Florida Department of Transportation

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KEVIN J. THIBAULT, P.E.
SECRETARY

August 16, 2021

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: **REVISED 9950207 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 Engineering and Operations Office is to move the materials section from Division II to Division III. Since the Wrong Way Vehicle Detection System must interface with the SunGuide Software, a supplemental requirements document will facilitate the application programming interface development. This proposed specification revision is associated with changes to Section 650 and 653.
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 5-14-21)

SUBARTICLE 995-2.7.2 is deleted and the following substituted:

995-2.7.2 Communications: Major components of the WWVDS (such as the sensor and any separate hardware used for contact closures) shall include a minimum of one serial or Ethernet communications interface and shall meet the following criteria:

1. The serial interface and connector conforms to TIA-232 standards and the serial ports support data rates up to 115200 bps; error detection utilizing parity bits (i.e., none, even, and odd); and stop bits (1 or 2).

2. Wired Ethernet interfaces provides, at a minimum, a 10/100 Base TX connection. Verify that all unshielded twisted pair/shielded twisted pair network cables and connectors comply with TIA-568.

3. Wireless communications are secure and that wireless devices are FCC certified. The FCC identification number is displayed on an external label and all WWVDS devices operate within their FCC frequency allocation.

4. Cellular communications devices are compatible with the cellular carrier used by the agency responsible for system operation and maintenance.

5. The system can be configured and monitored via one or more communications interface.

6. The WWVDS is compatible with the Department's SunGuide® software. The SunGuide software requirements are listed in supplemental requirement SR-995-2.7.2-01, Supplemental Wrong Way Vehicle Detection System SunGuide HTTP Protocol, as published on the Department's State Traffic Engineering and Operations Office website at the following URL: https://www.fdot.gov/traffic/Traf-Sys/Product-Specifications.shtm.

7. For WWVDS installed on ramps, the device shall:

a. Send an alert ~~and a sequence of images for up to ten seconds~~ to the SunGuide® software when the wrong-way vehicle is detected.~~that covers a configurable time before and after the wrong-way vehicle detection.~~

b. Send a sequence of images for up to ten seconds to the SunGuide software that covers a configurable time before and after the wrong-way vehicle detection.

~~b~~c. Activate all highlighted signs associated with the WWVDS.

SUBARTICLE 995-2.9.1 is deleted and the following substituted:

995-2.9 Traffic Data Detection System Acceptance Requirements:

995-2.9.1 Data Accuracy: ~~Provide a~~The vehicle detection system shall be capable of meeting the minimum total roadway segment accuracy levels of 95% for volume, 90% for occupancy, and 90% for speed for all lanes, up to the maximum number of lanes that the device can monitor as specified by the manufacturer.

To verify conformance with the accuracy requirements in this Section and as a precondition for listing on the APL, sample data collected from the vehicle detection system

will be compared against ground truth data collected during the same time by human observation or by another method approved by the TERL. Sample data shall be collected over several time periods under a variety of traffic conditions. Weight each data sample to represent the predominant conditions over the course of a 24-hour period. Samples shall consist of 15- and 30-minute data sets collected at various times of the day. Representative data periods and their assigned weights are provided in Table 995-1.

SECTION 995 is expanded by the following new Articles:

995-4 Vehicular Traffic Signal Assemblies.

995-4.1 General: Vehicular traffic signal 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.

Vehicular traffic signal assemblies must meet the requirements of Section 603 and the Institute of Transportation Engineers (ITE) Standard for Vehicle Traffic Control Signal Heads.

Fastening hardware such as bolts, screws, nuts, washers, latches, and studs must be SAE Type 316 or 304 stainless steel.

Horizontal signal assemblies must be constructed so the door hinges, when installed, are located on the bottom of the signal assembly. Vertical mounted five-section cluster assemblies must be constructed so that the door hinges, when installed, are located along the outside edges of the complete assembly and each section opens away from the horizontally adjacent section.

Vehicular traffic signal assemblies must be permanently marked with the manufacturer's name or trademark, part or model number and date of manufacture or serial number.

995-4.2 Twelve Inch Signal Head Assemblies: Construct the assembly of materials and alloys specified in the ITE Standard for Vehicle Traffic Control Signal Heads.

