



## Florida Department of Transportation

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GOVERNOR

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**ANANTH PRASAD, P.E.**  
SECRETARY

August 15, 2013

Chad Thompson  
Program Operations Engineer  
Federal Highway Administration  
545 John Knox Road, Suite 200  
Tallahassee, Florida 32303

Re: State Specifications and Estimates Office  
Section **700**  
Proposed Specification: **7000000 Highway Signing.**

Dear Ms. Gourdine:

We are submitting, not for approval but for your information, two copies of the above referenced Supplemental Specification. These changes were submitted to your office on July 29, 2013 and approved on August 6, 2013. For that submittal, the title for 700-1.2.3 (**Static Sign Assembly Requirements**) was inadvertently omitted. Omitted text has been highlighted.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to SP965DS or daniel.scheer@dot.state.fl.us.

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

Sincerely,

Signature on file

Daniel Scheer, P.E.  
State Specifications Engineer

DS/cah

Attachment

cc: Florida Transportation Builders' Assoc.  
State Construction Engineer

**HIGHWAY SIGNING.**(REV ~~765-29215362013~~-13)

SECTION 700 (Pages 826 – 833) is deleted and the following substituted:

**SECTION 700  
HIGHWAY SIGNING****700-1 General Requirements.****700-1.1 Description.**

Furnish and erect roadway signs, at the locations shown in the Plans, in accordance with the details shown in the Plans. ~~All overhead cantilever and truss mounted signs are to be lighted and retroreflective unless otherwise noted in the Plans. Sign assemblies as specified in the Plans fall into three general categories; ground sign assemblies, overhead sign assemblies, and electronic display signs.~~

The Department designates ground traffic signs as signs erected on the shoulders, slopes, or medians, but not extending over the traveled roadway, *and may further classify these signs as single post or multi-column.*

The Department designates signs erected partially or completely over the traveled roadway or mounted on bridges as overhead traffic signs, and may further classify ~~some of~~ these signs as overhead cantilever or span traffic signs.

~~The Department designates signs that include certain electronic display components as Electronic Display Signs (EDS) and may further classify them as Electronic Warning Signs (EWS), Electronic Regulatory Signs (ERS), Electronic Speed Feedback Signs (ESFS), or Blank Out Signs (BOS). EDS may be erected on the shoulders, slopes, or in the medians, or installed on mast arms, monotube assemblies, or span wires.~~

~~Obtain multi post and overhead sign structures from a fabrication facility that is listed on the Department's list of metal producers with an accepted quality control program, meeting the requirements of 105-3.~~

**700-1.2 Materials.**

**700-1.2.1 General:** *Meet the materials requirements shown in the Specifications and Design Standards ~~this Section~~ and any additional requirements identified in the Plans.*

**700-1.2.2 Concrete:** *Use concrete meeting the requirements of Section 346. Obtain concrete from a fabrication facility that is listed on the Department's list of concrete producers with an accepted quality control program, meeting the requirements of Section 105.*

**700-1.2.3 Static Sign Assembly Requirements:** *All sign panels shall be aluminum unless otherwise shown in the plans. Sheets and plates for sign panels shall meet the requirements of ASTM B 209, Aluminum Association Alloy 6061-T6, 5154-H38 or 5052-H38. Sign panels for single column ground mounted signs shall utilize aluminum plate with a minimum thickness of 0.08 inches. All other sign panels shall utilize aluminum plate with a minimum thickness of 0.125 inches. All panels shall have rounded corners.*

### **700-1.2.43 Retroreflective Sign Sheeting**~~Static Sign Assembly~~

**Requirements:** ~~Use signs that have been fabricated with~~ meet the materials and processes that meet the requirements of Section 994.

Use Type XI sheeting for all regulatory, warning and overhead signs. ~~All the red ink~~ The R1-1, R1-2, R5-1 and R5-1a signs must use a sheeting system that includes a colorless film overlay.

Type XI sheeting shall also be used for all limited access advance exit and exit guide signs.

Use Type IV yellow-green fluorescent sheeting for school S1-1, S3-1, S4-3, S4-5 and supplemental panels used with S1-1 signs. Do not mix signs having fluorescent yellow-green sheeting with signs having yellow retroreflective sheeting.

Use fluorescent orange ~~Type IV sheeting for all orange vinyl work zone signs.~~ Vinyl ~~Roll-up signs shall meet the requirements of Type VI sheeting.~~ Mesh signs shall meet the color, daytime luminance and nonreflective property requirements of Section 994, Type VI.

Use Type IV sheeting for all other signs.

### **700-1.3 Sign Assembly Design Fabrication Requirements.**

Multi-post and overhead sign structures shall be fabricated in a facility that is listed on the Department's list of fabricators with an accepted quality control program, meeting the requirements of Section 105.

~~700-1.3.1 Static Sign Requirements Panels: Fabricate standard sign panel messages in accordance with details included in the Standard Highway Signs Manual published by the U.S. Department of Transportation. The Engineer will not require the submittal of shop drawings for these signs or for non-standard sign panels and messages fabricated in accordance with details shown in the Plans. Submit seven copies of shop drawings indicating detailed layout of the sign legend, spacing, and border for all other signs to the Engineer prior to fabrication.~~

~~If the size of a sign is not specified in the Plans, provide the size sign for conventional roadways as shown in the MUTCD.~~

~~Use Type III, VII or XI sheeting colors identified in the MUTCD and Type IV sheeting and sheeting systems on all signs except as identified in Table XX [Determine and Update Policy, insert into Table]~~

~~Do not mix signs having fluorescent yellow-green sheeting with signs having yellow retroreflective sheeting.~~

~~[Expand Table]~~

### **700-1.4 Storage, Handling and Labeling.**

If signs are stored prior to installation, store them in accordance with the manufacturer's recommendations. Properly package signs to protect them during storage, shipment and handling to prevent damage to the sign face and panel.

In addition to the information required in Section 994, all ~~For~~ permanent roadway signs must be labeled on the back ~~of all finished panels at the bottom edge with the date of installation.~~ Make the labels unobtrusive, but legible enough to be easily read by an observer on the ground when the sign is in its final position. Apply the label in a manner that is at least as durable as the sign face.

### **700-1.85 Acceptance of Signs.**

**700-1.58.1 Sign Inspection:** ~~Do not install signs until the Engineer inspects them for conformance with this Section. Provide all manufacturer certifications and recommendations prior to the Engineer's inspection. The Contractor shall provide certification that the sign assembly meet the material and installation requirements of~~ ~~has been installed in accordance with this section the contract. The Engineer will inspect the signs upon delivery to the storage or project site and again at the final construction inspection. Repair and replace signs deemed unacceptable by the Engineer at no expense to the Department.~~

**700-1.58.2 Imperfections and Repairs:** Repair ~~and~~ replace signs containing imperfections or damage regardless of the kind, type, or cause of the imperfections or damage. For sign panels exceeding 30 square feet, the contractor may make 1 patch, if necessary, to each sign panel not to exceed 2 square inches. Make repairs according to the manufacturer's recommendations and to the satisfaction of the Engineer. Ensure that completed repairs provide a level of quality necessary to maintain the service life ~~warranty~~ of the sign and are satisfactory in appearance to the Engineer.

## **700-2 Static Signs** ~~Sign Assembly Design Requirements.~~

### **700-2.1 Ground Mounted Signs.**

Ground mounted signs consist of both single column and multi-column static signs.

**700-2.1.1 Materials** ~~General:~~ Sign assemblies as specified in the Plans fall into three general categories: ~~ground sign assemblies, overhead sign assemblies, and electronic display signs. [a] single, galvanized multipost details in DI]~~ Use aluminum tubing materials meeting the general provisions of Section 965 ~~or galvanized steel meeting the general provisions of Section 962 for all single column ground signs. Multi-column signs shall~~ ~~must be~~ aluminum tubing, galvanized steel W or S beams steel columns meeting the general provisions of Section 962 ~~or aluminum tubing. All Materials shall~~ ~~must~~ meet the requirements of the appropriate Design Standard. ~~Obtain multi-post and overhead aluminum sign structures from a fabrication facility that is listed on the Department's list of aluminum fabricators with an accepted quality control program, meeting the requirements of Section 105.~~

~~700-2.1.2 Extruded Tubing:~~ Use extruded aluminum tubing meeting the requirements shown in the Plans.

~~700-2.1.3 Channels:~~ For aluminum channels, meet the requirements of ASTM B 308 for the alloys shown in the Plans.

~~700-2.1.4 Bolts, Nuts, and Lockwashers:~~ For aluminum bolts, nuts, and lockwashers, meet the requirements shown in the Plans. Ensure that finished bolts and washers are given an anodic coating of at least 0.0002 inch in thickness and are chromate-sealed.

**700-2.1.2 Fabrication of Panel Messages:** ~~5-Installation~~ ~~[add pole height]~~

~~Install signs and posts in accordance with Plans~~ Fabricate standard sign panel messages in accordance with details included in the Standard Highway Signs Manual published by the U.S. Department of Transportation. Submit shop drawings to the Department for approval as specified in Section 5. ~~The Engineer will not require the submittal of shop drawings for these signs or for non-standard sign panels and messages fabricated in accordance with details shown in the Plans. Submit seven~~

~~copies of shop drawings indicating detailed layout of the sign legend, spacing, and border for all other signs to the Engineer prior to fabrication.~~

~~**700-2.1.3 Foundation:** Foundations shall be constructed in accordance with applicable Design Standards, Index No. 11200 and 11860. Contractor may use precast foundations in ~~predrilledaugeredaugured~~ or excavated holes a minimum of 12 inches" larger than ~~each~~ each axis dimension of the precast foundation ~~in either in wet or dry conditions~~. The holes ~~shall~~ must be clean and without loose material. Temporary casing ~~shall~~ will be required if the soil is unstable. Fill the void around the precast foundation with flowable fill meeting the requirements of Section 121 or clean sand placed using hydraulic methods. ~~and Design Index. [Expand]~~~~

~~**700-2.2 Sign Panels:** All sign panels shall be aluminum. Fabricate standard sign panel messages in accordance with details included in the Standard Highway Signs Manual published by the U.S. Department of Transportation. The Engineer will not require the submittal of shop drawings for these signs or for non-standard sign panels and messages fabricated in accordance with details shown in the Plans. Submit seven copies of shop drawings indicating detailed layout of the sign legend, spacing, and border for all other signs to the Engineer prior to fabrication.~~

~~————— If the size of a sign is not specified in the Plans, provide the size sign for conventional roadways as shown in the MUTCD.~~

#### **700-2.31.46 Breakaway Support Mechanisms for Ground Traffic**

##### **Signs:**

**700-2.3.1.46.1 Frangible Supports:** Provide *support* posts for all frangible sign assemblies consisting of aluminum tubes up to 3 1/2 inches outside diameter with 3/16 inch wall thickness in accordance with the requirements in the Design Standards.

**700-2.31.246.2 Slip Bases:** ~~Slip base assemblies for single column signs *sha* will use aluminum sleeves and base plates. For posts with s~~ Slip base assemblies for multi-column signs ~~sha~~ will; use galvanized steel *bases*. All slip bases ~~shall~~ must be fabricated in accordance with the requirements of ~~in~~ the Design Standards.

**700-2.1.5 Installation:** ~~It shall be the Contractor's responsibility to verify the length of the column supports in the field prior to fabrication to permit the appropriate sign mounting height. Fabricate the supports and wind beams in accordance with the Design Standards. Panels shall~~ must be level with the proper orientation.

~~————— **700-2.1.67 Method of Measurement.**~~

~~————— **700-2.1.67.1 Quantities:** The quantities to be paid for will be:~~

~~————— (1) The number of ground traffic signs of each designated class of assembly, complete.~~

~~————— (2) The number of existing signs removed, relocated, modified of each designated class of assembly, complete.~~

~~————— (3) The number of flashing beacon signs, of each designated class of assembly, complete.~~

~~————— For the purpose of payment, a sign assembly consists of all the signs mounted on a single structure (one, two or three posts, or overhead structure) or all the signs on a bridge-mounted sign structure and the sign structure.~~

~~700-2.1.67.2 Removal or Relocation of Signs: Relocation of signs shall consist of removing the existing sign assembly and installing the sign on a new foundation.~~

~~When the Plans call for existing ground-mounted signs to be relocated or removed, immediately remove supports and footings that project more than 6 inches above ground surface after removing the sign panel from the assembly. Remove existing footings to a depth at least 12 inches below the ground surface. Restore the area of the sign removal or relocation to a similar condition of the immediate adjacent area. The costs will be included in the Contract unit price of the item to which it is incidental.~~

~~Notify the Engineer a minimum of 30 days prior to removal of existing Logo sign structures.~~

~~700.2.1.78 Basis of Payment. Price and payment will be full compensation for furnishing and installation of all materials necessary to complete the signs in accordance with the details shown in the Plans; including sign panels complete with sheeting, painting, and message; sign posts and supports, foundations, excavation, etc.; for lighted signs, include all costs of the electrical installation for lighting, up to the point of connection by others; for flashing beacon signs, include all costs of beacons, controllers, and electrical installation, up to the point of connection by others; and all other work specified in this Section, including all incidentals necessary for the complete item.~~

#### **700-2.24 Overhead Signs Assemblies Structures:**

~~700-2.24.1 General Shop Drawings: All overhead signs consist of both cantilever and span truss mounted signs cantilever and truss mounted signs are to be retroreflective unless otherwise noted in the Plans.~~

##### **700-2.2.12 Materials:**

**700-2.2.12.1 General:** Obtain reinforcing steel, multi-post and overhead sign structures from a fabrication facility that is listed on the Department's list of steel producers with an accepted quality control program, meeting the requirements of Section 105.

Only use structural steel, including bolts, nuts, and washers, that have been hot dip galvanized or metalized after fabrication. Perform hot dip galvanizing in accordance with Section 962 ~~ASTM A123 or ASTM A153~~ and metalizing in accordance with Section 562.

For galvanized steel members, meet the general requirements of Section 962. Obtain galvanized steel from a fabrication facility that is listed on the Department's list of galvanizers with an accepted quality control program, meeting the requirements of Section 105.

Use a galvanizing compound as specified in Section 975. Use a galvanizing repair compound listed on the QPL for large areas as defined in Section 975.

**700-2.2.12.2 Reinforcing Steel:** Use reinforcing steel in footings meeting the requirements of Section 415.

**700-2.2.12.3 Specific Uses of Aluminum and Galvanized Steel:** Use aluminum bolts, nuts, and hardware to connect parts of the cast base.

