

# ORINATION FORM

## Proposed Revisions to the Specifications

(Please provide all information - incomplete forms will be returned)

Date: Specification Section:

Originator: Articles/Subarticles:

Telephone:

email:

Will the proposed revision involve Design Standard Index changes? Yes No

Roadway Design staff contacted (name):

Structures Design staff contacted (name):

Will the proposed revision involve PPM changes? Yes No

Roadway Design staff contacted (name):

Will the proposed revision involve CPAM changes? Yes No

Construction staff contacted (name):

Will the proposed revision involve Pay Item changes? Yes No

Estimates staff contacted (name):

Will the proposed revision involve SDG changes? Yes No

Structures staff contacted (name):

Will the proposed revision involve APL changes? Yes No

Product Evaluation staff contacted (name):

Will the proposed revision involve Material Manual changes? Yes No

State Materials Office staff contacted (name):

Will this revision necessitate any of the following:

Design Bulletin Construction Bulletin Estimates Bulletin Materials Bulletin

Are all references to external publications current? Yes No

If not, what references need to be updated? (Please include changes in the redline document.)

Why does the existing language need to be changed?

Summary of the changes:

Are these changes applicable to all Department jobs? Yes No

If not, what are the restrictions?

Contact the State Specifications Office for assistance in completing this form.

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MIKE DEW  
INTERIM SECRETARY

**MEMORANDUM**

**DATE:** November 27, 2017  
**TO:** Specification Review Distribution List  
**FROM:** Dan Hurtado, P.E., State Specifications Engineer  
**SUBJECT:** Proposed Specification: **7000401 Highway Signing.**

In accordance with Specification Development Procedures, we are sending you a copy of a proposed specification change.

This change was proposed by Jeff Morgan of the State Traffic Engineering Research Lab (TERL) to update the language.

Please share this proposal with others within your responsibility. Review comments are due within four weeks and should be sent to Mail Station 75 or online at <http://www2.dot.state.fl.us/ProgramManagement/Development/IndustryReview.aspx> . Comments received after **December 25, 2017**, may not be considered. Your input is encouraged.

DH/dt  
Attachment

**HIGHWAY SIGNING.**  
**(REV ~~11-9-17~~11-17-17)**

SUBARTICLE 700-4.1 is deleted and the following substituted:

**700-4.1 General:** Dynamic Message Signs (DMS) must meet the requirements of NEMA TS4-200516. DMS are classified by the type of sign display and the type of mechanical construction. Provide monochrome, tri-color, or full-color signs as shown in the Contract Documents. Use only equipment and components that meet the requirements of these minimum specifications and are listed on the APL. DMS LED retrofit kits must be listed on the APL.

**700-4.1.1 Front Access DMS:** Ensure that front access signs meet the requirements of NEMA TS 4-200516, Section 3.2.56.

**700-4.1.2 Walk-In DMS:** Ensure that walk-in signs meet the requirements of NEMA TS 4-200516, Section 3.2.78.

**700-4.1.3 Embedded DMS:** Embedded DMSs are typically mounted to ground traffic signs, overhead traffic signs, or overhead cantilever traffic signs.

SUBARTICLE 700-4.2 is deleted and the following substituted:

**700-4.2 Sign Housing Requirements for all DMS:** Ensure that the external skin of the sign housing is constructed of aluminum alloy 5052 H32 that is a minimum of 0.125 inches thick for a walk-in DMS and 0.090 inch thick a for front or embedded DMS. Ensure the interior structure is constructed of aluminum. Ensure that the sign housing design and appearance is approved by the Engineer. Ensure that no internal frame connections or external skin attachments rely upon adhesive bonding or rivets.

Ensure the sign enclosure meets the requirements of NEMA TS 4-200516, Section 3.1.1. Ensure that all drain holes and other openings in the sign housing are screened to prevent the entrance of insects and small animals.

Ensure that the sign housing complies with the fatigue resistance requirements of the AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals. Design and construct the DMS unit for continuous usage of at least 20 years and the sign structure for a 50 year design life. The sign assembly must be designed and constructed to withstand loads, including a wind load of 150 miles per hour, as defined in the Department's Structures Manual.

Ensure that the top of the housing includes multiple steel lifting eyebolts or equivalent hoisting points. Ensure hoist points are positioned such that the sign remains level when lifted. Ensure that the hoist points and sign frame allow the sign to be shipped, handled, and installed without damage.