Construct signal housings to allow adjustment in multiple directions for proper signal alignment. If a serrated connection is used for positioning and alignment of the signal, the top and bottom opening of each signal head section must include a circular 72-tooth serrated connection (2 inch nominal I.D.) capable of providing positive positioning and alignment in 5 degree increments. When assembled and tightened, these connections must prevent rotation or misalignment of the signal head as well as misalignment between sections. The serrated area must start at the outside of the 2 inch hole and be at least 1/8 inch wide. The teeth must have a minimum depth of 3/64 inch between peaks and valleys, be free from burrs or other imperfections, and provide positive locking with the grooves of mating sections, framework, and brackets. The serration on the top circular connection of a signal section must have a valley at the 0 degree position and the serration on the bottom circular connection must have a peak at the 0 degree position, both aligned perpendicular to the front of the section. Connections must permit the assembly of a multi-section signal with the front of each section aligned within 1 degree.

Provide at least two latching points with latch pads and manual Type 316 or 304 stainless steel latching devices that are tamper resistant.

If backplates are mechanically attached, each signal section must have four backplate mounting attachment points on the back of the signal, on or no more than three inches

from each section corner. Attachment points must be capable of accepting No. 10-16x3/8 inch or No. 10-24x3/8 inch Type 316 or 304 stainless steel screws for attaching backplates.

Tri-stud washers, when utilized to secure signal sections, must have a minimum thickness of 0.090 inches. For five-section cluster assemblies, tri-stud washers used to attach the top signal section to the multi-signal bracket and the multi-signal bracket to the bottom four signal sections must have a minimum thickness of 3/8 inches. When fastened together, washer distortion is not allowed.

Design each signal section to prevent the accumulation of standing water within the assembly. All sections comprising a single multi-section assembly must be securely fastened together to form a rigid and weather-proof unit.

995-4.2.1 Doors: Construct each signal section with at least two hinges for mounting a door. Hinge pins must be captive. Doors must remain captive and secure at all times and be capable of either left or right swing. The door latch must hold the door tightly closed. The door must include slotted pads that allow the door to be opened and closed by engaging or disengaging the latching device. The outside face of the door must include four holes equally spaced around the circumference of the lens opening for the attachment of a visor. The lens opening in the door must have a diameter of 11 to 11-1/2 inches.

995-4.2.2 Visors: The rear of the visor must have four tabs, notches, or holes for securing the visor to the signal housing door. The visor mounting method must permit the visor to be rotated and secured at 90 degrees for horizontal signal head installations. All visors must have a minimum length of 9-1/2 inches, and a minimum downward tilt of 3.5 degrees measured from the center of the lens. Tunnel visors must encircle and shield the lens from 300 degrees, plus or minus 10 degrees. Louvers may only be used in combination with full circle visors. Light must not escape between the visor and the door.

995-4.2.3 Gaskets: Gaskets must be constructed of weather-resistant material and be glued or sealed where they meet to provide one continuous length of gasket capable of providing a weatherproof seal for the signal assembly. Provide seals between the housing and door, between the lens and the door, and between any other mating surfaces where dust and moisture could enter. Gasket material must meet NEMA 250 and be constructed of temperature stabilized material that prevents any residue from collecting on the internal surfaces of the signal head.

995-4.2.4 Terminal Blocks: Provide at least one five-connection terminal block in all three or more section signal head assemblies and at least three five-connection terminal blocks in all five section signal head assemblies. Terminal block connections in the signal assembly must not require any tools other than a screwdriver.

Mount terminal blocks to the signal housing with Type 316 or 304 passivated stainless steel hardware. Use only non-corrosive wire attachment screws approved by the Department.

995-4.2.5 Color and Finish: The housing, doors, visors and backplates must be powder coated dull black (Federal Standard 595-37038) with a reflectance value not exceeding 25 percent as measured by ASTM E1347. For plastic heads, the black color must be incorporated into the plastic material before molding.

The finish on interior and exterior surfaces of aluminum signal head assemblies, visors, doors, and housing, must be painted in accordance with Military Standard MIL-PRF-24712A or American Architectural Manufacturers Association-2603-02 and must meet the requirements of ASTM D3359, ASTM D3363, and ASTM D522. Surface erosion,

flaking, or oxidation must not occur within the normal life expectancy under typical installation conditions.