*Use galvanized steel anchor bolts for anchoring base plates to concrete bases and for the nuts and washers.*

*For all other metal parts of the cast base, the Engineer will allow galvanized steel as an alternative to aluminum.*

**700-2.2.23 Foundations:**

~~700-2.2.23.1 Spread Footings: Meet the requirement of Section 455-25 through 455-35~~

~~700-2.2.23.1.1 Excavation and Backfilling: Perform excavation and backfilling for the footings in accordance with Section 125, with the exceptions that no specific density is required and that the backfill may be tamped in 4 inches maximum layers. Use material that is at near optimum moisture and neither dry or saturated, and tamp to the extent directed by the Engineer. The Department may require that the backfilling be done with poured concrete.~~

~~Install spread footings which support sign structures overhanging the roadway as required in 455-25 through 455-37.~~

~~700-2.2.23.1.2 Mixing and Placing Concrete: For batching and mixing of concrete for footings, meet the requirements of Section 346, except that the Engineer will allow hand mixing by approved methods where the quantity to be mixed does not exceed 1/2 yd<sup>3</sup> cu yd. Use cast-in-place or precast concrete for the footings. Obtain precast concrete footings from a plant that is currently on the list of Producers with Accepted Quality Control Programs. Producers seeking inclusion on the list shall meet the requirements of Section 105.~~

~~700-2.2.23.1.3 Forms: The Engineer will not require forms when the ground is sufficiently firm, in which case, sufficiently moisten the adjacent earth to prevent it from absorbing the moisture from the concrete. Where forms are required and the soil is not moist, place sufficient water, as directed by the Engineer, in the hole, and pour the concrete as soon as the water has been absorbed. Place at least 4 inches of loose earth, free from clods or gravel, over the top of the footing for effect curing benefit.~~

~~700-2.2.23.2 Finishing Concrete: Trowel the top of the concrete to a smooth finish.~~

~~700-2.2.23.23 Drilled Shafts: Meet the requirements of Section 455. Submit shop drawings to the Department for approval as specified in Section 5. Prior to the submittal of the shop drawings, determine the actual length of support columns for all sign structures on the basis of existing field conditions and include these lengths on the shop drawings.~~

**700-2.2.34.2 Installation:** Install nuts on anchor bolts in accordance with *Section 649-5 and 649-6* with one exception. For cantilever overhead sign structures, after placement of the upright and prior to installation of the truss, adjust the leveling nuts beneath the base plate to achieve the back rake shown on the Camber Diagram. If the top surface of the base plate has a slope that exceeds 1:40, use beveled washers under the top nuts.

Use ASTM A325 bolt, nut and washer assemblies for all installations other than anchor bolts as follows. Use bolt, nut and washer assemblies that are free of rust and corrosion and that are lubricated properly as demonstrated by being able to easily hand turn the nut on the bolt thread for its entire length. Tighten nuts to a

snug-tight condition to bring the faying surfaces of the assembly into full contact which is referred to as snug-tight. Snug-tight is defined as the maximum nut rotation resulting from the full effort of one person on a 12 inch long wrench or equivalent. After bringing the faying surfaces of the assembly into full contact and to a snug-tight condition, tighten nuts to achieve the minimum torque as specified in Table 700-1 unless the connection is an alternate splice connection of a span sign structure, in which case, tighten nuts in accordance with the turn-of-nut method of Table 460-7 of Section 460. Maintain uniform contact pressure on the faying surfaces during snugging and the subsequent final tightening process, by using a bolt tightening pattern that balances the clamping force of each bolt, as closely as possible, with the equal clamping force of a companion bolt. Within 24 hours after final tightening, the Engineer will witness a check of the minimum torque using a calibrated torque wrench for 3 bolts or a minimum of 10% of the bolts, whichever is greater, for each connection; however, do not perform this check on alternate splice connections of span sign structures.

Bolt Diameter (in.)	Minimum Torque (ft.-lbs.)
3/8	15
1/2	37
5/8	74
3/4	120
7/8	190
1	275
1 1/8	375
1 1/4	525

**700-2.2.45 Erection of Signs and Sign Supports:** Do not erect overhead sign supports until the concrete strength in the support footing is at least 2,500 psi. Determine concrete strength from tests on a minimum of two test cylinders sampled and tested in accordance with ASTM C31 and ASTM C39 and verifying test results have been provided to the Engineer.

Erect the signs and sign structures in accordance with the details shown in the Plans. The Contractor may fabricate the structural steel sign trusses in sections that will fit into available galvanizing vats. Prior to galvanizing, weld the joints as specified in Section 460 and in accordance with the details shown in the Plans. Re-galvanize damaged parts as specified in Section 562.

Weld aluminum structures in accordance with Section 965.

Attach electronic display signs to the supporting structure in accordance with the manufacturer's recommendations using the mounting hardware provided by the manufacturer.

**700-2.2.56 Shop Drawings:** Submit shop drawings to the Department for approval as specified in Section 5. Prior to the submittal of the shop drawings, determine the actual in place ~~dimions~~ dimensions ~~length of support columns~~ for all sign structures on the basis of existing field conditions and include these ~~lengths~~ on the shop drawings.

**700-2.3 Method of Measurement.**

*For single post and multi post sign assemblies, an assembly consists of all the signs mounted on a single structure. The contract unit price per assembly for ground mounted signs (single post and multi-post), furnished and installed, will include furnishing the sign panels, support structure, foundation, hardware, and labor necessary for a complete and accepted installation.*

*For overhead signs, sign panels will be paid separately from support structures. The contract unit price per each for sign panels, furnished and installed, will include furnishing the sign panels, hardware, and labor necessary for a complete and accepted installation. The contract unit price for each overhead static sign structure, furnished and installed, will include furnishing the support structure, foundation, hardware, and labor necessary for a complete and accepted installation.*

*Relocation of signs will consist of removing the existing sign assembly and installing the sign on a new foundation.*

*When the Plans call for existing ground-mounted signs to be relocated or removed, after removing the sign panel from the assembly, remove supports and footings. Restore the area of the sign removal or relocation to the condition of the adjacent area.*

**700-2.4 Basis of Payment.**

*Price and payment will be full compensation for all work specified in this Section.*

*Payment will be made under:*

- Item No. 700- 1- Single Post Sign, per Assembly.*
- Item No. 700- 2- Multi Post Sign, per Assembly.*
- Item No. 700- 3- Sign Panel, per Each.*
- Item No. 700- 4- Overhead Static Sign Structure , per each.*

~~700-2.2.7 Method of Measurement: [Missy will Update] The quantities to be paid for will be:~~

~~(1) The number of lighted overhead traffic signs of each designated class of assembly, complete.~~

~~(2) The number of existing signs removed, relocated, modified of each designated class of assembly, complete.~~

~~(3) The number of overhead signs span wire mounted, bridge mounted, and lighted sequential, of each designated class of assembly, complete.~~

~~(4) The number of flashing beacon signs, of each designated class of assembly, complete.~~

~~For the purpose of payment, a sign assembly consists of all the signs mounted on a single structure (one, two or three posts, or overhead structure) or all the signs on a bridge mounted sign structure and the sign structure.~~

~~700-2.2.8 Basis of Payment: Price and payment will be full compensation for furnishing and installation of all materials necessary to complete the signs in accordance with the details shown in the Plans; including sign panels complete with sheeting, painting, and message; sign posts and supports, foundations, excavation, etc.; for lighted signs, include all costs of the electrical installation for lighting, up to the point of connection by others; for flashing beacon signs, include all costs of beacons, controllers, and electrical installation, up to the point of connection by others; and all other work specified in this Section, including all incidentals necessary for the complete item.~~  
**700-2.5 Sign Retroreflective Sheeting: Meet the requirements of Section 994. Use Type III, VII or XI sheeting for background sheeting, white legends, borders and shields on all signs with the following exceptions:**

~~a. Use Type VII sheeting for STOP, DO NOT ENTER and WRONG WAY signs.~~

~~b. Use Type III or greater prismatic material for white sheeting for overhead signs.~~

~~Use Type III, VII or XI yellow-green fluorescent sheeting for S1-1 school advance signs and supplemental panels used with S1-1, S3-1 and S4-5 school signs. Do not mix signs having fluorescent yellow-green sheeting with signs having yellow retroreflective sheeting. Use fluorescent orange Type VI or VII for all orange work zone signs. Mesh signs shall meet the color, daytime luminance and nonreflective property requirements of Section 994, Type VI.~~

~~700-2.6 Breakaway Support Mechanisms for Electronic Display Signs:  
Provide posts or posts with slip bases as shown in the Plans.~~

**700-3 Illuminated Signs.**

~~**700-3.1 Description:** Furnish and install Illuminated Signs in accordance with the details specified in the Contract Documents. This Section specifies the minimum requirements for listing Illuminated Signs (including Street Name and Guide Signs) on the Department's Approved Product List (APL). Certification for an internally illuminated street name sign will be limited to sign assemblies that are no more than 18 sq. ft. in area and weigh no more than 144 lbs. Illuminated signs that exceed maximum area or weight limitations will not be listed on the APL and must be submitted to the Project Engineer for approval in accordance with Section 699 of the FDOT Standard Specifications for Road and Bridge Construction (SSRBC).~~

~~**700-3.2 Materials:** Use illuminated signs and associated mounting hardware listed on the Department's Approved Product List (APL). Manufacturers seeking evaluation of their products must submit an application in accordance with Section 6 and include certification that shows they meet the requirements of this Section.~~

~~Signs must be marked with the name or trademark of the manufacturer, the part number, and the date of manufacturer. Marking must be accomplished by permanently affixing an indelible label, identification plate, dot peen type stamp, casting, metal-marking, or other approved method. Markings must remain visible after installation.~~

~~**700-3.2.1 Internally Illuminated Signs:**~~

~~**700-3.2.1.1 General** Signs larger than 18.0 sq. ft. in area or weighing more than 144 lbs. are not listed on the APL and must be submitted to approved by the Engineer for approval as detailed in 699-1.3. Ensure internally illuminated sign is marked in accordance with Section 603 and the markings are visible after installation. Provide a UL listed Ensure internally illuminated sign assemblies have been tested and listed for their specific use by a testing laboratory such as UL listed or equivalent or another comparable testing laboratory acceptable to the Department.~~

~~**700-3.2.1.2 Housing** Ensure that the Ssign housing is shall be constructed of continuous 5052 or 6063-T5 aluminum. or other aluminum alloys meeting the mechanical properties of 5052 or 6063-T5. All housing and door seams must seams shall be continuously welded. All corners must be welded. All exterior surfaces of the assembly shall must be powder-coat painted in accordance with Military Standard MIL-PRF-24712A or AAMA-2603-02. Finish must meet the requirements of ASTM D 3359, ASTM D 3363, and ASTM D 522. Sign housings with any interior airspace must consist of a box type enclosure and separate hinged door assembly. Box type enclosures shall include a separate hinged door assembly. Aluminum doors shall have all seams welded. The sign housing must shall include provisions means to prevent water from entering the sign housing. Drain holes in the sign larger than .125 inch must shall be covered by a screened.~~

~~Signs must shall have removable sign faces. The sign assembly must shall have one face unless specified otherwise in the plans. The sign face must shall be secured by a method that holds the sign face securely in place. Slide-in grooves are allowed to secure the sign face if the sign is edge lit.~~

The sign face must ~~shall~~ be a translucent lens constructed of 0.125 inch high impact strength polycarbonate or acrylic meeting UL48. Letters must ~~shall~~ be as detailed in the Contract Documents. Background must ~~shall~~ be translucent retroreflective sheeting coated with a transparent, pressure-sensitive adhesive film. ~~Green e~~Color must ~~shall~~ meet the criteria as detailed ~~signed~~ in ~~SSRBC~~ Sections 700 and 994. Retroreflective sheeting must ~~shall~~ meet ~~the criteria of the~~ requirements of Section 994 ~~ASTM D 4956~~, and be listed on the QPL.

~~Each door must shall have a concealed continuous hinge running the full length of the sign or a six inch stainless steel hinge of adequate capability to perform satisfactorily across from each latch. If a door opens upward, it shall have a bracket on each side to secure the door in the open position during maintenance. Doors shall be permanently and continuously sealed with a UL-listed foam gasket listed to UL 157 to prevent the entry of water into the sign housing. meeting NEMA 250 to prevent the entry of water into the sign housing. Gaskets must shall be installed on the door frame to seal the sign face to the door frame and on the sign body to seal the sign face to the body. To prevent the door from opening when the sign is flexed, e~~Each door must ~~shall~~ be secured from opening by a minimum of two stainless steel rotary action draw latches with an additional latch for every 6 feet of sign length.

The ~~manufacturer of the sign assembly must shall furnish a certification stating the design and construction of the complete sign assembly, including the sign panels and typical sign mounting hardware, has been~~ designed and constructed to withstand 150 mph wind loads meeting the requirements of the FDOT Structures Manual, Volume 9.

**700-3.2.1.3 Luminance** The sign face must ~~shall~~ be illuminated evenly across the entire surface. Contrast ratio between the background ~~white~~ and legend ~~green surfaces~~ shall be established by the lowest ~~white measurement~~ and the highest color ~~green~~ retroreflective measurement and shall be at least 4:1. Measure the retroreflectivity in accordance with ASTM D 4956.

**700-3.2.1.3.1 Background Luminance** Minimum luminance for the ~~green~~ legend portion of the street sign face shall be no less than 87.5 lux. The luminance shall be determined by averaging a minimum of seven readings. Four of the readings shall be taken near the midpoint of a line that would span between the outside corners of the background and the outside corners of the legend. One reading shall be taken near the midpoint of a line that would connect the top corner readings. One reading shall be taken near the midpoint of a line that would connect the bottom corner readings. One reading shall be taken near the vertical and horizontal midpoint of the sign.

**700-3.2.1.3.2 Border and Lettering Luminance** Minimum luminance of the legend and border shall be 350 lux. The luminance shall be determined by averaging a minimum of 17 readings. There shall be a minimum of 1 reading from each letter in the legend. Readings within the legend shall alternate between the top, middle and bottom portion of each letter. Readings within top and bottom of the border shall be perpendicular to the top and bottom readings in the background. Readings within the sides of the border shall be taken parallel to the readings taken within each letter.

**700-3.2.1.4 Clamp-On Cantilever Arm:** Use only clamp-on cantilever arms which meet all design and wind loading requirements as specified in the Contract Documents. Ensure the clamp is adjustable to accommodate various size poles.

