is imbedded into the casting, the bottom arm must be aluminum alloy 535.0-F in accordance with ASTM B26, with a minimum ultimate tensile strength of 23 ksi, meeting all standards listed in

ASTM B26, including chemical composition listed in Table 1 and material mechanical properties listed in Table 2. The end of the bottom support arm must have at least two 1/4 inch diameter Type 316 or 304 stainless steel set screws to secure its position on the support tube.

995-7.4.7.2 Threaded Arms: If threads are cut directly into the casting, the bottom arm must be aluminum alloy 535.0-F in accordance with ASTM B26, with a minimum ultimate tensile strength of 35 ksi and elongation of 9.0% in a two inch section, meeting all standards listed in ASTM B26, including chemical composition listed in Table 1 and material mechanical properties listed in Table 2. As an alternative, the arm can be die cast in aluminum with a minimum ultimate tensile strength of 27 ksi and a minimum yield strength of 24 ksi. The end of the bottom arm must have at least two 1/4 inch minimum diameter Type 316 or 304 stainless steel set screws to secure its position on the support tube.

995-7.4.7.3 Non-threaded Arms: Lower arm must be aluminum 356 having a minimum ultimate tensile strength of 30 ksi and meeting all standards listed in ASTM B26, including chemical composition listed in Table 1 and material mechanical properties listed in Table 2. The arm must have a locator tab to receive the support tube and be secured by a U-bolt.

995-7.4.7.4 Continuous Arm Support Tube: The continuous arm support tube must be of single form construction to support the weight of any combination of signal indicators with all accessories such as backplates and visors. Continuous support tubes must be Type 316 or 304 stainless steel with a minimum ultimate tensile strength of 75 ksi and a minimum yield strength of 30 ksi in accordance with ASTM A554, or aluminum with a minimum yield strength of 25 ksi and a minimum ultimate tensile strength of 30 ksi in accordance with ASTM B221.

The continuous arm support tube attachment to the signal head must have a minimum of two 5/16-18 Type 316 or 304 stainless steel bolts, nuts and washers. A rubber seal must be provided between the support tube and signal head.

995-7.5 Span Wire Mounting Assemblies: Span wire mounting assemblies must include a span wire clamp, a hanging device such as a drop pipe, adjustable hanger, or adjustable pivotal hanger with extension bar, messenger clamp, disconnect hanger, and multi-brackets.

995-7.5.1 Span Wire Clamp: Span wire clamps must be aluminum or stainless steel and must have a minimum ultimate tensile strength of 32 ksi and minimum yield strength of 22 ksi in accordance with ASTM B28, ASTM B108, ASTM B85, or ASTM A240.

995-7.5.2 Drop Pipe: Drop pipe hangers must be galvanized 1-1/2 inch steel aluminum having a minimum yield strength of 35 ksi and a minimum ultimate tensile strength of 42 ksi in accordance with ASTM B221 and have NPT on each end for assembly.

995-7.5.3 Aluminum Adjustable Hanger: Aluminum adjustable hangers must be aluminum alloy 535.0-F in accordance with ASTM B26 with a minimum ultimate tensile strength of 35 ksi and elongation of 9.0% in a two inch section, meeting the chemical composition listed in Table 1 and material mechanical properties listed in Table 2 in ASTM B26.

995-7.5.4 Stainless Steel Adjustable Hanger: Stainless steel adjustable hangers must be Type 316 or 304 stainless steel with a minimum ultimate tensile strength of 75 ksi and a minimum yield strength of 30 ksi in accordance with ASTM A276.

995-7.5.5 Aluminum Adjustable Pivotal Hanger: Aluminum pivotal hangers must be aluminum alloy 535.0-F in accordance with ASTM B26 with a minimum ultimate tensile strength of 35 ksi and elongation of 9.0% in a two inch section, meeting the chemical composition listed in Table 1 and material mechanical properties listed in Table 2 in ASTM B26.

995-7.5.6 Stainless Steel Adjustable Pivotal Hanger: Stainless steel pivotal hangers must be either Type 316 or 304 stainless steel with a minimum ultimate tensile strength of 75 ksi and a minimum yield strength of 30 ksi in accordance with ASTM A276.