995-4.2.6 Plastic Signal Housings and Visors: Construct signal housing assembly, door, and visors of UV stabilized plastic with a minimum thickness of 0.1 inches, plus or minus, 0.01 inches, with the following physical properties:

1. Specific Gravity: 1.17 minimum, as per ASTM D792
2. Vicat Softening Temperature: 305-325 F (152-163 C), as per ASTM D1525
3. Brittleness Temperature: Below -200 F (-129 C), as per ASTM D746
4. Flammability: Self-extinguishing, as per ASTM D635
5. Tensile Strength, yield: 8500 PSI (58 MPa) minimum, as per ASTM D638
6. Elongation at yield: 5.5-8.5 %, as per ASTM D638
7. Shear, strength, yield: 5500 PSI (38 Mpa) minimum, as per ASTM D732
8. Izod impact strength, [notched, 1/8 inch]: 15 ft-lb/in (800 j/m) minimum, as per ASTM D256
9. Fatigue strength at 2.5 mm cycles: 950 PSI (6.5 MPa) minimum, as per ASTM D671

995-4.2.7 Backplates: Backplates may be constructed of either aluminum or plastic. Minimum thickness for aluminum backplates is 0.060 inch and the minimum thickness for plastic backplates is 0.120 inch. The required width of the top, bottom, and sides of backplates must measure between five to six inches. Color of backplates must be black in accordance with 995-4.2.5. Backplate thickness measurement must not include the retroreflective sheeting thickness.

If backplates are mechanically attached, provide a minimum of four corner mounting attachment points per signal section (for example, a three-section signal assembly would have 12 mounting points). Attachment points must not interfere with the operation of traffic signal section doors. Backplate outside corners must be rounded and all edges must be de-burred.

If louvers are provided, louver orientation must be vertical on sides and horizontal on top and bottom of the backplate and must be at least 1/2 inch from the inner and outer edge of the backplate panel. Universal backplates must fit all traffic signals listed on the APL.

Mount the backplate securely to the signal assembly with Type 316 or 304 passivated stainless steel installation hardware. Backplates, if mechanically attached, must be marked in accordance with 995-4.1, on the long sides of the backplate.

Backplates must include retroreflective borders using Type IV yellow retroreflective sheeting listed on the APL. Place a 2 inch border on the entire outer perimeter of the backplate panel, no closer than 1/2 inch from any louvers.

All materials must be designed for exterior use and be UV stable.

995-4.2.7.1 Flexible Backplates: Flexible backplates must allow the entire length of longer portions of the backplate to flex 90 degrees, or until the backplate width is reduced to 2.5 inches or less, when influenced by high wind conditions, and return to zero degrees after the wind conditions subside. Flexible backplates must maintain visibility of the retroreflective border to approaching traffic, with up to 40 mph winds.

995-4.2.8 Light-Emitting Diode Optical Unit: The LED optical unit must conform to the requirements of ITE's Performance Specification, Vehicle Traffic Control Signal Heads - Light Emitting Diode (LED) Circular Signal Supplement, dated June 27, 2005 or Vehicle Traffic Control Signal Heads - Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Supplement, dated July 1, 2007, with the following exceptions.

995-4.2.8.1 Physical and Mechanical Requirements: Retrofit LED signal modules must be compatible with all traffic signal housings listed on the APL. The rear of the LED signal module must be marked in accordance with 995-4.1.

995-4.2.8.2 LED Signal Module Lens: The lens must be tinted with an appropriate color (red, amber, or green) to reduce sun phantom affect and enhance on/off contrast. The tinting must be uniform across the face of the lens and be free from streaks, wrinkles, chips, bubbles, or other imperfections. If a polymer lens is used, a surface coating must be incorporated to provide abrasion resistance.

995-4.2.8.3 Minimum Maintained Luminous Intensity Values: Red and green modules must meet the requirements of ITE's Performance Specification, Vehicle Traffic Control Signal Heads - Light Emitting Diode (LED) Circular Signal Supplement, dated June 27, 2005, with the exception that yellow modules must be 1.7 times brighter than the ITE specification. Arrow modules must meet the requirements of ITE's Performance Specification, Vehicle Traffic Control Signal Heads - Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Supplement, dated July 1, 2007.

995-4.2.9 Electrical: Electrical conductors for LED signal modules must be a minimum of 36 inches in length. Each lead from the LED module must be terminated with insulated slide-on terminals. The conductors must be color coded to identify the color of the module as follows:

1. White must identify the neutral lead.
2. Red circular signals must be identified with a red lead, yellow circular signals with a yellow lead, and green circular signals with a green lead.
3. Red arrows must be identified with a red and black tracer lead, yellow arrows with a yellow and black tracer lead, and green arrows with a green and black tracer lead.

995-5 Pedestrian Signal Assemblies.

995-5.1 General: Pedestrian signal 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.