#### **700-3.2.2 Highlighted Signs:**

**700-3.2.2.1 General.** Ensure highlighted signs meet the design and functional requirements set in this Section, Section 2A of the ~~FWHA~~ MUTCD and use Light Emitting Diodes (LEDs), ~~or other electronic devices~~, to highlight a sign's shape, color, or message.

Stop, Do Not Enter, Yield, and Wrong Way signs ~~which~~ that are highlighted with LEDs ~~must~~ shall use red LEDs. All other signs ~~must~~ shall use LEDs which resemble the color of the sign background color. ~~Signs must utilize a retroreflective sheeting listed on the Department's Qualified Products List (QPL).~~

**700-3.2.2.2 Performance Requirements.** Ensure highlighted signs are capable of automatically dimming to reduce brightness of the LEDs at nighttime.

Ensure highlighted signs that rely upon solar power or batteries are capable of at least 10 days of continuous operation without the need for charging.

#### **700-3.2.3 Cabinets.**

If the illuminated sign assembly includes a cabinet, the cabinet must be currently listed on the ~~FDOT~~ APL or meet the applicable cabinet material requirements listed in specification ~~of~~ A676 of the MSTCSD.

#### **700-3.2.4 Mechanical Requirements.**

Ensure all assembly ~~fastening~~ hardware, including nuts, bolts, external screws and locking washers less than 5/8 inch in diameter ~~(such as screws, nuts, bolts, washers, etc.) is constructed of passivated stainless steel~~ are Type 304 or Type 316 passivated stainless steel. All assembly hardware greater than or equal to 5/8 inch in diameter must be galvanized. Bolts, studs, and threaded rod must ~~and meets the requirements of~~ ASTM A307. Structural bolts must meet ~~F 593 and~~ ASTM A325 ~~F 594 for corrosion resistance.~~

#### **700-3.2.5 Electrical Requirements.**

Electrical wiring must meet NEC requirements for the light source provided. All wiring ~~shall~~ must be copper wire. All internal electrical wiring must be tight and secure. Ensure the sign includes an accessible electrical power service entrance compartment (internal or external) for connection of field wiring. External compartments must be weather-tight. All power supplies and ballasts ~~shall~~ must be FCC approved ~~and at minimum IP66 rated.~~

Ensure battery connections are protected against corrosion. All signs ~~sha~~ will have provisions for an integrated photocell.

#### **700-3.2.6 Environmental Requirements.**

Ensure that the illuminated sign assembly operates 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.

#### **700-3.2.7 Submittal Requirements for Internally Illuminated signs.**

**700-3.2.7.1 General:** Free-swinging, internally illuminated signs and clamp-on cantilever arms mounted on the upright poles of mast arm assemblies or

*monotube signal structures may be accepted either by certification or by shop drawing submittal and approval as stipulated in this Section.*

**700-3.2.7.2 Acceptance of signs by Certification:** *Provide evidence the sign has been reviewed, approved and is listed on the APL.*

**700-3.2.7.3 Acceptance of signs by Shop Drawing Approval:** *Submit Shop Drawings for internally illuminated signs larger than 18.0 sq. ft. in area or weighing more than 144lbs. Signs submitted for acceptance by shop drawing approval must be manufactured by a vendor with an approved internally illuminated sign listed on the APL.*

**700-3.2.7.4 Acceptance of Clamp-On Cantilever Arms:** *For cantilever arms supporting signs less than 18 sq. ft. in area or weighing less than 144 lbs, certify to the Engineer that the arm meets the criteria in this section.*

**700-3.3 Installation for Internally Illuminated Signs.**

**700-3.3.1 General:** *Secure the brackets to the sign housing in accordance with the manufacturer's instructions.*

**700-3.3.2 Single Sided Sign Assembly:** *Install as specified in the Contract Documents.*

**700-3.3.3 Double Sided Sign Assembly:** *Use a free swinging mounting method.*

**700-3.3.3.1 Two Point Support Assembly:** *Use a two point support assembly when the sign assembly is attached to a mast arm that is perpendicular to the street on which the sign is viewed.*

*Use a two point mast arm mounting assembly consisting of the following:*

- 1. Stainless steel band or cable type clamp,*
- 2. Clevis,*
- 3. Span wire adapter,*
- 4. Tri-stud hanger body.*

*Ensure one of the hangers has a mechanism for the horizontal adjustment of the sign.*

**700-3.3.3.2 One Point Support Assembly:** *Use a one point support assembly consisting of an articulated horizontal stainless steel band or cable type mast arm clamp, sign bracket and mounting hardware, when the ~~street name~~-sign assembly is attached to a mast arm that is diagonal to the street on which the sign is viewed. Do not use a one point support assembly for internally illuminated ~~street name~~-sign assemblies exceeding 4 feet in width.*

*Ensure the band or cable clamp is capable of horizontal rotation of 360 degrees.*

**700-3.3.3.3 Clamp-On Cantilever Arm:** *Attach the arm perpendicular to the street on which the ~~street name~~-sign assembly is viewed. Use a clamp and arm that are galvanized in accordance with ASTM A123 unless otherwise shown on the plans. Ensure the arm has a cap secured in place.*

**700-3.3.4 Electrical Wiring:** *Unless otherwise shown on the plans, install dedicated 14 AWG conductors to supply power to the sign and connect the conductors to a dedicated 15 amp circuit breaker located either inside the controller cabinet or inside the electrical service disconnect. Using the same conduit system for both signal cables*

and internally illuminated sign conductors is permitted, unless otherwise shown on the plans.

Install conductors in such a manner as to prevent damage to conductors or conductor insulation. Remove and replace all damaged conductors /insulation at no additional cost to the Department.

Ensure drilled hole(s) through which conductor(s) pass through are fitted with a weather tight ~~fitting~~ rubber grommet fitting.

Install continuous lengths of conductors between the dedicated circuit breaker and internally illuminated ~~street name~~ signs.

Do not splice conductors unless otherwise shown on the plans.

Provide one photoelectric cell ~~tfor turn-on/off~~ all internally illuminated ~~street name~~ signs at each intersection. Use an 'L' bracket to mount the photoelectric cell as specified in the Contract Documents. Connect the photoelectric cell to a contactor assembly inside the controller cabinet to provide switching of the internally illuminated ~~street name~~ signs.

#### **700-3.23.75 Warranty.**

**700-3.23.75.1 Internally Illuminated Signs:** Ensure that Internally Illuminated Signs have a manufacturer's warranty covering defects for five years from the date of final acceptance by the Engineer in accordance with 5-11 and Section 608 ~~of the FDOT SSRBC.~~

**700-3.23.75.2 Highlighted Signs:** Ensure that Highlighted Signs have a manufacturer's warranty covering defects for three years from the date of final acceptance by the Engineer in accordance with 5-11 and Section 608 ~~of the FDOT SSRBC.~~

#### **700-3.34 Method of Measurement.**

The contract unit price per each for internally illuminated signs, furnished and installed, will include furnishing the sign panels, housing, hardware, electrical connection, and labor necessary for a complete and accepted installation. When the internally illuminated sign is ground mounted, the contract price will include the support structure and foundation. All other mounting will include the hardware necessary to complete the attachment to the support structure; the span wire, monotube, or mast arm structure will be paid separately.

The contract unit price per each for highlighted signs, furnished and installed, will include furnishing the sign panels, support structure, foundation, hardware, solar panel, ~~electrical connection~~, and labor necessary for a complete and accepted installation.

#### **700-3.45 Basis of Payment.**

Price and payment will be full compensation for all work specified in this Section.

Payment will be made under:

Item No. 700- 5- Internally Illuminated Signs, per each.

Item No. 700- 6- Highlighted Signs, per assembly ~~each~~.

#### **Materials.**

~~700-3.1 General: Meet the materials requirements shown below and any additional requirements which the Plans might show.~~

~~700-3.2 Concrete: Use concrete meeting the requirements of Section 346.~~

~~700-3.3 Reinforcing Steel:~~ For reinforcing steel in footings, meet the requirements of Section 415.

~~700-3.4 Aluminum Materials:~~

~~700-3.4.1 General:~~ For aluminum materials, meet the general provisions of 965-1.

~~700-3.4.2 Sheets and Plates:~~ For aluminum sheets and plates for sign panels, meet the requirements of ASTM B 209, Aluminum Association Alloy 6061 T6, 5154 H38 or 5052 H38 and those shown in the Plans.

~~700-3.4.3 Extruded Tubing:~~ For extruded aluminum tubing, meet the requirements shown in the Plans.

~~700-3.4.4 Castings:~~ Provide aluminum castings of the alloys shown in the Plans. For aluminum alternates the Engineer will allow a cast base, provided the Contractor submits test reports giving evidence that the base to be used for each pole size is as strong as the pole with which it is to be used. Perform physical tests and submit certified reports for one base to be used with each pole size. Use Alloy A 356 T6 for the castings. Use aluminum bolts for connecting parts of the cast base.

~~700-3.4.5 Channels:~~ For aluminum channels, meet the requirements of ASTM B 308 for the alloys shown in the Plans.

~~700-3.4.6 Bolts, Nuts, and Lockwashers:~~ For aluminum bolts, nuts, and lockwashers, meet the requirements shown in the Plans. Ensure that finished bolts and washers are given an anodic coating of at least 0.0002 inch in thickness and are chromate sealed.

~~700-3.5 Steel:~~

~~700-3.5.1 General:~~ Only use structural steel, including bolts, nuts, and washers, that have been hot dip galvanized or metalized after fabrication. Perform hot dip galvanizing in accordance with ASTM A 123 or ASTM A 153 and metalizing in accordance with Section 562. For galvanized steel members meet the general requirements of Section 962 and the specific requirements of 962-9.

~~700-3.5.2 Specific Uses of Aluminum and Galvanized Steel:~~ Use aluminum bolts, nuts, and hardware to connect parts of the cast base.

~~Use galvanized steel anchor bolts for anchoring base plates to concrete bases and for the nuts and washers.~~

~~For all other metal parts of the cast base, the Engineer will allow galvanized steel as an alternate to aluminum.~~

~~700-3.6 Bearing Pads:~~ For bearing pads, meet the requirements of 932-2.

~~700-3.7 Retroreflective Sheeting:~~ All retroreflective sheeting must be listed on the QPL and meet the retroreflective sheeting requirements of Section 994.

~~700-3.8 Process Colors:~~ Use transparent and black opaque process colors listed on the QPL meeting the requirements of 994-4 on retroreflective and nonreflective sheeting.

#### **700-4 Dynamic Message Signs .**

*700-4.1 Sign Types: Dynamic Message Signs (DMS) must meet the requirements of NEMA TS4-2005. Dynamic Message Signs (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 Department's Approved Product List (APL).

**700-4.1.1 Front Access DMS:** Ensure that front access signs meet the requirements of NEMA TS4 2005, section 3.2.5.

**700-4.1.2 Walk-in DMS:** Ensure that walk-in signs meet the requirements of NEMA TS4 2005, section 3.2.7.

**700-4.1.3 Embedded DMS:** Embedded DMSs are DMSs that are typically mounted to Ground Traffic Signs, Overhead Traffic Signs, or Overhead Cantilever Traffic Signs.

**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 inch thick for walk-in DMS and 0.090 inch thick for front and 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 TS4 2005, 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 fifth edition (2001) American Association of State Highway and Transportation Officials (AASHTO) Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals with current addendums. Design and construct the DMS unit for continuous usage of at least 20 years and the sign structure for a 50 year design life. ~~Ensure that equipment and structures are designed to withstand loads, including a wind load of 150 miles per hour, as defined in the FDOT Structures Manual without deformation or damage~~ The sign assembly must be designed and constructed to withstand loads, including a wind load of 150 miles per hour, as defined in the FDOT 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 American Society for Testing and Materials (ASTM) F 593 and ASTM F 594. All assembly hardware greater than or equal to 5/8 inch in diameter must be galvanized and meet the requirements of ASTM A 307.

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 American National Standard Institute/American Welding Society (ANSI/AWS) Structural Welding Code-Aluminum.

Ensure the sign housing meets the requirements of NEMA TS4 2005, section 3.2.8 for convenience outlets.

*Manufacturers seeking evaluation of their products must submit an application in accordance with Section 6 and include certification that shows they meet the requirements of this Section.*

**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 inch 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, ~~Index No. 18300~~. Ensure ~~these~~ 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 ~~these~~ 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 TS4 2005, section 3.2.7.1. 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 TS4 2005, section 3.2.7.3 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 ~~minimum of~~ 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 TS4 2005, section 3.2.7.2. 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 TS4 2005, section 3.2.4. 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 TS4 2005, 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. Provide 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 TS4 2005, section 3.1.6.*

**700-4.2.3.1 Housing Face for Walk-in DMS:** *No exposed fasteners ~~sha~~ will be 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 ~~shall~~ must be the same color and finish as the housing face. Only captive fasteners ~~sh~~ will 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 sign includes lens panel assemblies, ensure they are modular in design, removable, and interchangeable without misalignment of the lens panel and the light-emitting diode (LED) pixels. The lens panel assembly must consist of an environmental shielding layer coating to protect and seal the LEDs and internal electronics. The coating ~~shall~~ must be a minimum 90% ultraviolet (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 TS4 2005, 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 will report 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. A humidistat is not acceptable.