Ensure all assembly hardware, including nuts, bolts, screws, and locking washers less than 5/8 inch in diameter, are Type 304 or 316 passivated stainless steel and meet the requirements of ASTM F593 and ASTM F594. All assembly hardware greater than or equal to 5/8 inch in diameter must be galvanized and meet the requirements of ASTM A307.

Ensure all exterior, excluding the sign face, and all interior housing surfaces are a natural aluminum mill finish. Ensure signs are fabricated, welded, and inspected in accordance with the requirements of the current ANSI/AWS Structural Welding Code-Aluminum.

Ensure the sign housing meets the requirements of NEMA TS 4-200516, Section 3.2.89 for convenience outlets.

**700-4.2.1 Sign Housing for Walk-In DMS:** Ensure that exterior seams and joints, except the finish coated face pieces, are continuously welded using an inert gas welding method. Limit the number of seams on the top of the housing to a maximum of three. Stitch weld the exterior housing panel material to the internal structural members to form a unitized structure.

Ensure that exterior mounting assemblies are fabricated from aluminum alloy 6061-T6 extrusions a minimum of 0.1875 inches thick. Include a minimum of three 6061-T6 structural aluminum Z members on the rear of the sign housing in accordance with the Design Standards. Ensure structural aluminum Z members run parallel to the top and bottom of the sign housing and are each a single piece of material that spans the full length of the sign. Ensure structural aluminum Z members are attached to the internal framework of the sign.

Ensure hoist points are attached directly to structural frame members by the sign manufacturer.

Ensure housing access is provided through an access door that meets the requirements of NEMA TS 4-200516, Section 3.2.78.1. Ensure the access door includes a keyed tumbler lock and a door handle with a hasp for a padlock. Ensure the door includes a closed-cell neoprene gasket and stainless steel hinges.

Ensure the sign housing meets the requirements of NEMA TS 4-200516, Section 3.2.78.3 for service lighting. If incandescent lamps are provided, ensure they are fully enclosed in heavy-duty shatterproof, protective fixtures. Ensure that incandescent fixtures include aluminum housing and base, a porcelain socket, and clear glass inner cover. Ensure that all removable components are secured with set screws. If fluorescent lamps are provided, ensure they are fitted with shatter proof protective guards.

Ensure that the sign housing includes emergency lighting that automatically illuminates the interior in the event of a power outage. Emergency lighting must be capable of operation without power for at least 90 minutes.

**700-4.2.1.1 Walk-In DMS Work Area:** Ensure the walk-in DMS has a work area that meets the requirements of NEMA TS 4-200516, Section 3.2.78.2. Finish all edges of the walkway to eliminate sharp edges or protrusions.

**700-4.2.2 Sign Housing for Front Access and Embedded DMS:** Ensure front access and embedded signs meet the requirements of NEMA TS 4-200516, Section 3.2.45 and Section 3.2.6. Ensure access does not require specialized tools or excessive force to operate.

**700-4.2.3 Housing Face Requirements for all DMS:** Ensure the sign face meets the requirements of NEMA TS 4-200516, Section 3.1.3. Ensure that all sign face surfaces are finished with a matte black coating system that meets or exceeds American Architectural Manufacturers Association (AAMA) Specification No. 2605. Submit certification that the sign face parts are coated with the prescribed thickness. Except for embedded DMS, ensure the sign face includes a contrast border that meets the requirements of NEMA TS 4-200516, Section 3.1.6.

**700-4.2.3.1 Housing Face for Walk-In DMS:** No exposed fasteners are allowed on the housing face. Ensure that display modules can be easily and rapidly removed from within the sign without disturbing adjacent display modules.

**700-4.2.3.2 Housing Face for Front Access and Embedded DMS:** Any exposed fasteners on the housing face must be the same color and finish as the housing face. Only captive fasteners may be used on the housing face.

**700-4.2.3.3 External Fascia Panels:** If the sign includes external fascia panels, ensure that they are constructed using aluminum. Finish each fascia panel with a matte black coating system that meets or exceeds AAMA Specification No. 2605.

**700-4.2.3.4 Lens Panel Assembly:** If the sign includes lens panel assemblies, ensure they are modular in design, removable, and interchangeable without misalignment of the lens panel and the LED pixels. The lens panel assembly must consist of an environmental shielding layer coating to protect and seal the LED and internal electronics. The coating must be a minimum 90% UV opaque. Lens panels must have a matte black coating that meets or exceeds AAMA Specification No. 2605. Lens panels must include a mask constructed of 0.080 inch minimum thickness aluminum. Ensure that the mask is perforated to provide an aperture for each pixel on the display module. Ensure that the apertures do not block the LED output at the required viewing angle.