Pedestrian signal assemblies must meet the requirements of Section 603, the latest edition of the Federal Highway Administration's (FHWA) Manual on Uniform Traffic Control Devices (MUTCD), and the Institute of Transportation Engineers (ITE) standard for Pedestrian Traffic Control Signal Indications.

995-5.2 Housing and Visor: The housing must be weatherproof, sectional and may consist of as many sections as optical units. The housing must prevent light from escaping from one unit to another. The top and bottom opening of the housing must include a circular 72-tooth serrated connection (2 inch nominal I.D.) capable of providing positive positioning and alignment in 5 degree increments. When assembled and tightened, these connections must prevent rotation or misalignment. The serrated area must start at the outside of the 2 inch hole and be at least 1/8 inch wide. The teeth must have a minimum depth of 3/64 inch between peaks and valleys, free from burrs or other imperfections, and provide positive locking with the grooves of mating sections, framework, and brackets. The serration on the top circular

connection of a signal section must have a valley at the 0 degree position and the serration on the bottom circular connection must have a peak at the 0 degree position, both aligned perpendicular to the front of the section. Housings must include latch pads and manual stainless steel latching devices that are captive, or non-removable. Housings must have at least two latching points.

Reinforce all mounting points and adjacent housing material. The door enclosing the lens must be hinged and held securely to the housing. Provide a gasket meeting the requirements of ASTM D1056, Grade 2B2 between the housing and door and between the lens and door. If the fitting between the housing and door is weather-tight, the gasket may be omitted.

Provide a visor or egg-crate louver that eliminates sun phantom for each signal face. Visor must be three-sided and extend a minimum of 7 inches at the top from the face of the lens. The visor must be constructed of noncorrosive No. 18 gauge sheet metal, not less than 0.05 inch thick, or 0.1 inch thick polycarbonate.

All metal housings and visors must be powder-coat painted black in accordance with Military Standard MIL-PRF-24712A or AAMA-2603-02 with a reflectance value not exceeding 25 percent as measured by ASTM E97. For polycarbonate heads, the black color must be incorporated into the material before the molding process.

The housing must be constructed of a non-corrosive material. Cast metal parts must have a minimum tensile strength of 1 ksi (117 MPa) and sheet metal parts a minimum tensile strength of 27 ksi (186 MPa).

995-5.2.1 Die Castings: Meet the requirements in ASTM B85 for the physical characteristics and chemical content for alloys S12A, S12B, SC84A, SC84B, SG100A and SG100B.

995-5.2.2 Sand Castings: Meet the requirements in ASTM B26 for the physical characteristics and chemical content for alloys S5A and CS72A.

995-5.2.3 Permanent Mold Castings: Meet the requirements in ASTM B108 for the physical characteristics and chemical content for alloys S5A and CS72A.

995-5.2.4 Polycarbonate: Polycarbonate housing assemblies, doors and visors must be molded from ultraviolet stabilized polycarbonate plastic with a minimum thickness of 0.1 inches, plus or minus 0.01 inch, and provide the following physical properties:

Table 995-2

Test	Minimum Requirement	Method
Specific Gravity	1.17	ASTM D 792
Vicat Softening Temp.	305-325°F (152 – 163°C)	ASTM D 1525
Brittleness Temp.	Below -200°F (-129°C)	ASTM D 746
Flammability	Self-extinguishing	ASTM D 635
Tensile Strength	Yield, 8500 psi (58 MPa)	ASTM D 638
Elongation at yield	5.5 - 8.5%	ASTM D 638
Shear Strength	Yield, 5500 psi (38 MPa)	ASTM D 732
Izod impact strength	15ft-lb/in (800 J/m)	ASTM D 256
Fatigue strength	950 psi (6.5MPa) at 2.5 mm cycles	ASTM D 671

995-5.3 Light Emitting Diode (LED) Pedestrian Signal Optical Unit (State Standard): Provide a countdown pedestrian signal module meeting the requirements of the latest ITE LED Pedestrian Signal Specifications.

995-5.4 Electrical: Wiring and terminals must meet the size, insulation, length and color-coding of the current ITE Pedestrian Traffic Control Signal Indicators LED specification. Wires must not have bare wiring exposed where wires are secured.

The pedestrian signal must include a terminal block containing a minimum of three circuits, each with two noncorrosive screw-type terminals. Each terminal must accommodate three No. 18 AWG conductors and be labeled for ease of identification. The terminal block must not be obstructed and be visible when the housing is open.