**700-4.2.7 Sign Housing Photosensors:** Ensure the sign meets the requirements of NEMA TS4 2005, section 8.8. 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.*

**700-4.3 Display Modules:** *Provide display modules manufactured by one source and fully interchangeable throughout the manufacturer's sign system(s). 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 TS4 2005.*

**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 TS4 2005, 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 ~~sh~~ will not be exceeded under any operating condition.*

*Provide a pixel test as a form of status feedback to the transportation management center (TMC) from the local sign controller. 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) 1203v0239 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 the LED motherboards with a complete conformal coating of silicone resin with a minimum thickness of 0.01 inch, except for the pixels on the front of the PCB. All other PCBs must be provided with a complete conformal coating of silicone resin with a minimum thickness of 0.01 inch. Meet 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 PCBs 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 of 15 characters using an 18 inch font that meets the height to width ratio and character spacing in the Manual on Uniform Traffic Control Devices for Streets and Highways 2009 Edition (MUTCD), section 2L.04, paragraphs 05, 06, and 08.*

**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 TS4 2005, 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 Federal Highway Administration (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.*

**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 TS4 2005, section 10.2.*

*~~Locate~~ 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 National Electrical Code (NEC). ~~Ensure that no 120 V<sub>AC</sub> wiring is exposed inside or outside of the sign housing.~~ 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.*

*Provide surge protective devices (SPD) 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 785-2](#). Ensure SPDs protect all electric power and data communication connections.*

**700-4.6 Uninterruptible Power Supply (UPS):** *If a UPS is required in the Contract Documents for walk-in DMS, ensure the UPS is installed within the sign housing or as shown in the Plans. If a UPS is required in the Contract Documents for front access and embedded signs, ensure the UPS is installed within the control cabinet or as shown in the Plans. The UPS system must be capable of displaying the current messages on a sign when a power outage occurs. ~~Signs with UPS must be able to operate on battery power and display text messages~~ for a minimum of two hours. Ensure the system uses sealed absorbed glass mat (AGM) batteries.*

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

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

<i>1 each</i>	<i>Sign controller and I/O board(s)</i>
<i>10 each</i>	<i>LED display modules</i>
<i>1 each</i>	<i>Display power supply</i>
<i>1 each</i>	<i>Uninterruptible power supply</i>
<i>1 each</i>	<i>Cable for connecting interface circuits to daughter boards</i>
<i>1 each</i>	<i>Display module cables</i>
<i>2 each</i>	<i>Surge suppression sets</i>
<i>1 each</i>	<i>Fan assembly</i>
<i>1 each</i>	<i>Time relay for fan control</i>
<i>10 each</i>	<i>Each type of small fuse (<math>\leq 10</math> amp)</i>
<i>2 each</i>	<i>Each type of large fuse (<math>&gt; 10</math> amp)</i>
<i>1 each</i>	<i>Each type of sensor</i>

**700-4.8 Components:** *All components must meet the requirements of NEMA TS4 2005, [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 Type 304 and meet the requirements of ASTM F 593 and ASTM F 594 for corrosion resistance. Ensure that all bolts and nuts 5/8 inch and over in diameter are galvanized and meet the requirements of ASTM A 307. 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 TS4 2005, ~~s~~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 TS4 2005, sections 8.9, 8.10. 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 EIA-310 19 inch rack, and include 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, Electronic Industries Alliance (EIA)-232 null modem cables (minimum of 4 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~~-785-4. 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 4 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 TS4 2005, section 8.7.1. Ensure that EIA-232 serial interfaces support the following:*

<i>Table 700-3 Communication Interface Requirements</i>	
<i>Data Bits</i>	<i>7 or 8 bits</i>
<i>Parity</i>	<i>Even, Odd, or None</i>
<i>Number Stop Bits</i>	<i>1 or 2 bit</i>

*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.

**700-4.9 Message and Status Monitoring:** Ensure the DMS provides two modes of operation: (1) remote operation, where the TMC commands and controls the sign and determines the appropriate message or test pattern; and (2) local operation, where the sign controller or a laptop computer commands and controls the sign and determines the appropriate message or test pattern.

Ensure that the sign can perform the following functions:

1. Control Selection – Ensure that local or remote sign control can be selected. Ensure that there is a visual indicator on the controller that identifies whether the sign is under local or remote control.

2. Message Selection – Ensure that the sign controller can select a blank message or any one of the messages stored in the sign controller's nonvolatile memory when the control mode is set to local.

3. Message Implementation – Ensure that the sign controller can activate the selected message.

Ensure that the sign can be programmed to display a user-defined message, including a blank page, in the event of power loss.

Ensure that message additions, deletions, and sign controller changes may be made from either the remote TMC or a local laptop computer. Ensure that each font may be customized, and modifications to a font may be downloaded to the sign controller from the TMC or a laptop computer at any time without any software or hardware modifications.

Ensure that there is no perceivable flicker or ghosting of the pixels during sign erasure and writing periods.

**700-4.10 TMC Communication Specification for all DMS:** Ensure that the sign controller is addressable by the TMC through the Ethernet communications network using software that complies with the NTCIP 1101 base standard (formerly the NEMA TS 3.2 -1996 standard), including all amendments as published at the time of contract letting, the NTCIP Simple Transportation Management Framework, and conforms to Compliance Level 1. Ensure that the software implements all mandatory objects in the supplemental requirement SR-781-3-1, FDOT Dynamic Message Sign NTCIP Requirements, as published on the FDOT State Traffic Engineering and Operations Office web site at the time of contract letting. Ensure that the sign complies with the NTCIP 1102v01.15, 2101 v01.19, 2103v02.07, 2201v01.15, 2202 v01.05, and 2301v02.19 standards. Ensure that the sign complies with NTCIP 1103v02.17, section 3.

Ensure that the controller's internal time clock can be configured to synchronize to a time server using the network time protocol (NTP). NTP synchronization frequency must be user-configurable and permit polling intervals from once per minute to once per week in one-minute increments. The controller must allow the user to define the NTP server by internet protocol (IP) address.

Provide communications line circuits that are point-to-point or multipoint, and that provide full duplex asynchronous data transmissions at the rate shown in the contract documents or directed by the Engineer.

*Assign each sign controller a unique address.*

**700-4.11 Sign Control Software:** *Ensure that the sign is provided with computer software from its manufacturer that allows an operator to program, operate, exercise, diagnose, and read current status of all sign features and functions using a laptop computer. Ensure that sign control software provides a graphical representation that visibly depicts the sign face and the current ON/OFF state of all pixels as well as allows messages to be created and displayed on the sign. Ensure that the laptop computer and sign can communicate when connected directly by an EIA-232 cable and via Ethernet. Ensure that the software will allow communication between multiple users and multiple signs across the same communication network.*

**700-4.12 Sign Support Structure:** *Meet the requirements of 700-2.24.*

**700-4.13 Installation Requirements:** *Provide walk-in DMS for locations over interstate travel lanes. Do not install the sign prior to the availability of electric power. Verify that any ventilation system incorporated within the sign is operational within 72 hours after sign installation.*

*Ensure that the location of the lifting eyebolts, left in place or removed, is sealed to prevent water entry after installation.*

*Load the initial message libraries on both the sign control software and the sign controller. The Engineer will furnish the messages to be placed in these libraries.*

**700-4.14 Documentation:** *Provide documentation for electronic equipment in accordance with 603-8.*

**700-4.15 Licensing:** *Ensure that the manufacturer grants the Department a license that allows the Department to use and internally distribute any and all sign communications protocols, operating systems, drivers, and documentation.*

**700-4.16 Technical Assistance:** *Ensure that a manufacturer's representative is available to assist the Contractor's technical personnel during pre-installation testing and installation.*

*Do not provide initial power to the sign(s) without the permission of the manufacturer's representative.*

**700-4.17 Environmental Requirements:** *The DMS must meet the requirements of NEMA TS4 2005, section 2.*

**700-4.18 Pre-installation Field Testing:** *Conduct pre-installation tests on all units at a Contractor-provided facility within the appropriate District. Perform the tests on each unit supplied to verify that no damage was done to any sign during the shipment and delivery process. Notify the Engineer a minimum of 10 calendar days before the start of any tests. Conduct all tests according to the approved test procedures detailed in this Section. Each DMS must pass the individual tests detailed below prior to installation.*

**700-4.18.1 Material Inspection:** *Examine each DMS carefully to verify that the materials, design, construction, markings, and workmanship comply with all applicable standards, specifications, and requirements.*

**700-4.18.2 Operational Test:** *Operate each DMS long enough to permit equipment temperature stabilization, and to check and record an adequate number of performance characteristics to ensure compliance with applicable standards, specifications, and requirements.*

**700-4.18.3 Pre-installation Test Failure Consequence:** *If any unit fails, the unit shall be corrected or another unit substituted in its place and the test repeated.*

*If a unit has been modified as a result of a failure, a report shall be prepared and delivered to the Engineer. The report shall describe the nature of the failure and the corrective action taken.*

*If a failure pattern develops, the Engineer may direct that design and construction modifications be made to all units without additional cost to the Department or an extension of the contract period.*

**700-4.19 Installed Site Tests:** *Conduct an approved, stand-alone equipment installation test at the field site. Test all stand-alone (i.e., non-network) functions of the field equipment using equipment installed as detailed in the Plans and as approved by the Engineer.*

*Complete approved data forms and turn them over to the Engineer for review and as a basis for rejection or acceptance. Provide a minimum notice of 30 calendar days prior to all tests to permit the Engineer or his representative to observe each test.*

*If any unit fails to pass its stand-alone test, correct the unit or substitute another unit in its place, then repeat the test.*

*If a unit has been modified as a result of a stand-alone test failure, prepare a report describing the nature of the failure and the corrective action taken and deliver it to the Engineer prior to re-testing the unit. If a failure pattern develops, the Engineer may direct that design and construction modifications be made to all units without additional cost to the Department or an extension of the contract period.*

**700-4.20 System Testing:** *Conduct approved DMS system tests on the field equipment with the master equipment including, at a minimum, all remote control functions. Display the return status codes from the sign controller for a minimum of 72 hours. Complete approved data forms and turn them over to the Engineer for review, and as a basis for rejection or acceptance.*

*Demonstrate the sign's ability to display the proper predefined message or remain blank when power is restored following an AC power interruption.*

*If the system test fails because of any subsystem component, repair that component or substitute another in its place, then repeat the test. If a component has been modified as a result of a system test failure, prepare a report and deliver it to the Engineer prior to retesting.*

**700-4.21 Operational Testing:** *After the system testing is successfully completed, conduct one continuous 72 hour, full-operating test prior to conducting the 60 day acceptance test. The Engineer will approve the type of tests to be conducted. Include in the tests all control, monitoring, and communications functions of the field equipment by the master equipment.*

**700-4.22 Acceptance Testing:** *Conduct a 60 day acceptance test after the successful completion of the approved 72 hour operational test. During the 60 day test period, limit downtime due to mechanical, electrical, or other malfunctions to a maximum total of five calendar days. If the equipment fails to operate for a total of five or more calendar days, testing will be restarted. The Engineer may select to pause and extend the 60 day test period by the number of days lost by failure and repair time in lieu*

of restarting the full 60 day test. The Engineer will furnish the Contractor with a letter of approval and completion stating the first and last day of the 60 day test period.

**700-4.23 Warranty:** Ensure that the DMS and HAR systems and equipment have a manufacturer's warranty covering defects for a minimum of five years from the date of final acceptance by the Engineer in accordance with 5-11 and Section 608.

~~700-4.23 Truck Mounted Incident Management Dynamic Message Sign:~~

~~700-4.23.1 Description:~~ This section specifies the minimum requirements for the certification of truck mounted incident management dynamic message signs. This equipment is for "first response" vehicles (trucks) responding to an incident. No trailer mounted signs will be accepted. **This equipment is not to be used for planned events.** All traffic control devices of this type must also meet the physical display and operational requirements as described in the Federal Highway Administration's **Manual on Uniform Traffic Control Devices (MUTCD)**. The message display shall utilize light emitting diodes (LED). Alternate illumination technology may be submitted for approval as long as the functional requirements of this specification are met.

~~700-4.23.2 Display Panel and Housing:~~

~~1) The housing maximum size shall not exceed the following: width = 72 inches; height = 48 inches; thickness = 12 inches.~~

~~2) The housing shall be designed to withstand exposure to the elements and offer some degree of protection against vandalism.~~

~~3) All nuts, bolts, washers and other fasteners (less than 5/8 inch) shall be stainless steel type 304 or 316.~~

~~4) Provisions (by convection or fan) shall be made for heat dissipation within the unit.~~

~~5) The message matrix panel background and frame for the changeable message assembly shall be painted flat black, federal specification TT-E-489.~~

~~6) The face of the display shall be easily opened from the front, and locked to stay open far enough to allow for servicing of all message panel components.~~

~~7) All message panels shall aid against sun glare. The face of the sign shall be covered by an impact resistant polycarbonate non-glare face with an ultraviolet inhibitor to protect from fading and/or yellowing.~~

~~8) The display panel support structure, when raised in the upright position, shall be designed to allow for a minimum height of seven feet from the bottom of the panel to the ground and shall be a minimum of one inch above the height of any light bar mounted on the cab of a truck. The highest part of the unit, when in the travel or rest position, shall be no greater than 7.5 feet above the ground. The unit shall have a manual and automatic control mechanism to raise and lower the display assembly. A locking device shall also be provided to ensure the display panel will remain in the raised or lowered position.~~

~~700-4.23.3 Message Matrix:~~

~~1) The message display area shall be a minimum of 3 feet high by 5 feet wide.~~

~~2) The display shall provide variable letter, graphic and symbol sizes from 9 to 36 inches.~~

3) LEDs used shall be amber (590 nm dominate wavelength) and shall meet the visibility requirements of this specification. LEDs shall have a viewing angle no less than 30 degrees. LED intensity shall not fall below 80 percent within three years.

4) All display modules shall be identical and interchangeable.

#### **700-4.23.4 Electrical System:**

1) The power supply shall be a 12 VDC system designed to operate the sign with a dedicated battery or batteries that are charged by the vehicle electrical system, but isolated so it does not drain the vehicle battery.

2) All internal sign components shall be treated with a protective, weather-resistant polyurethane conformal coating to protect against the adverse effects of humidity and moisture.

#### **700-4.23.5 Controller:**

1) The controller shall be housed inside the sign and shall be equipped with a security lockout feature to prevent unauthorized use.

2) An external weather-resistant, hand-held control keypad shall be used to display the message on the sign.

3) The sign shall not be affected by radio transmissions.

4) The controller shall have the capability to provide a stipulated default message upon loss of controller function. A blank message is acceptable.

#### **700-4.23.6 Operation and Performance:**

1) The message shall be displayed in upper case.

2) The message matrix panel shall be visible from one-half mile. With a 9 inch character displayed, the sign shall be legible from a distance of 400 feet in both day and night conditions. Under variable light level conditions, the sign shall automatically adjust its light source to meet the 400 foot visibility requirement.

3) The sign shall have the capability to store a minimum of 40 common messages / graphics of which a minimum of 30 shall be user programmable messages.

4) All messages shall be capable of being flashed or sequenced. In the sequence mode, the controller shall have the capability to sequence three complete messages during one cycle. A displayed message shall not exceed three lines. Both message dwell time and message flash rate shall be individually programmable.

5) The sign assembly shall be designed for operation in ambient temperature ranges from -30 to +165 degree Fahrenheit at 5 percent to 95 percent relative humidity, non-condensing. Other environmental requirements shall be followed as specified in Section A615 of the FDOT's.

#### **700-4.23.7 Other Requirements:**

1) The sign shall be secured on the vehicle for normal operation.

2) The sign's total weight (including all mounting brackets) shall not require a forklift to lift onto a truck (i.e., must be able to be loaded by hand using only 2-3 people).

3) A fault light, visible to the driver, shall be located on the sign to indicate if it is not operating properly.

4) An operator's manual shall be furnished with each sign.