**700-4.2.4 Sign Housing Ventilation System:** The ventilation systems for walk-in, front-access, and embedded DMS must meet the requirements of NEMA TS 4-2005~~16~~16, Section 3.1.2.

Ensure that air drawn into the sign is filtered upon entry. Ensure the ventilation system is automatically tested once each day and that it may be tested on command from remote and local control access locations. Ensure the sign includes a sensor or a sensor assembly to monitor airflow volume to predict the need for a filter change. Ensure the ventilation system fans possess a 100,000 hour, L10 life rating.

**700-4.2.4.1 Ventilation System for Walk-In DMS:** Ensure the sign includes a fail-safe ventilation subsystem that includes a snap disk thermostat that is independent of the sign controller. Preset the thermostat at 130°F. If the sign housing's interior reaches 130°F, the thermostat must override the normal ventilation system, bypassing the sign controller and turning on all fans. The fans must remain on until the internal sign housing temperature falls to 115°F.

**700-4.2.5 Sign Housing Temperature Sensor:** Ensure that the sign controller continuously measures and monitors the temperature sensors. Ensure that the sign blanks when a critical temperature is exceeded and that the sign reports this event when polled. Ensure that remote and local computers can read all temperature measurements from the sign controller.

**700-4.2.6 Sign Housing Humidity Sensor:** Humidity sensors must detect from 0 to 100% relative humidity in 1% or smaller increments. Sensors must operate and survive in 0 to 100% relative humidity, and have an accuracy that is better than plus or minus 5% relative humidity. Use of a humidistat is not acceptable.

**700-4.2.7 Sign Housing Photosensors:** Ensure the sign meets the requirements of NEMA TS 4-2005~~16~~16, Section ~~89.81.3~~89.81.3. Ensure that the sensors provide accurate ambient light condition information to the sign controller for automatic light intensity adjustment. Ensure that the automatic adjustment of the LED driving waveform duty cycle occurs in small enough increments that the sign's brightness changes smoothly, with no perceivable brightness change between adjacent levels. Ensure that stray headlights shining on the photoelectric sensor at night do not cause LED brightness changes.

Ensure that the brightness and color of each pixel is uniform over the sign's entire face within a 30 degree viewing angle in all lighting conditions.

SYUBARTICLE 700-4.3 is deleted and the following substituted:

**700-4.3 Display Modules:** Provide display modules manufactured by one source and fully interchangeable throughout the manufacturer's sign system. Ensure that removal or replacement of a complete display module or LED board can be accomplished without the use of special tools.

Ensure display modules contain solid-state electronics needed to control pixel data and read pixel status.

Ensure that the sign has a full matrix display area as defined in [the glossary of NEMA TS 4-200516, Section 1.6](#).

**700-4.3.1 LED and Pixel Specifications:** Ensure that LED lamps have a minimum viewing angle of 30 degrees.

Ensure that all pixels in all signs in a project, including operational support supplies, have equal color and on-axis intensity. Ensure that the sign display meets the luminance requirements of NEMA TS 4-200516, Section 5.4, for light emitting signs connected at full power. Ensure that amber displays produce an overall luminous intensity of at least 9200 candelas per square meter when operating at 100% intensity. Provide the LED brightness and color bins that are used in each pixel to the Engineer for approval. Ensure that the LED manufacturer demonstrates testing and binning according to the International Commission on Illumination (CIE) 127-1997 Standard.

Ensure that all LEDs operate within the LED manufacturer's recommendations for typical forward voltage, peak pulsed forward current, and other ratings. Component ratings must not be exceeded under any operating condition.

Ensure that the operational status of each pixel in the sign can be automatically tested once a day. Ensure that the pixel status test determines the functional status of the pixel as defined by the pixel Failure Status object in National Transportation Communications for ITS Protocol (NTCIP) 1203 v02.39 and does not affect the displayed message for more than half a second.

Ensure that LEDs are individually mounted directly on a printed circuit board (PCB).

**700-4.3.2 Optical, Electrical, and Mechanical Specifications for Display Modules:** Ensure the display modules are rectangular and have an identical vertical and horizontal pitch between adjacent pixels. Ensure that the separation between the last column of one display module and the first column of the next module is equal to the horizontal distance between the columns of a single display module. Full-color signs must have a pitch equal to or less than 35 mm.