995-5.5 Hardware: All brackets used to mount pedestrian signals must be an aluminum alloy cast fitting, pipe or equivalent material approved by the Department. Aluminum and aluminum alloy bars, rods, wires, profiles, and tubes must meet ASTM B221. Aluminum-alloy sand casting must meet ASTM B26. All mounting hardware must be painted black with a reflectance value not exceeding 25 percent as measured by ASTM E97.

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.

TRAFFIC CONTROL SIGNAL AND DEVICE MATERIALS
(REV 5-14-21)

SUBARTICLE 995-2.7.2 is deleted and the following substituted:

995-2.7.2 Communications: Major components of the WWVDS (such as the sensor and any separate hardware used for contact closures) shall include a minimum of one serial or Ethernet communications interface and shall meet the following criteria:

1. The serial interface and connector conforms to TIA-232 standards and the serial ports support data rates up to 115200 bps; error detection utilizing parity bits (i.e., none, even, and odd); and stop bits (1 or 2).
2. Wired Ethernet interfaces provides, at a minimum, a 10/100 Base TX connection. Verify that all unshielded twisted pair/shielded twisted pair network cables and connectors comply with TIA-568.
3. Wireless communications are secure and that wireless devices are FCC certified. The FCC identification number is displayed on an external label and all WWVDS devices operate within their FCC frequency allocation.
4. Cellular communications devices are compatible with the cellular carrier used by the agency responsible for system operation and maintenance.
5. The system can be configured and monitored via one or more communications interface.
6. The WWVDS is compatible with the Department's SunGuide® software. The SunGuide software requirements are listed in supplemental requirement SR-995-2.7.2-01, Supplemental Wrong Way Vehicle Detection System SunGuide HTTP Protocol, as published on the Department's State Traffic Engineering and Operations Office website at the following URL: https://www.fdot.gov/traffic/Traf-Sys/Product-Specifications.shtm.
7. For WWVDS installed on ramps, the device shall:
    a. Send an alert to the SunGuide® software when the wrong-way vehicle is detected.
    b. Send a sequence of images for up to ten seconds to the SunGuide software that covers a configurable time before and after the wrong-way vehicle detection.
    c. Activate all highlighted signs associated with the WWVDS.

SUBARTICLE 995-2.9.1 is deleted and the following substituted:

995-2.9 Traffic Data Detection System Acceptance Requirements:

995-2.9.1 Data Accuracy: The vehicle detection system shall be capable of meeting the minimum total roadway segment accuracy levels of 95% for volume, 90% for occupancy, and 90% for speed for all lanes, up to the maximum number of lanes that the device can monitor as specified by the manufacturer.

To verify conformance with the accuracy requirements in this Section and as a precondition for listing on the APL, sample data collected from the vehicle detection system will be compared against ground truth data collected during the same time by human observation

or by another method approved by the TERL. Sample data shall be collected over several time periods under a variety of traffic conditions. Weight each data sample to represent the predominant conditions over the course of a 24-hour period. Samples shall consist of 15- and 30-minute data sets collected at various times of the day. Representative data periods and their assigned weights are provided in Table 995-1.

SECTION 995 is expanded by the following new Articles:

995-4 Vehicular Traffic Signal Assemblies.

995-4.1 General: Vehicular traffic signal 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.

Vehicular traffic signal assemblies must meet the requirements of Section 603 and the Institute of Transportation Engineers (ITE) Standard for Vehicle Traffic Control Signal Heads.

Fastening hardware such as bolts, screws, nuts, washers, latches, and studs must be SAE Type 316 or 304 stainless steel.

Horizontal signal assemblies must be constructed so the door hinges, when installed, are located on the bottom of the signal assembly. Vertical mounted five-section cluster assemblies must be constructed so that the door hinges, when installed, are located along the outside edges of the complete assembly and each section opens away from the horizontally adjacent section.

Vehicular traffic signal assemblies must be permanently marked with the manufacturer's name or trademark, part or model number and date of manufacture or serial number.

995-4.2 Twelve Inch Signal Head Assemblies: Construct the assembly of materials and alloys specified in the ITE Standard for Vehicle Traffic Control Signal Heads.

Construct signal housings to allow adjustment in multiple directions for proper signal alignment. If a serrated connection is used for positioning and alignment of the signal, the top and bottom opening of each signal head section must include a circular 72-tooth serrated connection (2 inch nominal I.D.) capable of providing positive positioning and alignment in 5 degree increments. When assembled and tightened, these connections must prevent rotation or misalignment of the signal head as well as misalignment between sections. The serrated area must start at the outside of the 2 inch hole and be at least 1/8 inch wide. The teeth must have a minimum depth of 3/64 inch between peaks and valleys, be free from burrs or other imperfections, and provide positive locking with the grooves of mating sections, framework, and brackets. The serration on the top circular connection of a signal section must have a valley at the 0 degree position and the serration on the bottom circular connection must have a peak at the 0 degree position, both aligned perpendicular to the front of the section. Connections must permit the assembly of a multi-section signal with the front of each section aligned within 1 degree.