~~5) The following shall be painted or affixed with a permanent tamper proof, water resistant label located on the driver's side of the housing:~~

- ~~a) Manufacturer name~~
- ~~b) FDOT Certification Number~~
- ~~c) Message stating: "Certification of this device by the Florida Department of Transportation allows for its use for Incident Management only."~~

#### **700-4.234 Method of Measurement.**

For DMS, the quantity to be paid will be each sign furnished, installed, complete in accordance with the details shown in the Plans, warranted, made fully operational, and tested in accordance with the specifications in this Section.

For DMS Support Structure, the quantity to be paid will be each structure furnished, installed, complete in accordance with the details shown in the Plans; including posts and supports, catwalks, handrails, footings, excavation, site grounding, painting, and incidentals necessary to complete the work.

#### **700-4.245 Basis of Payment.**

Price and payment will be full compensation for furnishing all materials and completing all work as specified in this section or shown in the Plans.

Payment will be made under:

<del>Item No. 700- 7</del>	<del>Dynamic Message Sign – each.</del>
Item No. 700- 7	Embedded Dynamic Message Sign – each.
Item No. 700- 8	Front Access Dynamic Message Sign –
	each.
Item No. 700- 9	Walk-in Dynamic Message Sign – each.
Item No. 700- <del>8</del> 10-	Dynamic Message Sign Support Structure –
	each.

#### **700-5 Electronic Display Sign.**

##### **700-5.1 Description:**

All Electronic Display Signs (EDS) must meet the physical display and operational requirements for warning or regulatory signs described in the Federal Highways Administration (FHWA) Manual on Uniform Traffic Control Devices (MUTCD) and its companion document, the Standard Highway Signs Book (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 Regulatory Signs (ERS), Electronic Speed Feedback Signs (ESFS), and Blank-Out Signs (BOS).

##### **700-5.2 Material:**

EWS, 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. BOS are not required to include static sign attachment provisions.

Manufacturers seeking evaluation of their products must submit an application in accordance with Section 6 and include certification that shows they meet the requirements of the Section. ~~All electronic assemblies must meet the requirements of FCC, Title 47 Subpart B Section 15.~~

**700-5.2.1 Requirements common to all EDS.** All EDS must be designed to withstand the loads defined in the ~~Florida Department of Transportation (FDOT) 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 ~~conform to the ANSI/AWS Structural Welding Code —Aluminum.~~

**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 Approved Products List (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.

~~**700-5.2.1.3 Static Sign Panel.** Static sign panels shall meet FDOT requirements for Highway Signing found in this Section 700 of the Standard Specifications for Road and Bridge Construction.~~

**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.** Cover the electronic display panel with a non-glare transparent polycarbonate face to protect and seal the dynamic display and other internal electronics. The polycarbonate face must be a minimum 90% ~~percent~~ ultraviolet (UV) opaque and resistant to fading and yellowing. Electronic displays incorporated within static signs must be mounted to the back of the static sign face. The top of polycarbonate face shall not be recessed more than 0.375 inches from the front of the static sign. The housing shall be National Electrical Manufacturers Association (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 light emitting diodes (LED) 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 2 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 percent 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 percent 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 percent intensity. Provide 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 shall 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 SHS companion document. Fonts and graphics shall 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 electronic display shall must not be adversely affected by radio transmissions. 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 1 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 in order to meet or exceed visibility requirements. The EDS shall must be equipped with a light sensor that accurately measures ambient light level conditions at the sign location. The EDS shall 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 shall 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 FDOT 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 A325 ~~Use only nuts, bolts, washers, and other fasteners meeting Section 603 of the SSRBC.~~

**700-5.2.6 Electrical Specifications.** All power inputs ~~shall~~ 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 ~~shall~~ must be capable of fully autonomous operation 24 hours per day, 365 days per year. Batteries ~~shall~~ 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 ~~sha~~ will use a solar charge controller with temperature compensation. The system ~~shall~~ must provide for automatic battery charging, overcharge protection, and have indications that display current status and faults.

**700-5.2.6.2 AC Power.** AC powered signs ~~shall~~ must be capable of operation from 89-135 volts with a frequency of 60 Hz, plus or minus 3. Fluctuations in line voltage ~~shall~~ must have no visible effect on the appearance of the display.

**700-5.2.7 Electronic Warning Signs.** 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 ~~shall~~ 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 (Federal Standard 595A-37038) with a reflectance value not exceeding 25 percent. EWS must utilize yellow LEDs with a peak wavelength of either 585 or 590 nanometers. EWS ~~sha~~ will have a minimum 1 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 will 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 ~~shall~~ must detect when the posted speed is exceeded by 1 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 ~~sha~~ will be blank.

The speed detector ~~sha~~ will not activate alerts for vehicles outside the display cone of vision.

The speed detector ~~shall~~ must not be affected by normal radio transmissions. ~~The EWS shall meet the requirements of FCC Part 90 and The EWS shall not require an FCC operating license.~~ The speed detector ~~sha~~ will operate on 10.8 to 16.6 VDC and draw less than 3 amperes. The EWS ~~sha~~ will monitor and display the speed of approaching traffic only. The EWS detector ~~shall~~ must be able to accurately detect and determine the speed of approaching vehicles. ~~The EWS shall be able to detect a motorized vehicle 1,000 feet in advance of the sign.~~ The EWS ~~shall~~ must be capable of measuring speeds of approaching traffic between 10 and 99 mph with an accuracy of plus or minus 1 mph, 1,000 feet in advance of the sign.

**700-5.2.8 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 5 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.

**700-5.2.8.1 Foreground/Background Colors and Display Types.** ~~The dynamic display of ERS used for variable speed limit applications must display black characters on a white background.~~ Display Modules for all ERS ~~sha~~ will have a minimum 2 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.

**700-5.2.8.2 LED and Pixel Specifications for Type 1 ERS.** Type 1 ERS ~~shall~~ must meet the LED and Pixel specifications defined in ~~section~~ 700-5.2.2.4.

**700-5.2.8.3 Scrolling Film Mechanism for Type 2 ERS.** The dynamic display for Type 2 ERS ~~sha~~ will utilize 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 ~~sha~~ will 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.

**700-5.2.8.4 ERS Character Size and Font.** Fonts and graphics for Type 1 ERS ~~shall~~ must mimic the characteristics of fonts and graphics defined in the MUTCD and SHS. Fonts and graphics for Type 2 ERS ~~sha~~ will exactly match the characteristics of fonts and graphics defined in the MUTCD and SHS.

**700-5.2.8.5 Variable Speed Limit ERS Controller Communications.** ERS for variable speed applications ~~shall~~ must be equipped with a sign controller that includes a minimum of 1 Ethernet 10/100 Base TX 8P8C port.

**700-5.2.8.6 Configuration and Management Requirements for Variable Speed Limit 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 will 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 Florida Department of Transportation Traffic Engineering Research Laboratory at: <http://www.dot.state.fl.us/trafficoperations>. 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 FDOT SunGuide® software.

**700-5.2.812.7 ERS Battery Backup System.** AC powered signs must include a battery backup system that maintains full operation of the sign for a minimum of 2 hours in the event of utility power loss. Operation on battery backup can have no visible effect on the appearance of the display.

**700-5.2.911 Blank-Out Signs.** ERS designed for BOS applications shall have a black exterior finish (Federal Standard 595A-37038) with a reflectance value not exceeding 25 percent. BOS shall include a visor.

~~700-5.2.12 ERS Battery Backup System. AC powered signs shall must include a battery backup system that maintains full operation of the sign for a minimum of 2 hours in the event of utility power loss. Operation on battery backup shall can have no visible effect on the appearance of the display.~~

**700-5.2.103 Electronic Speed Feedback Signs.** The ESFS must be designed to alert road users of their speed as they approach the sign.

**700-5.2.103.1 ESFS Background/Foreground Colors.** The ESFS display background must be flat black (Federal Standard 595A-37038) with a reflectance value not exceeding 25 percent. ESFS must utilize amber LEDs with a peak wavelength of 590 nanometers. ESFS shall have a minimum 1-inch contrasting margin around illuminated characters or graphics.

**700-5.2.103.2 Speed Detector.** The ESFS shall 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 will 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 shall detect when the posted speed is exceeded by 1 mph and then activate the alert. When the alert is activated, the display shall flash at a rate of 50 to 60 cycles per minute. When no advancing traffic is detected, the display shall be blank. The speed detector shall not activate alerts or display speeds for vehicles outside the display's cone of vision. ~~The speed detector shall and not be affected by normal radio transmissions. The ESFS shall must meet the requirements of FCC Part 90. The ESFS shall and not require an FCC operating license. The speed detector shall must operate on 10.8 to 16.6 VDC. The ESFS shall monitor and display the speed of approaching traffic only. The ESFS detector shall be able to accurately detect and determine the speed of approaching vehicles. The ESFS shall be able to detect a motorized vehicle 1,000 feet in advance of the sign. The ESFS shall must be capable of~~

measuring speeds of approaching traffic between 10 and 99 mph with an accuracy of plus or minus 1 mph, 1,000 feet in advance of the sign.

**700-5.2.114 Environmental Requirements.** The electronic display ~~shall~~ must meet the environmental requirements in Section A615 and ~~The display shall be~~ designed and constructed in a manner that prohibits fogging, frost, or condensation from forming within the dynamic portion of the sign.

**700-5.2.125 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 3 years.

**700-5.3 Installation.**

For EDS within the clear zone, meet the crash testing requirements of NCHRP 350 OR MASH 2009.

**700-5.43 Method of Measurement.**

The contract unit price per assembly ~~each~~ for electronic display sign, furnished and installed, will include ~~furnishing~~ the static sign panels, electronic display, support structure, foundation, housing, cabinet, controller, speed detector, hardware, electrical connection, and labor necessary for a complete and accepted installation. When the electronic display sign is ground mounted, the contract price will include the support structure and foundation. All other mounting will include the hardware necessary to complete the attachment to the support structure; the span wire, monotube, or mast arm structure will be paid separately.

When a solar panel is specified ~~called for~~ in the eContract ~~d~~ Documents, the contract price will include the solar panel and batteries.

**700-5.54 Basis of Payment.**

Price and payment will be full compensation for all work specified in this Section.

Payment will be made under:

Item No. 700- ~~911-~~ Electronic Display Sign, per assembly ~~each~~.

**700-6 Flashing Sign Beacon Assemblies.**

**700-6.1 Description.**

Furnish and install flashing beacon assemblies as shown in the plans.

**700-6.2 Materials.**

Use flashing beacon assemblies and components listed on the APL. Ensure ~~that all~~ equipment is permanently marked with manufacturer name or trademark, part number, date of manufacture, or serial number ~~in accordance with Section 603~~. Flashing beacon assemblies incorporating a circular traffic signal must meet the design and functional requirements set forth in MUTCD Chapter 4L. All circular beacons must have a minimum nominal diameter of 12 inches and meet the requirements of A650-3 of the MSTCSD. All beacons must use a light-emitting diode (LED) light source. Beacons designed for use with school zone signing must include a means of calendar scheduling to program days and times of operation.

**700-6.2.1 Vehicle Activated Beacon:** Vehicle activated beacons ~~sha~~ will utilize a vehicle detection system ~~currently~~ listed on the ~~FDOT's~~ APL.

**700-6.2.2 Pedestrian Activated Beacon:** Pedestrian activated beacons ~~sha~~ will utilize a pedestrian detector ~~currently~~ listed on the ~~FDOT's~~ APL.

**700-6.2.3 Cabinets, Housings, and Hardware:** *Flashing beacon cabinets must be currently listed on FDOT's APL or meet the applicable criteria of A676 of the MSTCSD.*

*All housings, other than pole-mounted cabinets, must be powder coated ~~paint~~ dull black (Federal Standard 595A-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.*

*Flashing beacon assemblies ~~shall~~ must allow installation on 4.5 inch outer diameter posts.*

*Ensure all exposed ~~all~~ assembly hardware including nuts, bolts, screws, and locking washers less than 5/8 inch in diameter, is Type 304 or 316 passivated stainless steel and meets 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.*

**700-6.2.4 Electrical Specifications:** *Provide equipment that operates on solar power or a nominal voltage of 120 volts alternating current (VAC). If the device requires operating voltages of less than 120 VAC, supply the appropriate voltage converter. Solar powered beacon systems must be designed to provide 10 days of continuous operation without sunlight. ~~Solar powered systems~~ and must automatically charge batteries and prevent overcharging and over-discharging. Solar powered systems must include a charge indicator and AC/DC battery charger.*

**700-6.2.5 Environmental Specifications:** *All electronic assemblies ~~shall~~ must 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. All electronic equipment must comply with Federal Communications Commission, Title 47 Subpart B Section 15.*

### **700-6.3 Installation.**

*Install equipment according to the manufacturer's instructions. Flashing beacons installations must meet MUTCD Chapter 4L. Install beacons used for school signs in accordance with Design Standards.*

*For EDS within the clear zone, meet the crash testing requirements of NCHRP 350 or MASH 2009.*

### **700-6.4 Warranty.**

*Ensure all flashing beacons have a manufacturer's warranty covering defects for a minimum of five years from the date of final acceptance in accordance with 5-11 and Section 608. Ensure the manufacturer will furnish replacements for any part or equipment found to be defective during the warranty period at no cost to the Department or maintaining agency within 30 calendar days of notification.*

### ~~700-6.5 Method of Measurement.~~

~~700-6.5.1 General: Measurement for payment will be in accordance with the following work tasks.~~

~~700-6.5.2 Furnish and Install: The Contract unit price for each flashing beacon assembly, furnished and installed, will consist of the flashing beacon assembly, including all attachment hardware necessary to make a complete unit, all mounting brackets, labor, and materials necessary for a complete and accepted installation.~~

~~700-6.5.3 Furnish: The Contract unit price for each flashing beacon assembly, furnished, will include the cost of all components of a flashing beacon assembly including all attachment hardware and mounting brackets, plus all shipping and handling cost involved in delivery as specified in the Contract Documents.~~

~~700-6.5.4 Install: The Contract unit price for each flashing beacon assembly, installed, will consist of all labor necessary to assemble all flashing beacon assembly components for a complete and accepted installation.~~

~~The Engineer will supply all flashing beacon assembly components. The Contractor shall furnish any required minor miscellaneous standard hardware items, such as nuts and bolts, as part of the installation task.~~

~~700-6.6 Basis of Payment.~~

~~No separate payment will be made for a flashing beacon assembly. When attached to a sign, payment will be made under the appropriate sign in Section 700. When used as an Intersection control Beacon, payment will be made under the applicable signal items.~~

#### **700-6.5 Method of Measurement.**

~~The contract unit price for each ground mounted flashing sign beacon assembly, furnished and installed, will consist of the flashing beacon(s), static sign panel, cabinet, housing, controller, support structure, foundation, hardware, and labor necessary for a complete and accepted installation. Signal cable from the cabinet to the sign(s) will be paid separately under the applicable item for signal cable. When solar power is specified in the Contract Documents, the contract price will include the solar panel, batteries, and electronics.~~

~~The contract unit price for each span wire mounted flashing beacon assembly, furnished and installed, will consist of the flashing beacon, static sign panel, and hardware necessary for a complete and accepted installation. The signal cable, span wire, and support structure will be paid separately, under the applicable pay items.~~

#### **700-6.6 Basis of Payment.**

~~Price and payment will be full compensation for all work specified in this Section.~~

~~Payment will be made under:~~

~~Item No. 700- 912- Flashing Sign Beacon Sign, per assembly each~~

~~700-3.9 Electronic Display Signs: Use electronic display signs and mounting hardware that meet the requirements of the MSTCSD and are listed on the Department's Approved Products List.~~

~~Use only new signs and mounting hardware.~~

~~Provide signs marked in accordance with Section 603 and ensure the markings are visible after installation.~~

~~Provide installation guides and operator's manuals for each EDS. Ensure the manuals include functional block diagrams and wiring diagrams; with information required to operate, maintain, troubleshoot, and repair the EDS; and with recommended maintenance and calibration procedures.~~

~~Ensure signs have a manufacturer's warranty covering defects in assembly, fabrication, and materials for a minimum of three years from the date of final~~

acceptance in accordance with 5-11. Ensure Guaranties on EDS comply with Section 608.