995-7.5.7 Aluminum Extension Bar: Extension bars used to extend the length of the adjustable hanger must be T6061-T6 extrusion aluminum having a minimum yield strength of 35 ksi and a minimum ultimate tensile strength of 42 ksi in accordance with ASTM B221.

995-7.5.8 Stainless Steel Extension Bar: Stainless steel extension bar used to extend the length of adjustable hangers must be Type 316 or 304 stainless steel with a minimum ultimate tensile strength of 75 ksi and a minimum yield strength of 30 ksi in accordance with ASTM A276.

995-7.5.9 Disconnect Hanger: The disconnect hanger must be supplied with the following as a minimum:

1. Wired screw type/compression terminal block and wiring rated at 600 V_{AC} Root Mean Square (rms) with 12 or 18 circuits. The terminal block must be easily accessible for connection of the field wiring. Attach the terminal block to the disconnect with Type 316 or 304 stainless steel or brass fastening hardware.

2. Weather resistant grommets in each signal cable entrance of the disconnect hanger to prevent insect and animal access and to protect the signal cable from chafing.

3. A two inch opening in the top of the disconnect hanger with an integral serrated area (or 1-1/2 inch NPT threaded top section) to interface with the hanger method employed above it.

4. A securable door that allows access to all areas of the interior. The door securing device must be Type 316 or 304 stainless steel and captive. Hinge or groove pins for the door must be Type 316, 304, 303, or 302 stainless steel.

995-7.5.10 Multi-Brackets: Top and bottom (multi) brackets used in the assembly of span wire mounted multi-directional signals must be constructed of aluminum having a minimum yield strength of 13 ksi and a minimum ultimate tensile strength of 23 ksi per ASTM B26.

Top brackets must be of one-piece hollow design, with a cross-sectional diameter of at least 1-1/2 inch I.D. for receiving signal wires. The wall thickness must be at least 3/16 inch. Each top bracket (2- way, 3-way, and 4-way) must have a two inch diameter hole (with integral serrated boss as specified above) in the top side of the bracket for receiving a 1-1/2 inch entrance fitting. The underside of the top bracket must have a covered hole of at least three inches in diameter for the installation of the signal wires.

Bottom brackets must be of one-piece solid construction and must hold the signal heads firmly in place.

For the five section cluster configuration, provide 3/8 inch thick Type 316 or 304 stainless steel tri-stud washers and nylock nuts with lock washers to secure the top and lower signal sections of the cluster to the top multi bracket. Washer distortion must not occur after assembly of the five section cluster. Multi-brackets must include all fastening hardware necessary to attach to the signal.

995-7.6 Pole (Pedestal and Post) Mounting Assemblies: All trunnions, brackets, and suspensions used in mounting vehicular and pedestrian signals to concrete, steel, aluminum, or wood poles must be an aluminum alloy cast fitting, pipe or equivalent as approved by the

Engineer. The aluminum alloy must have a minimum ultimate tensile strength of 35 ksi in accordance with ASTM B221, ASTM B85, or ASTM B26.

Pole side-mount brackets used for pedestrian signals may be constructed of polycarbonate material.

995-7.7 Mounting Assemblies for Signs, Cameras, Detectors, and Other Traffic Control Devices: Mounting assemblies or assembly components used for signs, cameras, detectors, and other traffic control devices must be constructed of the same material, and meet the same mechanical and chemical properties as mounting assemblies for signals.

995-7.8 Miscellaneous Mounting Components: Miscellaneous mast arm, span wire, and pole mounting components and accessories included with assemblies must meet the mechanical properties for its associated main assembly components or be listed separately on the APL. Mounting assemblies not approved with a specific primary device (such as a camera, detector, etc.), must be approved and listed separately on the APL.

995-8 Signal Priority and Preemption Systems.

995-8.1 General: Signal priority and preemption system equipment shall be listed on the Department's Approved Product List (APL). Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6.

Signal priority and preemption system equipment may utilize optical, GPS, and radio frequency based technologies.

995-8.2 Functional Requirements: Ensure that in-vehicle equipment operates without requiring any action from the vehicle operator or occupants once power is applied.

995-8.2.1 Security: The system must include features that secure the system and restrict its configuration and operation to authorized users and vehicles only.