Ensure that the LED circuit board is a NEMA FR4-rated, single 0.062 inch, black PCB. Ensure that no PCB has more than two PCB jumper wires present. Finish all PCBs with a solder mask and a component-identifying silk screen.

Provide PCBs with conformal coating meeting the material requirements of MIL-I-46058C Military Standard, United States Department of Defense (USDOD).

Ensure that any devices used to secure LEDs do not block air flow to the LED leads or block the LED light output at the required viewing angle. Ensure that all components on the LED side of a PCB are black.

Ensure that there are a minimum of two power supplies that are wired in a parallel configuration for redundancy. Ensure that if one, or 25% of the supplies in a group, whichever is greater, completely fails, the sign shall still be supplied with enough power to run 40% of all pixels at a 100% duty cycle with an ambient operating temperature of 165°F.

Ensure that the sign controller continuously measures and monitors all LED module power supply voltages and provides the voltage readings to the TMC or a laptop computer on command.

Ensure that LEDs are protected from external environmental conditions, including moisture, snow, ice, wind, dust, dirt, and UV rays. Do not use epoxy to encapsulate the LEDs.

**700-4.3.3 Display Area for Walk-In DMS:** Ensure that the display area is capable of displaying three lines with a minimum of 15 characters each per line, using an 18 inch font that meets the height to width ratio and character spacing in the MUTCD, Section 2L.04, paragraphs 05, 06, and 08.

SUBARTICLE 700-4.4 is deleted and the following substituted:

**700-4.4 Characters, Fonts, and Color:** Ensure that the signs are capable of displaying American Standard Code for Information Interchange (ASCII) characters 32 through 126, including all uppercase and lowercase letters, and digits 0 through 9, at any location in the message line. Submit a list of the character fonts to the Engineer for approval.

All signs must be loaded (as a factory default) with a font in accordance with or that resembles the standard font set described in NEMA TS 4-2005~~16~~, Section 5.6. For signs with a pixel pitch of 35 mm or less, ensure the sign is loaded (as a factory default) with a font set that resembles the FHWA Series E2000 standard font.

Ensure DMS fonts have character dimensions that meet the MUTCD, Section 2L.04, paragraph 08.

Ensure that full-color signs can display the colors prescribed in the MUTCD, Section 1A.12.

SUBARTICLE 700-4.5 is deleted and the following substituted:

**700-4.5 Main Power Supply and Energy Distribution Specifications:** Provide a nominal single-phase power line voltage of 120/240 V<sub>AC</sub>. Ensure the DMS meets the requirements of NEMA TS 4-2005~~16~~, Section 10.2.

Ensure all 120 V<sub>AC</sub> wiring has an overall nonmetallic jacket or is placed in metal conduit, pull boxes, raceways, or control cabinets and installed as required by the NEC. Do not use the sign housing as a wiring raceway or control cabinet.

Provide Type XHHW power cables sized as required by the NEC for acceptable voltage drops while supplying alternating current to the sign.

Ensure surge protective devices (SPD) are installed or incorporated in the sign system by the manufacturer to guard against lightning, transient voltage surges, and induced current. Ensure that SPDs meet or exceed the requirements of Section 620. Ensure SPDs protect all electric power and data communication connections.

SUBARTICLE 700-4.7 is deleted and the following substituted:

**700-4.7 Operational Support Supplies:** Furnish the operational support supplies listed in Table 700-2. Promptly replace any of the supplies used to perform a warranty repair.

For every group of 10 or fewer DMSs provided or required, provide one set of supplies as follows:

Table 700-2 Operational Support Supplies	
1 each	Sign controller and I/O board(s)
<del>10 each</del> <u>per DMS</u>	LED display modules
1 each	Display power supply
1 each	Uninterruptible power supply
<del>1 each</del>	<del>Cable for connecting interface circuits to daughter boards</del>
<del>1 each</del>	<del>Display module cables</del>
2 each	Surge suppression sets
1 each	Fan assembly
<del>1 each</del>	<del>Time relay for fan control</del>
<del>10 each</del>	<del>Each type of small fuse (<math>\leq 10</math> amp)</del>
<del>1 each</del>	<del>Sign controller and I/O board(s)</del>
<del>10 each</del>	<del>LED display modules</del>