700-4 Preparation of Sign Blanks.

~~700-4.1 De-greasing and Etching for Aluminum Sign Blanks:~~

~~700-4.1.1 General:~~ Prior to the application of retroreflective sheeting, use any of the methods shown below to de-grease and etch the aluminum sign blanks.

~~700-4.1.2 Hand Method:~~ Under this method, de-grease and etch the blanks in one operation, using steel wool (medium grade) with any of the following combinations of materials:

~~(1) An abrasive cleanser of a commercial grade kitchen scouring powder.~~

~~(2) Acid and a suitable detergent solution.~~

~~(3) An alkaline solution.~~

~~Thoroughly rinse the blanks with clean water following all hand de-greasing operations.~~

~~700-4.1.3 Power Washer Method:~~ Under this method, de-grease the blanks with an inhibited alkaline cleanser, by spraying for 90 seconds with the solution between 135 and 249°F, the exact temperature to be as recommended by the manufacturer of the cleanser. After the spraying, rinse the blanks with clean water. Then etch the blanks by immersing them in a 6 to 8% solution of phosphoric acid at a temperature of 100 to 180°F for 60 seconds. After immersion, rinse the blanks in clean water.

~~700-4.1.4 Immersion Method:~~ Under this method, de-grease the blanks by immersing them in a solution of inhibited alkaline cleanser at a temperature between 160 and 180°F for three to five minutes, and then rinsing with clean water. Then etch blanks by immersing them in a 6 to 8% solution of phosphoric acid at a temperature of 100°F for three minutes. After immersion, rinse the blanks in clean water.

~~700-4.1.5 Vapor De-greasing Method:~~ Under this method, de-grease the blanks by totally immersing them in a saturated vapor of trichloroethylene. Remove trademark printing with lacquer thinner or a controlled alkaline cleaning system.

~~700-4.1.6 Alkaline De-greasing Method:~~ De-grease the blanks by totally immersing them in a tank containing an alkaline solution, controlled and titrated in accordance with the solution manufacturer's directions. Adapt immersion time to the amount of soil present and the thickness of the metal. After immersion, thoroughly rinse the blanks with running water.

~~700-4.1.7 Etching Method when De-greasing is Separate Operation:~~ If using either of the de-greasing methods described under 700-4.1.5 and 700-4.1.6, accomplish etching by one of the following alternate methods:

~~(1) Acid Etch:~~ Etch well in a 6 to 8% phosphoric acid solution at 100°F, or in a proprietary acid etching solution. Rinse thoroughly with running cold water, which may be followed by a hot water rinse.

~~(2) Alkaline Etch:~~ Etch aluminum surfaces in an alkaline etching material that is controlled by titration. Meet the time, temperature, and concentration requirements specified by the solution manufacturer. After completing etching is complete, rinse the panel thoroughly.

~~———— **700-4.2 Drying:** Dry the panels using a forced air drier. Use a device or clean canvas gloves, to handle the material between all cleaning and etching operations and the application of retroreflective sheeting. Do not allow the metal to come in contact with greases, oils or other contaminants prior to the application of retroreflective sheeting.~~

~~———— **700-4.3 Fabrication of Sign Blanks:** Fabricate all metal parts to ensure a proper fit of all sign components. Complete all fabrication, with the exception of cutting and punching of holes, prior to metal de-greasing and applying the retroreflective sheeting. Cut metal panels to size and shape and keep free of buckles, warp, dents, burrs, and defects resulting from fabrication. Provide all sign panels with a flat surface.~~

~~700-5 Fabrication of Retroreflectorized Sign Faces.~~

~~———— **700-5.1 Application of Sheeting:** Apply retroreflective sheeting to the base panels with mechanical equipment in a manner specified for the manufacture of traffic control signs by the sheeting manufacturer. Ensure that sheeting applied to extruded aluminum sections adheres over and around the side legs of all panels to a minimum distance of 1/16 inch beyond the radius of top edge.~~

~~———— Match sign faces comprising two or more pieces of retroreflective sheeting for color and retroreflectivity at the time of sign fabrication. Reverse and apply consecutively alternate successive width sections of either sheeting or panels to ensure that corresponding edges of sheeting lie adjacent on the finished sign. The Engineer will not accept nonconformance that may result in non-uniform shading and an undesirable contrast between adjacent widths of applied sheeting.~~

~~———— **700-5.2 Finish:** Seal retroreflective sheeting splices and sign edges with materials the sheeting manufacturer supplies in a manner the sheeting manufacturer specifies for traffic control signs.~~

~~———— **700-5.3 Screening on Message:** Screen message and borders on retroreflective sheeting in accordance with the recommendations of the ink or overlay manufacturer. Process either before or after applying the sheeting to the base panels.~~

~~———— **700-5.4 Finished Sign Face:** Provide finished signs with clean cut and sharp messages and borders. Ensure that finished background panels are essentially a plane surface.~~

~~———— **700-5.5 Stenciling:** For permanent roadway signs, mark the back of all finished panels at the bottom edge with “FDOT”, the date of fabrication, the date of installation, and the fabricator’s initials. Make the markings unobtrusive, but legible enough to be easily read by an observer on the ground when the sign is in its final position. Apply the markings in a manner that is at least as durable as the sign face.~~**700-6-7 Acceptance of Signs.**

~~———— **700-67.1 Manufacturer’s Certification and Recommendations:** Ensure that the sign manufacturer certifies that the delivered signs conform to this Section and provides recommendations for storing and repairing signs.~~

~~———— **700-67.2 Packaging and Shipping:** Have the manufacturer package and ship the signs in a manner which will minimize possible damage.~~

~~———— **700-67.3 Storage of Signs:** If signs are stored prior to installation, store them in accordance with the manufacturer’s recommendations.~~

~~———— **700-67.4 Sign Inspection:** Do not install signs until the Engineer inspects them for conformance with this Section. Provide all manufacturer certifications and recommendations prior to the Engineer’s inspection. The Engineer will inspect the signs~~

upon delivery to the storage or project site and again at the final construction inspection. Repair and replace signs deemed unacceptable by the Engineer at no expense to the Department.

—————**700-67.5 Imperfections and Repairs:** Repair and replace signs containing imperfections or damage regardless of the kind, type, or cause of the imperfections or damage. Make repairs according to the manufacturer's recommendations and to the satisfaction of the Engineer. Ensure that completed repairs provide a level of quality necessary to maintain the service life warranty of the sign and are satisfactory in appearance to the Engineer.

—————**700-67.6 Electronic Display Signs:** In addition to the requirements of this Section, meet the requirements of Section 611.

700-7-8 Foundations.

—————**700-78.1 Footings:**

—————**700-78.1.1 Excavation and Backfilling:** Perform excavation and backfilling for the footings in accordance with Section 125, with the exceptions that no specific density is required and that the backfill may be tamped in 4 inches maximum layers. Use material that is at near optimum moisture and neither dry or saturated, and tamp to the extent directed by the Engineer. The Department may require that the backfilling be done with poured concrete.

—————Install spread footings which support sign structures overhanging the roadway as required in 455-25 through 455-37.

—————**700-78.1.2 Mixing and Placing Concrete:** For batching and mixing of concrete for footings, meet the requirements of Section 346, except that the Engineer will allow hand mixing by approved methods where the quantity to be mixed does not exceed  $1/2 \text{ yd}^3$ . Use cast in place or precast concrete for the footings. Obtain precast concrete footings from a plant that is currently on the list of Producers with Accepted Quality Control Programs. Producers seeking inclusion on the list shall meet the requirements of 105-3.

—————**700-78.1.3 Forms:** The Engineer will not require forms when the ground is sufficiently firm, in which case, sufficiently moisten the adjacent earth to prevent it from absorbing the moisture from the concrete. Where forms are required and the soil is not moist, place sufficient water, as directed by the Engineer, in the hole, and pour the concrete as soon as the water has been absorbed. Place at least 4 inches of loose earth, free from clods or gravel, over the top of the footing to effect curing.

—————**700-78.1.4 Finishing Concrete:** Trowel the top of the concrete to a smooth finish.

—————**700-78.2 Drilled Shafts:** Meet the requirements of Section 455.

700-8-9 Erection of Signs and Sign Supports.

—————Do not erect overhead sign supports until the concrete strength in the support footing is at least 2,500 psi. Determine concrete strength from tests on a minimum of two test cylinders sampled and tested in accordance with ASTM C 31 and ASTM C 39 and verifying test results have been provided to the Engineer.

—————Erect the signs and sign structures in accordance with the details shown in the Plans. The Contractor may fabricate the structural steel sign trusses in sections that will fit into available galvanizing vats. Prior to galvanizing, weld the joints as specified in

~~460-6 and in accordance with the details shown in the Plans. Re-galvanize damaged parts as specified in Section 562.~~

~~————Weld aluminum structures in accordance with 965-3.~~

~~————Attach electronic display signs to the supporting structure in accordance with the manufacturer's recommendations using the mounting hardware provided by the manufacturer.~~

~~700-9-10 Removal or Relocation of Signs.~~

~~————Relocation of signs shall consist of removing the existing sign assembly and installing the sign on a new foundation.~~

~~————When the Plans call for existing ground-mounted signs to be relocated or removed, immediately remove supports and footings that project more than 6 inches above the ground surface after removing the sign panel from the assembly. Remove existing footings to a depth at least 12 inches below the ground surface. Restore the area of the sign removal or relocation to the condition of the adjacent area. The costs will be included in the Contract unit price of the item to which it is incidental.~~

~~————Notify the Engineer a minimum of 30 days prior to removal of existing Logo sign structures.~~

~~700-10-711 Overlay Existing Sign Panels.~~

~~————Use 0.040 inch thick aluminum sheeting for overlays larger than 3 square feet placed on a sign panel. Replace hex head bolts on the sign surface using stainless steel flat head machine screws with nuts and lock washers to give a flat surface for the overlay panel. Install the overlay panels starting at the edge away from traffic. Place each panel against the sign using a clamp at the top to hold the panel in place. Drill 1/8 inch holes 1 inch inside the panel edge every 6 inches to 8 inches and install 1/4 inch to 3/8 inch length pop rivets. Install additional rivets along the outer edge 6 inches to 8 inches. Place the remaining panels using the same procedure with the overlap in the direction away from the traffic and with rivets along the overlap on 12 inch centers.~~

~~700-11-12 Method of Measurement.~~

~~————The quantities to be paid for will be:~~

~~————(1) The number of ground traffic signs of each designated class of assembly, complete.~~

~~————(2) The number of lighted overhead traffic signs of each designated class of assembly, complete.~~

~~————(3) The number of existing signs removed, relocated, modified of each designated class of assembly, complete.~~

~~————(4) The number of overhead signs span wire mounted, bridge mounted, and lighted sequential, of each designated class of assembly, complete.~~

~~————(5) The number of electronic display signs, of each designated class of assembly, complete.~~

~~————(6) The number of flashing beacon signs, of each designated class of assembly, complete.~~

~~————For the purpose of payment, a sign assembly consists of all the signs mounted on a single structure (one, two or three posts, or overhead structure) or all the signs on a bridge mounted sign structure and the sign structure.~~

**700-12-13 Basis of Payment.**

Price and payment will be full compensation for furnishing and installation of all materials necessary to complete the signs in accordance with the details shown in the Plans; including sign panels complete with sheeting, painting, and message; sign posts and supports, foundations, excavation, etc.; for lighted signs, include all costs of the electrical installation for lighting, up to the point of connection by others; for flashing beacon signs, include all costs of beacons, controllers, and electrical installation, up to the point of connection by others; and all other work specified in this Section, including all incidentals necessary for the complete item.

**HIGHWAY SIGNING.****(REV 7-29-13)**

SECTION 700 (Pages 826 – 833) is deleted and the following substituted:

**SECTION 700  
HIGHWAY SIGNING****700-1 General Requirements.****700-1.1 Description.**

Furnish and erect roadway signs, at the locations shown in the Plans, in accordance with the details shown in the Plans.

The Department designates ground traffic signs as signs erected on the shoulders, slopes, or medians, but not extending over the traveled roadway, and may further classify these signs as single post or multi-column.

The Department designates signs erected partially or completely over the traveled roadway or mounted on bridges as overhead traffic signs, and may further classify these signs as overhead cantilever or span traffic signs.

**700-1.2 Materials.**

**700-1.2.1 General:** Meet the materials requirements shown in the Specifications and Design Standards and any additional requirements identified in the Plans.

**700-1.2.2 Concrete:** Use concrete meeting the requirements of Section 346. Obtain concrete from a fabrication facility that is listed on the Department's list of concrete producers with an accepted quality control program, meeting the requirements of Section 105.