995-8.2.2 Vehicle Identification: The system must be able to assign a unique identifier for each authorized vehicle. The system must be able to associate the identifier with vehicle information such as vehicle classification (e.g., fire, police, rescue, transit), owner/operator, and priority level.

995-8.2.3 Configuration and Management: The system must allow authorized local and remote users to set and read all user-programmable features and retrieve data collected by the system. The manufacturer must provide computer software required to configure, operate, and maintain the system at no additional cost to the Department.

995-8.2.4 Logging: The system installed in the field cabinet must store a record of events, including time, vehicle ID, class, priority level, and approaching direction for all vehicles detected. The log must operate on a first-in, first out (FIFO) principle with a minimum capacity of 5,000 events.

995-8.2.5 Detection Range and Accuracy: The priority and preemption system must be capable of detecting and identifying multiple authorized vehicles at various ranges up to 2,500 feet. The system must be able to determine the approaching direction of authorized vehicles. The detection range and programming of emergency (high priority) and transit signal (low priority) preemption shall be adjustable from within the traffic signal cabinet. High priority calls must override low priority calls.

The system must service preemption calls having equal priority on a first-come, first-served basis.

995-8.3 Preemption System Cabinet Electronics: The priority and preemption system must be compatible with NEMA TS 1, NEMA TS 2, Type 170, and Type 2070 traffic signal controllers and their respective cabinets.

The system must be able to provide calls to the controller via input file and detector rack. The system must include two channel or four channel detector card units compatible with NEMA TS 2-2003 v02.06. The system must include a shelf mount option.

The system must be able to provide emergency preemption (high priority) and transit signal (low priority) preemption calls to the controller. Detectors must include programmable timers that allow the operator to configure detector call extension as well as limit the length of channel output calls.

Channel outputs must deliver a constant signal while emergency vehicles are detected for high priority preemption activation. Channel outputs must deliver a pulsed output for low priority preemption activation. Inputs and outputs must be optically isolated.

995-8.3.1 Serial Interface: Ensure that the serial ports support data rates up to 115 kbps; error detection procedures utilizing parity bits (i.e., none, even, and odd); and stop bits (1 or 2). Serial interface ports may utilize RJ-45 connectors, D-sub connectors, or screw terminals.

995-8.3.2 Network Interface: Ensure that local area network (LAN) connections support the requirements detailed in the Institute of Electrical and Electronics Engineers (IEEE) IEEE 802.3 Standard for 10/100 Ethernet connections. Ensure that the connector complies with applicable Electronic Industries Alliance (EIA) and Telecommunications Industry Association (TIA) requirements.

995-8.4 Optical Preemption Detectors: Optical preemption detectors must respond to light impulses generated from a visible or infrared light source.

995-8.5 Intersection Radio/GPS Modules: Radio/GPS preemption systems must include radio/GPS modules that transmit a beacon signal and receive data transmitted by Radio/GPS vehicle equipment.

995-8.6 Mechanical Specifications: Ensure equipment is permanently marked with manufacturer name or trademark, part number, and date of manufacture or serial number.

Ensure that every conductive contact surface or pin is gold-plated or made of a noncorrosive, conductive metal. Do not use self-tapping screws on the exterior of the assembly.

All external parts must be made of corrosion-resistant materials, such as plastic, stainless steel, anodized aluminum, brass, or gold-plated metal.

Detector cards must include indicators for power and vehicle detection. Detector cards must include a test switch that can be used to manually generate detector calls that the system provides during normal operations.

995-8.7 Electrical Specifications: Provide equipment that operates on a nominal voltage of 120 volts alternating current (V_{AC}). If the device requires operating voltages of less than 120 V_{AC}, supply the appropriate voltage converter.

995-8.8 Environmental Specifications: Ensure system electronics perform all required functions during and after being subjected to the environmental testing procedures described in NEMA TS 2, Sections 2.2.7, 2.2.8, and 2.2.9. Detectors and detector connections that are exposed to the elements must be weatherproof and designed for outdoor use.

995-9 Pedestrian Detection System.

995-9.1 General: Pedestrian detection system equipment shall be listed on the Department's Approved Product List (APL). Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6.