SUBARTICLE 700-4.8 is deleted and the following substituted:

**700-4.8 Components:** All components must meet the requirements of NEMA TS 4-200516, Section 8.

**700-4.8.1 Mechanical Components:** Ensure that all fasteners, including bolts, nuts, and washers less than 5/8 inch in diameter, are passivated stainless steel, Type 316 or 304 and meet the requirements of ASTM F593 and ASTM F594 for corrosion resistance. Ensure that all bolts and nuts 5/8 inch and over in diameter are galvanized and meet the requirements of ASTM A307. Do not use self-tapping screws. Ensure that all parts are fabricated from corrosion resistant materials, such as plastic, stainless steel, aluminum, or brass. Ensure that construction materials are resistant to fungus growth and moisture deterioration. Ensure that all dissimilar metals are separated with an inert, dielectric material.

**700-4.8.2 Sign Controller:** Ensure that the sign controller monitors the sign in accordance with NEMA TS 4-200516, Section 9. Ensure the sign monitors the status of any photocells, LED power supplies, humidity, and airflow sensors. Ensure sign controllers use fiber optic cables for data connections between the sign housing and ground-level cabinet.

Ensure that the sign controller meets the requirements of NEMA TS 4-200516, Sections 8.93 and 8.104. Ensure that the sign controller is capable of displaying a self-updating time and date message on the sign. Ensure that sign controllers within ground cabinets are rack-mountable, designed for a standard Electronic Industries Alliance (EIA) EIA-310 19 inch rack, and includes a keypad and display.

**700-4.8.3 Display System Hardware:** Ensure the sign utilizes a system data interface circuit for communications between the sign controller and display modules. Except for embedded DMS, ensure that the following components reside inside the sign housing: sign controller (master or slave), display system interface circuits, display modules, power supplies, local and remote control switches, LED indicators, EIA-232 null modem cables (minimum of four feet long for connecting laptop computer to sign controller), and surge protective devices.

**700-4.8.4 Control Cabinet:** Provide a control cabinet that meets the requirements of Section 676. Ensure that the minimum height of the cabinet is 46 inches.

Provide a ground control cabinet that includes the following assemblies and components: power indicator, surge suppression on both sides of all electronics, communication interface devices, connection for a laptop computer for local control and programming, a four foot long cable to connect laptop computers, a workspace for a laptop computer, and duplex outlets.

Provide for all telephone, data, control, power, and confirmation connections between the sign and ground control box, and for any required wiring harnesses and connectors.

**700-4.8.5 Sign Controller Communication Interfaces:** Ensure the sign controller has communication interfaces in accordance with NEMA TS 4-2005~~16~~16, Section 8. ~~73.42~~. Ensure that EIA-232 serial interfaces support the following:

Data Bits	7 or 8 bits
Parity	Even, Odd, or None
Number Stop Bits	1 or 2 bit

Ensure the sign controller has a 10/100 Base TX 8P8C port or a 100 Base FX port Ethernet interface.

For dial-up operations, acquire and bear the charges of installing and connecting the dial-up telephone line. Provide modems to be retained by the Department at each location. Provide a user-selectable data transmission rate of up to 19.2 kbps for dial-up operations. Ensure that switching between dial-up, Ethernet, and multidrop operation does not require sign controller software or hardware modifications.

Ensure that the TMC or a laptop computer can be used to remotely reset the sign controller.

SUBARTICLE 700-4.17 is deleted and the following substituted:

**700-4.17 Environmental Requirements:** The DMS must meet the requirements of NEMA TS 4-2005~~16~~16, Section 2.

SUBARTICLE 700-5.1 is deleted and the following substituted:

**700-5.1 Description:** All Electronic Display Signs (EDS) must meet the physical display and operational requirements for warning, guide or regulatory signs described in the MUTCD and the SHS.

EDS are specialized electronic signs that include dynamic display components. The term EDS refers to a general category of electronically enhanced signs that includes electronic warning signs (EWS), electronic guide signs (EGS), electronic regulatory signs (ERS), electronic speed feedback signs (ESFS), and blank-out signs (BOS).

SUBARTICLE 700-5.2 is deleted and the following substituted:

**700-5.2 Material:** EWS, EGS, ERS, and ESFS must allow attachment to vertical and horizontal support structures as part of a single or double sign post configuration. Bolts must be used for load bearing attachments.