Provide at least two latching points with latch pads and manual Type 316 or 304 stainless steel latching devices that are tamper resistant.

If backplates are mechanically attached, each signal section must have four backplate mounting attachment points on the back of the signal, on or no more than three inches from each section corner. Attachment points must be capable of accepting No. 10-16x3/8 inch or No. 10-24x3/8 inch Type 316 or 304 stainless steel screws for attaching backplates.

Tri-stud washers, when utilized to secure signal sections, must have a minimum thickness of 0.090 inches. For five-section cluster assemblies, tri-stud washers used to attach the top signal section to the multi-signal bracket and the multi-signal bracket to the bottom four signal sections must have a minimum thickness of 3/8 inches. When fastened together, washer distortion is not allowed.

Design each signal section to prevent the accumulation of standing water within the assembly. All sections comprising a single multi-section assembly must be securely fastened together to form a rigid and weather-proof unit.

995-4.2.1 Doors: Construct each signal section with at least two hinges for mounting a door. Hinge pins must be captive. Doors must remain captive and secure at all times and be capable of either left or right swing. The door latch must hold the door tightly closed. The door must include slotted pads that allow the door to be opened and closed by engaging or disengaging the latching device. The outside face of the door must include four holes equally spaced around the circumference of the lens opening for the attachment of a visor. The lens opening in the door must have a diameter of 11 to 11-1/2 inches.

995-4.2.2 Visors: The rear of the visor must have four tabs, notches, or holes for securing the visor to the signal housing door. The visor mounting method must permit the visor to be rotated and secured at 90 degrees for horizontal signal head installations. All visors must have a minimum length of 9-1/2 inches, and a minimum downward tilt of 3.5 degrees measured from the center of the lens. Tunnel visors must encircle and shield the lens from 300 degrees, plus or minus 10 degrees. Louvers may only be used in combination with full circle visors. Light must not escape between the visor and the door.

995-4.2.3 Gaskets: Gaskets must be constructed of weather-resistant material and be glued or sealed where they meet to provide one continuous length of gasket capable of providing a weatherproof seal for the signal assembly. Provide seals between the housing and door, between the lens and the door, and between any other mating surfaces where dust and moisture could enter. Gasket material must meet NEMA 250 and be constructed of temperature stabilized material that prevents any residue from collecting on the internal surfaces of the signal head.

995-4.2.4 Terminal Blocks: Provide at least one five-connection terminal block in all three or more section signal head assemblies and at least three five-connection terminal blocks in all five section signal head assemblies. Terminal block connections in the signal assembly must not require any tools other than a screwdriver.

Mount terminal blocks to the signal housing with Type 316 or 304 passivated stainless steel hardware. Use only non-corrosive wire attachment screws approved by the Department.

995-4.2.5 Color and Finish: The housing, doors, visors and backplates must be powder coated dull black (Federal Standard 595-37038) with a reflectance value not exceeding 25 percent as measured by ASTM E1347. For plastic heads, the black color must be incorporated into the plastic material before molding.

The finish on interior and exterior surfaces of aluminum signal head assemblies, visors, doors, and housing, must be painted in accordance with Military Standard MIL-PRF-24712A or American Architectural Manufacturers Association-2603-02 and must meet the requirements of ASTM D3359, ASTM D3363, and ASTM D522. Surface erosion, flaking, or oxidation must not occur within the normal life expectancy under typical installation conditions.

995-4.2.6 Plastic Signal Housings and Visors: Construct signal housing assembly, door, and visors of UV stabilized plastic with a minimum thickness of 0.1 inches, plus or minus, 0.01 inches, with the following physical properties:

1. Specific Gravity: 1.17 minimum, as per ASTM D792
2. Vicat Softening Temperature: 305-325 F (152-163 C), as per ASTM D1525
3. Brittleness Temperature: Below -200 F (-129 C), as per ASTM D746
4. Flammability: Self-extinguishing, as per ASTM D635
5. Tensile Strength, yield: 8500 PSI (58 MPa) minimum, as per ASTM D638
6. Elongation at yield: 5.5-8.5 %, as per ASTM D638
7. Shear, strength, yield: 5500 PSI (38 Mpa) minimum, as per ASTM D732
8. Izod impact strength, [notched, 1/8 inch]: 15 ft-lb/in (800 j/m) minimum, as per ASTM D256
9. Fatigue strength at 2.5 mm cycles: 950 PSI (6.5 MPa) minimum, as per ASTM D671