**700-1.2.3 Static Sign Assembly Requirements:** All sign panels shall be aluminum unless otherwise shown in the plans. Sheets and plates for sign panels shall meet the requirements of ASTM B 209, Aluminum Association Alloy 6061-T6, 5154-H38 or 5052-H38. Sign panels for single column ground mounted signs shall utilize aluminum plate with a minimum thickness of 0.08 inches. All other sign panels shall utilize aluminum plate with a minimum thickness of 0.125 inches. All panels shall have rounded corners.

**700-1.2.4 Retroreflective Sign Sheeting:** Use signs that meet the material and process requirements of Section 994.

Use Type XI sheeting for all regulatory, warning and overhead signs. The R1-1, R1-2, R5-1 and R5-1a signs must use a sheeting system that includes a colorless film overlay.

Type XI sheeting shall also be used for all limited access advance exit and exit guide signs.

Use Type IV yellow-green fluorescent sheeting for school S1-1, S3-1, S4-3, S4-5 and supplemental panels used with S1-1 signs. Do not mix signs having fluorescent yellow-green sheeting with signs having yellow retroreflective sheeting.

Use fluorescent orange for all work zone signs. Roll-up signs shall meet the requirements of Type VI sheeting.

Use Type IV sheeting for all other signs.

**700-1.3 Sign Fabrication Requirements.**

Multi-post and overhead sign structures shall be fabricated in a facility that is listed on the Department's list of fabricators with an accepted quality control program, meeting the requirements of Section 105.

#### **700-1.4 Storage, Handling and Labeling.**

If signs are stored prior to installation, store them in accordance with the manufacturer's recommendations. Properly package signs to protect them during storage, shipment and handling to prevent damage to the sign face and panel.

In addition to the information required in Section 994, all permanent roadway signs must be labeled on the back bottom edge with the date of installation. Make the labels unobtrusive, but legible enough to be easily read by an observer on the ground when the sign is in its final position. Apply the label in a manner that is at least as durable as the sign face.

#### **700-1.5 Acceptance of Signs.**

**700-1.5.1 Sign Inspection:** The Contractor shall provide certification that the sign assembly meet the material and installation requirements of the contract. The Engineer will inspect the signs upon delivery to the storage or project site and again at the final construction inspection. Repair and replace signs deemed unacceptable by the Engineer at no expense to the Department.

**700-1.5.2 Imperfections and Repairs:** Repair or replace signs containing imperfections or damage regardless of the kind, type, or cause of the imperfections or damage. For sign panels exceeding 30 square feet, the contractor may make 1 patch, if necessary, to each sign panel not to exceed 2 square inches. Make repairs according to the manufacturer's recommendations and to the satisfaction of the Engineer. Ensure that completed repairs provide a level of quality necessary to maintain the service life of the sign and are satisfactory in appearance to the Engineer.

### **700-2 Static Signs.**

#### **700-2.1 Ground Mounted Signs.**

Ground mounted signs consist of both single column and multi-column static signs.

**700-2.1.1 Materials:** Use aluminum tubing materials meeting the general provisions of Section 965 for all single column ground signs. Multi-column signs must be galvanized steel W or S beams steel columns meeting the general provisions of Section 962. All Materials must meet the requirements of the appropriate Design Standard.

#### **700-2.1.2 Fabrication of Panel Messages:**

Fabricate standard sign panel messages in accordance with details included in the Standard Highway Signs Manual published by the U.S. Department of Transportation. Submit shop drawings to the Department for approval as specified in Section 5.

**700-2.1.3 Foundation:** Foundations shall be constructed in accordance with applicable Design Standards. Contractor may use precast foundations in augured or excavated holes a minimum of 12 inches larger than each axis dimension of the precast foundation. The holes must be clean and without loose material. Temporary casing will be required if the soil is unstable. Fill the void around the precast foundation with flowable fill meeting the requirements of Section 121 or clean sand placed using hydraulic methods.

**700-2.1.4 Breakaway Support Mechanisms for Ground Traffic Signs:**

**700-2.1.4.1 Frangible Supports:** Provide support posts for all frangible sign assemblies consisting of aluminum tubes up to 3 1/2 inches outside diameter with 3/16 inch wall thickness in accordance with the requirements in the Design Standards.

**700-2.1.4.2 Slip Bases:** Slip base assemblies for single column signs will use aluminum sleeves and base plates. Slip base assemblies for multi-column signs will use galvanized steel bases. All slip bases must be fabricated in accordance with the requirements of the Design Standards.

**700-2.1.5 Installation:** It is the Contractor's responsibility to verify the length of the column supports in the field prior to fabrication to permit the appropriate sign mounting height. Fabricate the supports and wind beams in accordance with the Design Standards. Panels must be level with the proper orientation.

**700-2.2 Overhead Signs.****700-2.2.1 Materials:**

**700-2.2.1.1 General:** Obtain reinforcing steel, multi-post and overhead sign structures from a fabrication facility that is listed on the Department's list of steel producers with an accepted quality control program, meeting the requirements of Section 105.

Only use structural steel, including bolts, nuts, and washers, that have been hot dip galvanized or metalized after fabrication. Perform hot dip galvanizing in accordance with Section 962 and metalizing in accordance with Section 562.

For galvanized steel members, meet the general requirements of Section 962. Obtain galvanized steel from a fabrication facility that is listed on the Department's list of galvanizers with an accepted quality control program, meeting the requirements of Section 105.

Use a galvanizing compound as specified in Section 975. Use a galvanizing repair compound listed on the QPL for large areas as defined in Section 975.

**700-2.2.1.2 Reinforcing Steel:** Use reinforcing steel in footings meeting the requirements of Section 415.

**700-2.2.1.3 Specific Uses of Aluminum and Galvanized Steel:** Use aluminum bolts, nuts, and hardware to connect parts of the cast base.

Use galvanized steel anchor bolts for anchoring base plates to concrete bases and for the nuts and washers.

For all other metal parts of the cast base, the Engineer will allow galvanized steel as an alternative to aluminum.

**700-2.2.2 Foundations:** Meet the requirements of Section 455.

**700-2.2.3 Installation:** Install nuts on anchor bolts in accordance with Section 649 with one exception. For cantilever overhead sign structures, after placement of the upright and prior to installation of the truss, adjust the leveling nuts beneath the base plate to achieve the back rake shown on the Camber Diagram. If the top surface of the base plate has a slope that exceeds 1:40, use beveled washers under the top nuts.

Use ASTM A325 bolt, nut and washer assemblies for all installations other than anchor bolts as follows. Use bolt, nut and washer assemblies that

are free of rust and corrosion and that are lubricated properly as demonstrated by being able to easily hand turn the nut on the bolt thread for its entire length. Tighten nuts to a snug-tight condition to bring the faying surfaces of the assembly into full contact which is referred to as snug-tight. Snug-tight is defined as the maximum nut rotation resulting from the full effort of one person on a 12 inch long wrench or equivalent. After bringing the faying surfaces of the assembly into full contact and to a snug-tight condition, tighten nuts to achieve the minimum torque as specified in Table 700-1 unless the connection is an alternate splice connection of a span sign structure, in which case, tighten nuts in accordance with the turn-of-nut method of Table 460-7 of Section 460. Maintain uniform contact pressure on the faying surfaces during snugging and the subsequent final tightening process, by using a bolt tightening pattern that balances the clamping force of each bolt, as closely as possible, with the equal clamping force of a companion bolt. Within 24 hours after final tightening, the Engineer will witness a check of the minimum torque using a calibrated torque wrench for 3 bolts or a minimum of 10% of the bolts, whichever is greater, for each connection; however, do not perform this check on alternate splice connections of span sign structures.

Bolt Diameter (in.)	Minimum Torque (ft.-lbs.)
3/8	15
1/2	37
5/8	74
3/4	120
7/8	190
1	275
1 1/8	375
1 1/4	525

**700-2.2.4 Erection of Signs and Sign Supports:** Do not erect overhead sign supports until the concrete strength in the support footing is at least 2,500 psi. Determine concrete strength from tests on a minimum of two test cylinders sampled and tested in accordance with ASTM C31 and ASTM C39 and verifying test results have been provided to the Engineer.

Erect the signs and sign structures in accordance with the details shown in the Plans. The Contractor may fabricate the structural steel sign trusses in sections that will fit into available galvanizing vats. Prior to galvanizing, weld the joints as specified in Section 460 and in accordance with the details shown in the Plans. Re-galvanize damaged parts as specified in Section 562.

Weld aluminum structures in accordance with Section 965.

Attach electronic display signs to the supporting structure in accordance with the manufacturer's recommendations using the mounting hardware provided by the manufacturer.

**700-2.2.5 Shop Drawings:** Submit shop drawings to the Department for approval as specified in Section 5. Prior to the submittal of the shop drawings, determine

the actual in place dimensions for all sign structures on the basis of existing field conditions and include these on the shop drawings.

### **700-2.3 Method of Measurement.**

For single post and multi post sign assemblies, an assembly consists of all the signs mounted on a single structure. The contract unit price per assembly for ground mounted signs (single post and multi-post), furnished and installed, will include furnishing the sign panels, support structure, foundation, hardware, and labor necessary for a complete and accepted installation.

For overhead signs, sign panels will be paid separately from support structures. The contract unit price per each for sign panel, furnished and installed, will include furnishing the sign panels, hardware, and labor necessary for a complete and accepted installation. The contract unit price for each overhead static sign structure, furnished and installed, will include furnishing the support structure, foundation, hardware, and labor necessary for a complete and accepted installation.

Relocation of signs will consist of removing the existing sign assembly and installing the sign on a new foundation.

When the Plans call for existing ground-mounted signs to be relocated or removed, after removing the sign panel from the assembly, remove supports and footings. Restore the area of the sign removal or relocation to the condition of the adjacent area.

### **700-2.4 Basis of Payment.**

Price and payment will be full compensation for all work specified in this Section.

Payment will be made under:

- |                  |  |
|------------------|--|
| Item No. 700- 1- | Single Post Sign, per Assembly.            |
| Item No. 700- 2- | Multi Post Sign, per Assembly.             |
| Item No. 700- 3- | Sign Panel, per Each.                      |
| Item No. 700- 4- | Overhead Static Sign Structure , per each. |

## **700-3 Illuminated Signs.**

**700-3.1 Description:** Furnish and install Illuminated Signs in accordance with the details specified in the Contract Documents.

**700-3.2 Materials:** Use illuminated signs and associated mounting hardware listed on the Department's Approved Product List (APL). Manufacturers seeking evaluation of their products must submit an application in accordance with Section 6 and include certification that shows they meet the requirements of this Section.

Signs must be marked with the name or trademark of the manufacturer, the part number, and the date of manufacturer. Marking must be accomplished by permanently affixing an indelible label, identification plate, dot peen type stamp, casting, metal-marking, or other approved method. Markings must remain visible after installation.

### **700-3.2.1 Internally Illuminated Signs:**

**700-3.2.1.1 General** Signs larger than 18.0 sq. ft. in area or weighing more than 144 lbs. are not listed on the APL and must be submitted to the Engineer for approval. Provide a UL listed internally illuminated sign assembly or equivalent.

**700-3.2.1.2 Housing** Ensure that the sign housing is constructed of continuous 5052 or 6063-T5 aluminum. All housing and door seams must be continuously welded. All corners must be welded. All exterior surfaces of the assembly must be powder-coat painted in accordance with Military Standard MIL-PRF-24712A or AAMA-2603-02. Finish must meet the requirements of ASTM D 3359, ASTM D 3363, and ASTM D 522. Sign housings with any interior airspace must consist of a box type enclosure and separate hinged door assembly. The sign housing must include provisions to prevent water from entering the sign housing. Drain holes in the sign larger than .125 inch must be covered by a screen.

Signs must have removable sign faces. The sign assembly must have one face unless specified otherwise in the plans. The sign face must be secured by a method that holds the sign face securely in place. Slide-in grooves are allowed to secure the sign face if the sign is edge lit.

The sign face must be a translucent lens constructed of 0.125 inch high impact strength polycarbonate or acrylic meeting UL48. Letters must be as detailed in the Contract Documents. Background must be translucent retroreflective sheeting coated with a transparent, pressure-sensitive adhesive film. Color must meet the criteria as detailed in Sections 994. Retroreflective sheeting must meet the requirements of Section 994, and be listed on the QPL.

If a door opens upward, it shall have a bracket on each side to secure the door in the open position during maintenance. Doors shall be permanently and continuously sealed with a foam gasket listed to UL 157 to prevent the entry of water into the sign housing. Each door must be secured from opening by a minimum of two stainless steel rotary action draw latches with an additional latch for every 6 feet of sign length.

The sign assembly must be designed and constructed to withstand 150 mph wind loads meeting the requirements of the FDOT Structures Manual.

**700-3.2.1.3 Luminance** The sign face must be illuminated evenly across the entire surface. Contrast ratio between the background and legend shall be established by the lowest and the highest color retroreflective measurement and shall be at least 4:1. Measure the retroreflectivity in accordance with ASTM D 4956.

**700-3.2.1.3.1 Background Luminance** Minimum luminance for the legend portion of the street sign face shall be no less than 87.5 lux. The luminance shall be determined by averaging a minimum of seven readings. Four of the readings shall be taken near the midpoint of a line that would span between the outside corners of the background and the outside corners of the legend. One reading shall be taken near the midpoint of a line that would connect the top corner readings. One reading shall be taken near the midpoint of a line that would connect the bottom corner readings. One reading shall be taken near the vertical and horizontal midpoint of the sign.

**700-3.2.1.3.2 Border and Lettering Luminance** Minimum luminance of the legend and border shall be 350 lux. The luminance shall be determined by averaging a minimum of 17 readings. There shall be a minimum of 1 reading from each letter in the legend. Readings within the legend shall alternate between the top, middle and bottom portion of each letter. Readings within top and bottom of the border shall be perpendicular to the top and bottom readings in the background. Readings

within the sides of the border shall be taken parallel to the readings taken within each letter.

**700-3.2.1.4 Clamp-On Cantilever Arm:** Use only clamp-on cantilever arms which meet all design and wind loading requirements as specified in the Contract Documents. Ensure the clamp is adjustable to accommodate various size poles.

**700-3.2.2 Highlighted Signs:**

**700-3.2.2.1 General.** Ensure highlighted signs meet the design and functional requirements set in this Section, Section 2A of the MUTCD and use Light Emitting Diodes (LEDs) to highlight as sign's shape, color, or message.

Stop, Do Not Enter, Yield, and Wrong Way signs that are highlighted with LEDs must use red LEDs. All other signs must use LEDs which resemble the color of the sign background color.

**700-3.2.2.2 Performance Requirements.** Ensure highlighted signs are capable of automatically dimming to reduce brightness of the LEDs at nighttime.