**700-5.2.1 Requirements Common to all EDS:** All EDS must be designed to withstand the loads defined in the Department's Structures Manual without deformation or damage. EDS, other than BOS, must provide an option to include flashing beacons. Printed circuit boards shall be protected with conformal coating. Housings that contain electronics shall be constructed of aluminum alloy sheet a minimum of .090 inches thick. Welding used during the construction of EDS must be accordance with Section 965.

**700-5.2.1.1 General:** EDS, other than BOS, shall include a static sign panel with an integrated dynamic display. Signs included on the APL will be designated with a size and type category and may be listed with restrictions, such as "requires District Traffic Operations Engineer approval", "school zones only", or "low speed only".

**700-5.2.1.2 Electronic Display Sign with Static Sign Panel:** EDS that include both a static sign and dynamic display may be a modular system comprised of a static sign with an attached electronic display. Static sign panels shall meet the Department's requirements for highway signing found in this Section.

**700-5.2.2 Electronic Display:** Electronic displays shall appear completely blank (dark) when not energized. No phantom characters or graphics will be allowed under any ambient light conditions.

**700-5.2.2.1 Housing:** The housing must protect and seal the dynamic display and other internal electronics. Any polycarbonate material used on the sign face must be a minimum 90% UV opaque and resistant to fading and yellowing. The housing shall be NEMA 3R rated and prevent unauthorized access. The housing shall include weather tight cable entry or connection points for any required power or data connections.

**700-5.2.2.2 Cabinet:** Any equipment cabinets provided with the EDS must be listed on the APL.

**700-5.2.2.3 Optical, Electrical, and Mechanical Specifications for Display Modules:** Ensure that all LEDs operate within the LED manufacturer's recommendations for typical forward voltage, peak pulsed forward current, and other ratings. Component ratings shall not be exceeded under any operating conditions.

**700-5.2.2.4 LED and Pixel Specifications:** Ensure that all LEDs used in the display have a wavelength output that varies no more than plus or minus two nanometers from the specified peak wavelength. Ensure that the display and LED pixel cone of vision is a

minimum of 15 degrees (centered around the optical axis, or zero point, of the pixel). The cone perimeter is defined by the point where light output intensity is 50% of the intensity measured at the zero point of the pixel. For all colors other than white, ensure that the sign display produces an overall luminous intensity of at least 9200 candelas per square meter when operating at 100% intensity. For white or full color matrix displays ensure that the sign display produces white with an overall luminous intensity of at least 12,400 candelas per square meter when operating at 100% intensity. Submit documentation that indicates the LED brightness and color bins that are used in each pixel. Ensure that LEDs are individually mounted on a PCB, and are able to be removed and replaced using conventional electronic repair methods. Encapsulated LEDs within a pixel are not allowed. ERS LEDs must be arranged and powered in a manner that maintains a discernible message in the event of a single LED or pixel failure.

**700-5.2.2.5 Character Size, Fonts, and Graphics:** The minimum numeral and letter size of the electronic display must meet or exceed the numeral and letter sizes prescribed in the MUTCD and the SHS. Fonts and graphics must mimic the characteristics of fonts and graphics defined in the MUTCD and SHS.

**700-5.2.3 Electronic Display Controller:** Any electronic display controller required for the operation of the EDS shall be housed within the sign and be equipped with a security lockout feature to prevent unauthorized use. The controller shall have the capability to provide a stipulated default message upon loss of controller function. A blank message is acceptable.

**700-5.2.3.1 Communication:** The electronic display controller shall possess a minimum of one serial interface with the ability to connect to a laptop computer. The serial data interface shall support multiple data rates from 9600 bps to 115200 bps.

**700-5.2.3.2 Configuration and Management:** Ensure that the sign is provided with computer software from its manufacturer that allows a user to program, operate, exercise, diagnose, and read current status of all sign features and functions using a laptop.

**700-5.2.4 Operation and Performance:** Ensure that the EDS is visible from a distance of at least 1/4 mile and legible from a distance of 400 feet for applications on roads with a speed limit less than 45 mph and visible from a distance of at least 1/2 mile and legible from a distance of at least 650 feet for roads with speed limits 45 mph or higher. In both cases, the requirements must be met under both day and night conditions.

The electronic display shall automatically adjust brightness for day and night operation. The EDS must be equipped with a light sensor that accurately measures ambient light level conditions at the sign location. The EDS must automatically adjust LED intensity based on the ambient light conditions in small enough increments that the sign's brightness changes smoothly, with no perceivable brightness change between adjacent levels. Stray headlights shining on the photoelectric sensor at night must not cause LED brightness changes.