995-4.2.7 Backplates: Backplates may be constructed of either aluminum or plastic. Minimum thickness for aluminum backplates is 0.060 inch and the minimum thickness for plastic backplates is 0.120 inch. The required width of the top, bottom, and sides of backplates must measure between five to six inches. Color of backplates must be black in accordance with 995-4.2.5. Backplate thickness measurement must not include the retroreflective sheeting thickness.

If backplates are mechanically attached, provide a minimum of four corner mounting attachment points per signal section (for example, a three-section signal assembly would have 12 mounting points). Attachment points must not interfere with the operation of traffic signal section doors. Backplate outside corners must be rounded and all edges must be de-burred.

If louvers are provided, louver orientation must be vertical on sides and horizontal on top and bottom of the backplate and must be at least 1/2 inch from the inner and outer edge of the backplate panel. Universal backplates must fit all traffic signals listed on the APL.

Mount the backplate securely to the signal assembly with Type 316 or 304 passivated stainless steel installation hardware. Backplates, if mechanically attached, must be marked in accordance with 995-4.1, on the long sides of the backplate.

Backplates must include retroreflective borders using Type IV yellow retroreflective sheeting listed on the APL. Place a 2 inch border on the entire outer perimeter of the backplate panel, no closer than 1/2 inch from any louvers.

All materials must be designed for exterior use and be UV stable.

995-4.2.7.1 Flexible Backplates: Flexible backplates must allow the entire length of longer portions of the backplate to flex 90 degrees, or until the backplate width is reduced to 2.5 inches or less, when influenced by high wind conditions, and return to zero degrees after the wind conditions subside. Flexible backplates must maintain visibility of the retroreflective border to approaching traffic, with up to 40 mph winds.

995-4.2.8 Light-Emitting Diode Optical Unit: The LED optical unit must conform to the requirements of ITE's Performance Specification, Vehicle Traffic Control Signal

Heads - Light Emitting Diode (LED) Circular Signal Supplement, dated June 27, 2005 or Vehicle Traffic Control Signal Heads - Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Supplement, dated July 1, 2007, with the following exceptions.

995-4.2.8.1 Physical and Mechanical Requirements: Retrofit LED signal modules must be compatible with all traffic signal housings listed on the APL. The rear of the LED signal module must be marked in accordance with 995-4.1.

995-4.2.8.2 LED Signal Module Lens: The lens must be tinted with an appropriate color (red, amber, or green) to reduce sun phantom affect and enhance on/off contrast. The tinting must be uniform across the face of the lens and be free from streaks, wrinkles, chips, bubbles, or other imperfections. If a polymer lens is used, a surface coating must be incorporated to provide abrasion resistance.

995-4.2.8.3 Minimum Maintained Luminous Intensity Values: Red and green modules must meet the requirements of ITE's Performance Specification, Vehicle Traffic Control Signal Heads - Light Emitting Diode (LED) Circular Signal Supplement, dated June 27, 2005, with the exception that yellow modules must be 1.7 times brighter than the ITE specification. Arrow modules must meet the requirements of ITE's Performance Specification, Vehicle Traffic Control Signal Heads - Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Supplement, dated July 1, 2007.

995-4.2.9 Electrical: Electrical conductors for LED signal modules must be a minimum of 36 inches in length. Each lead from the LED module must be terminated with insulated slide-on terminals. The conductors must be color coded to identify the color of the module as follows:

1. White must identify the neutral lead.
2. Red circular signals must be identified with a red lead, yellow circular signals with a yellow lead, and green circular signals with a green lead.
3. Red arrows must be identified with a red and black tracer lead, yellow arrows with a yellow and black tracer lead, and green arrows with a green and black tracer lead.

995-5 Pedestrian Signal Assemblies.

995-5.1 General: Pedestrian signal 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.

Pedestrian signal assemblies must meet the requirements of Section 603, the latest edition of the Federal Highway Administration's (FHWA) Manual on Uniform Traffic Control Devices (MUTCD), and the Institute of Transportation Engineers (ITE) standard for Pedestrian Traffic Control Signal Indications.