Pedestrian detection systems are classified into three categories: Standard Pedestrian Pushbutton Detectors, Accessible (Audible/Tactile) Pedestrian Pushbutton Detectors,

and Passive Detectors. The components of the pedestrian detection system include pushbuttons, pedestrian actuation signs, electronics, wiring, and mounting hardware.

995-9.2 Standard Pedestrian Pushbutton Detector: Pushbuttons must be raised from or flush with their housings and be a minimum of 2 inches in the smallest dimension. The pushbutton must require no more than 5 pounds of force to activate. The detector must be weather-tight and tamper resistant.

995-9.2.1 Housing: The housing must be a two piece unit consisting of a base housing and a removable cover. The housing must be cast aluminum meeting the physical characteristics and chemical content established in ASTM B26 for alloys S5A and CS72A.

The housing or adapter (saddle) must conform to the shape of a pole and provide a flush, secure fit. Saddles must be of the same material and construction as the housing. Pushbuttons for wood pole mounting must have threaded holes for 1/2 inch conduit provided in the housing top or bottom. A 3/4 inch hole with an insulated bushing shall be provided through the back of the housing. Unused openings shall be closed with a weatherproof closure and painted to match the housing.

The housing must have a powder-coat finish and painted in accordance with Military Standard MIL-PRF-24712A. The housing must be permanently marked with manufacturer name or trademark, part number, date of manufacture, and serial number.

995-9.2.2 Pushbutton: The pushbutton must include a normally open, mechanical phenolic enclosed, positive-acting, spring-loaded, audible (i.e., click) snap-action switch with single pole, single throw contacts, or a Piezo driven solid state switch rated for a minimum of 50 V. The Piezo driven solid state switch, when activated, must give an audible (i.e., two-tone chirp) indication of actuation. A visual indication of actuation is optional. The visual indication must remain illuminated until the pedestrian's WALKING PERSON (symbolizing WALK) signal indication is displayed. Switch connections inside the housing must allow wiring and installation without binding. The switch must have a design life of one million operations (minimum) at rated load.

995-9.2.3 Electrical Requirements: The wiring must be No. 18 AWG stranded (minimum) with 600 V outdoor insulation rating.

995-9.3 Accessible (Audible/Tactile) Pedestrian Pushbutton Detector: The accessible pedestrian pushbutton detector must consist of all electronic control equipment, wiring, mounting hardware, pushbuttons, and pedestrian actuation signs designed to provide both a pushbutton with a raised, vibrating tactile arrow on the button as well as a variety of audible indications for differing pedestrian signal functions.

995-9.3.1 Electronic Control Equipment: The accessible pedestrian pushbutton detector must include electronic control equipment that is programmable and adjustable using a laptop computer or vendor supplied programmer. Electronic control equipment must be able to be installed within a traffic controller cabinet or within a pedestrian signal housing. Electronic control equipment installed within a traffic controller cabinet must allow the use of up to 16 pushbuttons (4 maximum per channel) with a single traffic controller cabinet. The accessible pedestrian pushbutton detector must receive timing from Walk and Don't Walk signals.

995-9.3.1.1 Audible Messages: Audible messages must be programmable. All audible messages and tones must emanate from the accessible pedestrian pushbutton housing. The accessible pedestrian pushbutton detector must utilize digital audio technology. The system shall have, at a minimum, three programmable locator tones. The accessible pedestrian pushbutton detector must have independent minimum and maximum

volume limits for the Locator Tone, Walk, and Audible Beacons features. The Wait message must only announce once per actuation.

995-9.3.1.2 Pushbutton locator tone: The accessible pedestrian pushbutton detector must provide independent ambient sound adjustment for the locator tone feature. The accessible pedestrian pushbutton detector must allow the locator tone to be deactivated.

995-9.3.1.3 Vibrating Pushbutton (VPB): The accessible pedestrian pushbutton detector must include a Vibrating Pushbutton (VPB). The VPB must be a single assembly containing an ADA compliant, vibro-tactile, directional arrow button, weatherproof audible speaker and pedestrian actuation sign with optional placard Braille messages. The VPB tactile arrow must be 2 inches in length, be field adjustable to two directions, and require no more than 5 pounds of applied force to activate.