Flashing messages must not exceed 150 flashes per minute.

**700-5.2.5 Mechanical Specifications:** EDS mounting provisions and mounting hardware must accommodate sign weight and wind loading requirements of the Department's Structures Manual. BOS must be designed to accommodate overhead attachment using a tri-stud signal hanger. Multiple tri-stud attachment points may be used to meet weight and wind loading requirements. Tri-stud attachment points must be weather-tight and structurally reinforced.

**700-5.2.5.1 Fasteners and Attachment Hardware:** 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.

**700-5.2.6 Electrical Specifications:** All power inputs must be fuse and reverse polarity protected. All EDS must be able to recover from power loss and return to their operational state without user intervention.

**700-5.2.6.1 Solar Power:** Solar powered signs must be capable of fully autonomous operation 24 hours per day, 365 days per year. Batteries must be a standard 12 volt deep cycle battery suitable for the application and operating environment. Flooded lead-acid batteries are prohibited.

Batteries must be capable of providing 10 days of continuous operation without sunlight. Charging system must use a solar charge controller with temperature compensation. The system must provide for automatic battery charging, overcharge protection, and have indications that display current status and faults.

**700-5.2.6.2 AC Power:** Fluctuations in line voltage must have no visible effect on the appearance of the display.

**700-5.2.7 Electronic Warning Signs (EWS):** The EWS must be designed to alert road users to conditions that might call for a reduction of speed or an action, in the interest of safety and efficient traffic operations. EWS must include a secure wireless connection to communicate with a nearby laptop.

**700-5.2.7.1 EWS Foreground/Background Colors:** If a black background is used on the changeable electronic display, the color used for the legend must match the background color that would be used on a standard sign for that type of legend, in accordance with the MUTCD. Black EWS display backgrounds must be flat black (FED-STD-595-37038) with a reflectance value not exceeding 25%. EWS must utilize yellow LEDs with a peak wavelength of either 585 or 590 nanometers. EWS must have a minimum one inch contrasting margin around illuminated characters or graphics.

**700-5.2.7.2 Speed Detector:** EWS that detect or display the speed of approaching vehicles must be programmable for the posted speed limit and the maximum speed to display. When the detected speed exceeds the maximum programmed speed (high speed cut-off) threshold, the display must automatically blank. Alternately, the display may show an alert message such as "SLOW DOWN" when speeds above the maximum programmed speed threshold are detected.

The EWS must detect when the posted speed is exceeded by one mph and then activate the alert. When the alert is activated, the display shall be able to flash. When no advancing traffic is detected, the display must be blank. The speed detector must not activate alerts for vehicles outside the display cone of vision.

The speed detector must meet the requirements of FCC Title 47, Part 90 and not require an FCC operating license. The speed detector must operate on 10.8 to 16.6 V<sub>DC</sub> and draw less than three amperes. The EWS must monitor and display the speed of approaching traffic only. The EWS detector must be able to accurately detect and determine the speed of approaching vehicles. The EWS must be capable of measuring and displaying speeds of approaching traffic only between 10 and 99 mph with an accuracy of plus or minus one mph, 1,000 feet in advance of the sign.

**700-5.2.8 Electronic Guide Signs (EGS):** Meet the requirements of Electronic Warning Sign (EWS) with the following exceptions: Use a white legend and green background in accordance with the MUTCD. EGS must utilize white LEDs.

**700-5.2.9 Electronic Regulatory Signs:** The ERS must be designed to give notice of traffic laws or regulations, such as the posted speed limit. ERS used for variable speed limit (VSL) applications must be able to display speed limits from 5-70 mph in five mph increments and mimic the physical appearance of a static regulatory speed limit sign as shown in the MUTCD and SHS. ERS for VSL applications shall use black characters on a white background. ERS for VSL applications must log the time and date of any speed limit change to internal non-volatile memory. The log must be able to record a minimum of 1,000 events in a first-in, first-out fashion.

**700-5.2.89.1 Foreground/Background Colors and Display Types:** Display modules for all ERS must have a minimum two inch contrasting margin around digits, text, or graphics. Type 1 ERS must utilize LED technology for the dynamic display. Type 2 ERS must utilize scrolling-film technology for the dynamic display.