995-5.2 Housing and Visor: The housing must be weatherproof, sectional and may consist of as many sections as optical units. The housing must prevent light from escaping from one unit to another. The top and bottom opening of the housing must include a circular 72-tooth serrated connection (2 inch nominal I.D.) capable of providing positive positioning and alignment in 5 degree increments. When assembled and tightened, these connections must prevent rotation or misalignment. The serrated area must start at the outside of the 2 inch hole and be at least 1/8 inch wide. The teeth must have a minimum depth of 3/64 inch between peaks and valleys, free from burrs or other imperfections, and provide positive locking with the grooves of mating sections, framework, and brackets. The serration on the top circular connection of a signal section must have a valley at the 0 degree position and the serration on the bottom circular connection must have a peak at the 0 degree position, both aligned perpendicular

to the front of the section. Housings must include latch pads and manual stainless steel latching devices that are captive, or non-removable. Housings must have at least two latching points.

Reinforce all mounting points and adjacent housing material. The door enclosing the lens must be hinged and held securely to the housing. Provide a gasket meeting the requirements of ASTM D1056, Grade 2B2 between the housing and door and between the lens and door. If the fitting between the housing and door is weather-tight, the gasket may be omitted.

Provide a visor or egg-crate louver that eliminates sun phantom for each signal face. Visor must be three-sided and extend a minimum of 7 inches at the top from the face of the lens. The visor must be constructed of noncorrosive No. 18 gauge sheet metal, not less than 0.05 inch thick, or 0.1 inch thick polycarbonate.

All metal housings and visors must be powder-coat painted black in accordance with Military Standard MIL-PRF-24712A or AAMA-2603-02 with a reflectance value not exceeding 25 percent as measured by ASTM E97. For polycarbonate heads, the black color must be incorporated into the material before the molding process.

The housing must be constructed of a non-corrosive material. Cast metal parts must have a minimum tensile strength of 1 ksi (117 MPa) and sheet metal parts a minimum tensile strength of 27 ksi (186 MPa).

995-5.2.1 Die Castings: Meet the requirements in ASTM B85 for the physical characteristics and chemical content for alloys S12A, S12B, SC84A, SC84B, SG100A and SG100B.

995-5.2.2 Sand Castings: Meet the requirements in ASTM B26 for the physical characteristics and chemical content for alloys S5A and CS72A.

995-5.2.3 Permanent Mold Castings: Meet the requirements in ASTM B108 for the physical characteristics and chemical content for alloys S5A and CS72A.

995-5.2.4 Polycarbonate: Polycarbonate housing assemblies, doors and visors must be molded from ultraviolet stabilized polycarbonate plastic with a minimum thickness of 0.1 inches, plus or minus 0.01 inch, and provide the following physical properties:

Table 995-2

Test	Minimum Requirement	Method
Specific Gravity	1.17	ASTM D 792
Vicat Softening Temp.	305-325°F (152 – 163°C)	ASTM D 1525
Brittleness Temp.	Below -200°F (-129°C)	ASTM D 746
Flammability	Self-extinguishing	ASTM D 635
Tensile Strength	Yield, 8500 psi (58 MPa)	ASTM D 638
Elongation at yield	5.5 - 8.5%	ASTM D 638
Shear Strength	Yield, 5500 psi (38 MPa)	ASTM D 732
Izod impact strength	15ft-lb/in (800 J/m)	ASTM D 256
Fatigue strength	950 psi (6.5MPa) at 2.5 mm cycles	ASTM D 671

995-5.3 Light Emitting Diode (LED) Pedestrian Signal Optical Unit (State Standard): Provide a countdown pedestrian signal module meeting the requirements of the latest ITE LED Pedestrian Signal Specifications.

995-5.4 Electrical: Wiring and terminals must meet the size, insulation, length and color-coding of the current ITE Pedestrian Traffic Control Signal Indicators LED specification. Wires must not have bare wiring exposed where wires are secured.

The pedestrian signal must include a terminal block containing a minimum of three circuits, each with two noncorrosive screw-type terminals. Each terminal must accommodate three No. 18 AWG conductors and be labeled for ease of identification. The terminal block must not be obstructed and be visible when the housing is open.

995-5.5 Hardware: All brackets used to mount pedestrian signals must be an aluminum alloy cast fitting, pipe or equivalent material approved by the Department. Aluminum and aluminum alloy bars, rods, wires, profiles, and tubes must meet ASTM B221. Aluminum-alloy sand casting must meet ASTM B26. All mounting hardware must be painted black with a reflectance value not exceeding 25 percent as measured by ASTM E97.

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.