995-9.3.1.4 Conflict Monitoring: The accessible pedestrian pushbutton detector must monitor the Walk condition for conflict operation. The accessible pedestrian detector system must disable the Walk functionality if a conflict is detected.

995-9.3.1.5 Cabinet Control Unit (CCU): The accessible pedestrian pushbutton detector may include a CCU for interfacing and connecting the system. The CCU shall have labeled LED indicators for each channel operation. The CCU must reset upon loss of internal communication.

995-9.3.2 Inputs and Outputs: All inputs and outputs must use Mil-Spec Multi-pin connectors.

995-9.3.2.1 Inputs: Walk and Don't Walk inputs must be optically isolated 80-150 volts AC/DC, 5mA max. General purpose inputs must be optically isolated 10-36 volts AC/DC, 10mA max.

995-9.3.2.2 Outputs: Outputs must be optically isolated 36 volts AC/DC peak, 300mA solid state fused contact closures. CCUs must include a normally open relay contact fault output.

995-9.3.3 Communication: The CCU must include an Ethernet interface. The CCU must have an integral web server that provides information on audible/tactile pedestrian-pushbutton detector status, access to event logs, and provides for remote Configuration of accessible pedestrian pushbutton detector system options. VPBs must include an Ethernet, serial, USB, or Bluetooth programming interface.

995-9.4 Passive Detectors: The passive detector must consist of all electronic control equipment, wiring, and mounting hardware.

995-9.4.1 General: A passive detector system uses one or more sensors and analytics hardware and software to detect the presence and direction of pedestrians and activate the traffic control device without any required action by the pedestrian.

995-9.4.2 Configuration and Management: Ensure that the passive detector is provided with software that allows local and remote configuration and monitoring. Ensure that the system can display detection zones and detection activations overlaid on live passive detector inputs. Ensure that the passive detector allows a user to edit previously defined configuration parameters, including size, placement, and sensitivity of detection zones.

Ensure that the passive detector retains its programming in nonvolatile memory. Ensure that the detection system configuration data can be saved to a computer and restored from a saved file. Ensure that all communication addresses are user programmable.

995-9.4.3: Solid State Detection Outputs: Ensure outputs meet the requirements of NEMA TS2-2016, 6.5.2.26.

995-9.4.4: Electrical Requirements: Ensure the system operates using a nominal input voltage of 120V of alternating current (V_{AC}). Ensure that the system will operate with an input voltage ranging from 89 to 135 V_{AC} . If a system device requires operating voltages other than 120 V_{AC} , supply a voltage converter.

995-9.5 Electrical: All wiring must meet applicable NEC requirements. The accessible pedestrian pushbutton detector must operate using a nominal input voltage of 120 V alternating current (V_{AC}). If any device requires nominal input voltage of less than 120 V_{AC} , furnish the appropriate voltage converter.

Accessible pedestrian pushbutton detector control electronics that are mounted in a pedestrian signal head must be able to receive power from the Walk and Don't Walk circuits of the signal head. Control electronics shall not require more than four wires for each pushbutton connection, and no more than two wires for each controller pedestrian input. Voltage at the pushbutton shall not exceed 24 V_{AC} .

995-9.6 Mechanical: Equipment must be permanently marked with manufacturer name or trademark, part number, date of manufacture, and serial number. Do not use self-tapping screws on the exterior of the assembly.

Ensure that all parts are made of corrosion-resistant materials, such as plastic, stainless steel, anodized aluminum, brass, or gold-plated metal. Ensure that all assembly hardware, including nuts, bolts, external screws and locking washers less than 5/8 inch in diameter, are Type 304 or 316 passivated stainless steel. Stainless steel bolts, screws and studs must meet ASTM F593. Nuts must meet ASTM F594. All assembly hardware greater than or equal to 5/8 inch in diameter must be galvanized. Bolts, studs, and threaded rod must meet ASTM A307. Structural bolts must meet ASTM F3125, Grade A325.

Enclosures must have a NEMA 4X rating. Pushbutton housings for intersections must be black.

995-9.7 Environmental: Ensure equipment performs all required functions during and after being subjected to the environmental testing procedures described in NEMA TS2-2016, Sections 2.2.7, 2.2.8, and 2.2.9.