**700-5.2.89.2 LED and Pixel Specifications for Type 1 ERS:** Type 1 ERS must meet the LED and pixel specifications defined in 700-5.2.2.4.

**700-5.2.89.3 Scrolling Film Mechanism for Type 2 ERS:** The dynamic display for Type 2 ERS must utilize a scrolling film module comprised of a transparent film with black characters meeting the size and shape requirements shown in the MUTCD and SHS. The transparent film and characters must move in front of a background panel covered with reflective sheeting identical to that used on the static sign panel. The transparent film must be constructed of material that will not yellow, fade, deform, or otherwise deteriorate over the lifetime of the sign.

**700-5.2.89.4 ERS Character Size and Font:** Fonts and graphics for Type 1 ERS must mimic the characteristics of fonts and graphics defined in the MUTCD and SHS. Fonts and graphics for Type 2 ERS must exactly match the characteristics of fonts and graphics defined in the MUTCD and SHS.

**700-5.2.89.5 Variable Speed Limit (VSL) ERS Controller Communications:** ERS for variable speed applications must be equipped with a sign controller that includes a minimum of one Ethernet 10/100 Base TX 8P8C port.

**700-5.2.89.6 Configuration and Management Requirements for VSL ERS:** Ensure that ERS for VSL applications can be managed remotely from a TMC or managed locally using a laptop computer. Ensure that the TMC or a laptop computer can be used to remotely reset VSL sign controllers. Ensure that ERS for VSL applications log and report status, errors, and failures, including data transmission errors, receipt of invalid data, communication failure recoveries, alternating current power failures, power recoveries, display errors, fan and airflow status, temperature status, power supply status, and information on the operational status of the temperature, photocell, airflow, humidity, and LED power supply sensors.

Ensure that the sign controller is addressable through an Ethernet communication network using software that complies with the NTCIP requirements published online by the Department's Transportation Traffic Engineering Research Laboratory (TERL) at: <http://www.fdot.gov/traffic/>. Ensure that the sign implements any NTCIP standards required to achieve interoperability and interchangeability. Ensure that any additional objects implemented by the software do not interfere with the standard operation of any mandatory objects. ERS must be compatible with the Department's SunGuide® software.

**700-5.2.89.7 ERS Battery Backup System:** AC powered signs must include a battery backup system that maintains full operation of the sign for a minimum of two hours in the event of utility power loss. Operation on battery backup can have no visible effect on the appearance of the display.

**700-5.2.910 Blank-Out Signs:** EDSs designed for BOS applications must have a black exterior finish (FED-STD-595-37038) with a reflectance value not exceeding 25%. Overhead BOS must include a visor.

**700-5.2.101 Electronic Speed Feedback Signs (ESFS):** The ESFS must be designed to alert road users of their speed as they approach the sign.

**700-5.2.101.1 ESFS Background/Foreground Colors:** The ESFS display background must be flat black (FED-STD-595-37038) with a reflectance value not exceeding 25%. ESFS must utilize amber LEDs with a peak wavelength of 590 nanometers. ESFS shall have a minimum one inch contrasting margin around illuminated characters or graphics.

**700-5.2.101.2 Speed Detector:** The ESFS must be programmable for the posted speed limit and the maximum speed to display. When the detected speed exceeds the maximum programmed speed (high speed cut-off) threshold, the display must automatically blank. Alternately, the display may show an alert message such as "SLOW DOWN" when speeds above the maximum programmed speed threshold are detected. The ESFS must detect when the posted speed is exceeded by one mph and then activate the alert. When the alert is activated, the display must flash at a rate of 50 to 60 cycles per minute. When no advancing traffic is detected, the display must be blank. The speed detector must not activate alerts or display speeds for vehicles outside the display's cone of vision. The ESFS must meet the requirements of FCC Part 90 and not require an FCC operating license. The speed detector must operate on 10.8 to 16.6 V<sub>DC</sub>. The ESFS must be capable of measuring speeds of approaching traffic between 10 and 99 mph with an accuracy of plus or minus one mph, 1,000 feet in advance of the sign.

**700-5.2.112 Environmental Requirements:** The EDS assembly must operate properly 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. Fog, frost, or condensation must not form within the dynamic portion of the sign. Electronics must meet FCC Title 47, Subpart B Section 15.

**700-5.2.123 Warranty:** Ensure that the EDS systems and equipment furnished have a manufacturer's warranty covering defects in assembly, fabrication, and materials for a minimum of three years.