Ensure highlighted signs that rely upon solar power or batteries are capable of at least 10 days of continuous operation without the need for charging.

**700-3.2.3 Cabinets.**

If the illuminated sign assembly includes a cabinet, the cabinet must be currently listed on the APL or meet the applicable cabinet material requirements listed in specification A676 of the MSTCSD.

**700-3.2.4 Mechanical Requirements.**

Ensure all assembly hardware, including nuts, bolts, external screws and locking washers less than 5/8 inch in diameter are Type 304 or Type 316 passivated stainless steel. 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 A325.

**700-3.2.5 Electrical Requirements.**

Electrical wiring must meet NEC requirements for the light source provided. All wiring must be copper wire. All internal electrical wiring must be tight and secure. Ensure the sign includes an accessible electrical power service entrance compartment (internal or external) for connection of field wiring. External compartments must be weather-tight. All power supplies and ballasts must be FCC approved.

Ensure battery connections are protected against corrosion. All signs will have provisions for an integrated photocell.

**700-3.2.6 Environmental Requirements.**

Ensure that the illuminated sign assembly operates 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.

**700-3.2.7 Submittal Requirements for Internally Illuminated signs.**

**700-3.2.7.1 General:** Free-swinging, internally illuminated signs and clamp-on cantilever arms mounted on the upright poles of mast arm assemblies or monotube signal structures may be accepted either by certification or by shop drawing submittal and approval as stipulated in this Section.

**700-3.2.7.2 Acceptance of signs by Certification:** Provide evidence the sign has been reviewed, approved and is listed on the APL.

**700-3.2.7.3 Acceptance of signs by Shop Drawing Approval:** Submit Shop Drawings for internally illuminated signs larger than 18.0 sq. ft. in area or weighing more than 144lbs. Signs submitted for acceptance by shop drawing approval must be manufactured by a vendor with an approved internally illuminated sign listed on the APL.

**700-3.2.7.4 Acceptance of Clamp-On Cantilever Arms:** For cantilever arms supporting signs less than 18 sq. ft. in area or weighing less than 144 lbs, certify to the Engineer that the arm meets the criteria in this section.

**700-3.3 Installation for Internally Illuminated Signs.**

**700-3.3.1 General:** Secure the brackets to the sign housing in accordance with the manufacturer's instructions.

**700-3.3.2 Single Sided Sign Assembly:** Install as specified in the Contract Documents.

**700-3.3.3 Double Sided Sign Assembly:** Use a free swinging mounting method.

**700-3.3.3.1 Two Point Support Assembly:** Use a two point support assembly when the sign assembly is attached to a mast arm that is perpendicular to the street on which the sign is viewed.

Use a two point mast arm mounting assembly consisting of the following:

1. Stainless steel band or cable type clamp,
2. Clevis,
3. Span wire adapter,
4. Tri-stud hanger body.

Ensure one of the hangers has a mechanism for the horizontal adjustment of the sign.

**700-3.3.3.2 One Point Support Assembly:** Use a one point support assembly consisting of an articulated horizontal stainless steel band or cable type mast arm clamp, sign bracket and mounting hardware, when the sign assembly is attached to a mast arm that is diagonal to the street on which the sign is viewed. Do not use a one point support assembly for internally illuminated sign assemblies exceeding 4 feet in width.

Ensure the band or cable clamp is capable of horizontal rotation of 360 degrees.

**700-3.3.3.3 Clamp-On Cantilever Arm:** Attach the arm perpendicular to the street on which the sign assembly is viewed. Use a clamp and arm that are galvanized in accordance with ASTM A123 unless otherwise shown on the plans. Ensure the arm has a cap secured in place.

**700-3.3.4 Electrical Wiring:** Unless otherwise shown on the plans, install dedicated 14 AWG conductors to supply power to the sign and connect the conductors to a dedicated 15 amp circuit breaker located either inside the controller cabinet or inside the electrical service disconnect. Using the same conduit system for both signal cables and internally illuminated sign conductors is permitted, unless otherwise shown on the plans.

Install conductors in such a manner as to prevent damage to conductors or conductor insulation. Remove and replace all damaged conductors /insulation at no additional cost to the Department.

Ensure drilled hole(s) through which conductor(s) pass through are fitted with a weather tight rubber grommet fitting.

Install continuous lengths of conductors between the dedicated circuit breaker and internally illuminated signs.

Do not splice conductors unless otherwise shown on the plans.

Provide one photoelectric cell for all internally illuminated signs at each intersection. Use an 'L' bracket to mount the photoelectric cell as specified in the Contract Documents. Connect the photoelectric cell to a contactor assembly inside the controller cabinet to provide switching of the internally illuminated signs.

#### **700-3.3.5 Warranty.**

**700-3.3.5.1 Internally Illuminated Signs:** Ensure that Internally Illuminated Signs have a manufacturer's warranty covering defects for five years from the date of final acceptance by the Engineer in accordance with 5-11 and Section 608.

**700-3.3.5.2 Highlighted Signs:** Ensure that Highlighted Signs have a manufacturer's warranty covering defects for three years from the date of final acceptance by the Engineer in accordance with 5-11 and Section 608.

#### **700-3.4 Method of Measurement.**

The contract unit price per each for internally illuminated signs, furnished and installed, will include furnishing the sign panels, housing, hardware, electrical connection, and labor necessary for a complete and accepted installation. When the internally illuminated sign is ground mounted, the contract price will include the support structure and foundation. All other mounting will include the hardware necessary to complete the attachment to the support structure; the span wire, monotube, or mast arm structure will be paid separately.

The contract unit price per each for highlighted signs, furnished and installed, will include furnishing the sign panels, support structure, foundation, hardware, solar panel, and labor necessary for a complete and accepted installation.

#### **700-3.5 Basis of Payment.**

Price and payment will be full compensation for all work specified in this Section.

Payment will be made under:

- |                  |   |
|------------------|---|
| Item No. 700- 5- | Internally Illuminated Signs, per each. |
| Item No. 700- 6- | Highlighted Signs, per assembly.        |

#### **700-4 Dynamic Message Signs .**

**700-4.1 Sign Types:** Dynamic Message Signs (DMS) must meet the requirements of NEMA TS4-2005. Dynamic Message Signs 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 Department's Approved Product List (APL).

**700-4.1.1 Front Access DMS:** Ensure that front access signs meet the requirements of NEMA TS4 2005, section 3.2.5.

**700-4.1.2 Walk-in DMS:** Ensure that walk-in signs meet the requirements of NEMA TS4 2005, section 3.2.7.

**700-4.1.3 Embedded DMS:** Embedded DMSs are DMSs that are typically mounted to Ground Traffic Signs, Overhead Traffic Signs, or Overhead Cantilever Traffic Signs.

**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 inch thick for walk-in DMS and 0.090 inch thick for front and 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 TS4 2005, 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 fifth edition (2001) American Association of State Highway and Transportation Officials (AASHTO) Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals with current addendums. 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 FDOT 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 American Society for Testing and Materials (ASTM) F 593 and ASTM F 594. All assembly hardware greater than or equal to 5/8 inch in diameter must be galvanized and meet the requirements of ASTM A 307.

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 American National Standard Institute/American Welding Society (ANSI/AWS) Structural Welding Code-Aluminum.

Ensure the sign housing meets the requirements of NEMA TS4 2005, section 3.2.8 for convenience outlets.

Manufacturers seeking evaluation of their products must submit an application in accordance with Section 6 and include certification that shows they meet the requirements of this Section.

**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 inch 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 TS4 2005, section 3.2.7.1. 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 TS4 2005, section 3.2.7.3 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 TS4 2005, section 3.2.7.2. 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 TS4 2005, section 3.2.4. 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 TS4 2005, 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. Provide 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 TS4 2005, section 3.1.6.

**700-4.2.3.1 Housing Face for Walk-in DMS:** No exposed fasteners will be 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 will 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 sign includes lens panel assemblies, ensure they are modular in design, removable, and interchangeable without misalignment of the lens panel and the light-emitting diode (LED) pixels. The lens panel assembly must consist of an environmental shielding layer coating to protect and seal the LEDs and internal electronics. The coating must be a minimum 90% ultraviolet (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 TS4 2005, 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 will report 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. A humidistat is not acceptable.

**700-4.2.7 Sign Housing Photosensors:** Ensure the sign meets the requirements of NEMA TS4 2005, section 8.8. 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.

**700-4.3 Display Modules:** Provide display modules manufactured by one source and fully interchangeable throughout the manufacturer's sign system(s). 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 TS4 2005.

**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 TS4 2005, 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 will not be exceeded under any operating condition.

Provide a pixel test as a form of status feedback to the transportation management center (TMC) from the local sign controller. 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) 1203v0239 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 the LED motherboards with a complete conformal coating of silicone resin with a minimum thickness of 0.01 inch, except for the pixels on the front of the PCB. All other PCBs must be provided with a complete conformal coating of silicone resin with a minimum thickness of 0.01 inch. Meet 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 PCBs 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 of 15 characters using an 18 inch font that meets the height to width ratio and character spacing in the Manual on Uniform Traffic Control Devices for Streets and Highways 2009 Edition (MUTCD), section 2L.04, paragraphs 05, 06, and 08.

**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 TS4 2005, 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 Federal Highway Administration (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.

**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 TS4 2005, 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 National Electrical Code (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.

Provide surge protective devices (SPD) 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 785-2. Ensure SPDs protect all electric power and data communication connections.

**700-4.6 Uninterruptible Power Supply (UPS):** If a UPS is required in the Contract Documents for walk-in DMS, ensure the UPS is installed within the sign housing or as shown in the Plans. If a UPS is required in the Contract Documents for

front access and embedded signs, ensure the UPS is installed within the control cabinet or as shown in the Plans. The UPS system must be capable of displaying the current messages on a sign when a power outage occurs for a minimum of two hours. Ensure the system uses sealed absorbed glass mat (AGM) batteries.

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

For every group of 10 or fewer DMS 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)
10 each	LED display modules
1 each	Display power supply
1 each	Uninterruptible power supply
1 each	Cable for connecting interface circuits to daughter boards
1 each	Display module cables
2 each	Surge suppression sets
1 each	Fan assembly
1 each	Time relay for fan control
10 each	Each type of small fuse ( $\leq 10$ amp)
2 each	Each type of large fuse ( $> 10$ amp)
1 each	Each type of sensor

**700-4.8 Components:** All components must meet the requirements of NEMA TS4 2005, 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 Type 304 and meet the requirements of ASTM F 593 and ASTM F 594 for corrosion resistance. Ensure that all bolts and nuts 5/8 inch and over in diameter are galvanized and meet the requirements of ASTM A 307. 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 TS4 2005, 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 TS4 2005, sections 8.9, 8.10. 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 EIA-310 19 inch rack, and include 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, Electronic Industries Alliance (EIA)-232 null modem cables (minimum of 4 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 785-4. 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 4 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 TS4 2005, section 8.7.1. Ensure that EIA-232 serial interfaces support the following:

Table 700-3 Communication Interface Requirements	
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.

**700-4.9 Message and Status Monitoring:** Ensure the DMS provides two modes of operation: (1) remote operation, where the TMC commands and controls the sign and determines the appropriate message or test pattern; and (2) local operation, where the sign controller or a laptop computer commands and controls the sign and determines the appropriate message or test pattern.

Ensure that the sign can perform the following functions:

1. Control Selection – Ensure that local or remote sign control can be selected. Ensure that there is a visual indicator on the controller that identifies whether the sign is under local or remote control.

2. Message Selection – Ensure that the sign controller can select a blank message or any one of the messages stored in the sign controller's nonvolatile memory when the control mode is set to local.

3. Message Implementation – Ensure that the sign controller can activate the selected message.

Ensure that the sign can be programmed to display a user-defined message, including a blank page, in the event of power loss.

Ensure that message additions, deletions, and sign controller changes may be made from either the remote TMC or a local laptop computer. Ensure that each font may be customized, and modifications to a font may be downloaded to the sign controller from the TMC or a laptop computer at any time without any software or hardware modifications.

Ensure that there is no perceivable flicker or ghosting of the pixels during sign erasure and writing periods.

**700-4.10 TMC Communication Specification for all DMS:** Ensure that the sign controller is addressable by the TMC through the Ethernet communications network using software that complies with the NTCIP 1101 base standard (formerly the NEMA TS 3.2 -1996 standard), including all amendments as published at the time of contract letting, the NTCIP Simple Transportation Management Framework, and conforms to Compliance Level 1. Ensure that the software implements all mandatory objects in the supplemental requirement SR-781-3-1, FDOT Dynamic Message Sign NTCIP Requirements, as published on the FDOT State Traffic Engineering and Operations Office web site at the time of contract letting. Ensure that the sign complies with the NTCIP 1102v01.15, 2101 v01.19, 2103v02.07, 2201v01.15, 2202 v01.05, and 2301v02.19 standards. Ensure that the sign complies with NTCIP 1103v02.17, section 3.

Ensure that the controller's internal time clock can be configured to synchronize to a time server using the network time protocol (NTP). NTP synchronization frequency must be user-configurable and permit polling intervals from once per minute to once per week in one-minute increments. The controller must allow the user to define the NTP server by internet protocol (IP) address.

Provide communications line circuits that are point-to-point or multipoint, and that provide full duplex asynchronous data transmissions at the rate shown in the contract documents or directed by the Engineer.

Assign each sign controller a unique address.

**700-4.11 Sign Control Software:** Ensure that the sign is provided with computer software from its manufacturer that allows an operator to program, operate, exercise, diagnose, and read current status of all sign features and functions using a laptop computer. Ensure that sign control software provides a graphical representation that visibly depicts the sign face and the current ON/OFF state of all pixels as well as allows messages to be created and displayed on the sign. Ensure that the laptop computer and sign can communicate when connected directly by an EIA-232 cable and via Ethernet. Ensure that the software will allow communication between multiple users and multiple signs across the same communication network.

**700-4.12 Sign Support Structure:** Meet the requirements of 700-2.2.

**700-4.13 Installation Requirements:** Provide walk-in DMS for locations over interstate travel lanes. Do not install the sign prior to the availability of electric power. Verify that any ventilation system incorporated within the sign is operational within 72 hours after sign installation.

Ensure that the location of the lifting eyebolts, left in place or removed, is sealed to prevent water entry after installation.

Load the initial message libraries on both the sign control software and the sign controller. The Engineer will furnish the messages to be placed in these libraries.

**700-4.14 Documentation:** Provide documentation for electronic equipment in accordance with 603-8.

**700-4.15 Licensing:** Ensure that the manufacturer grants the Department a license that allows the Department to use and internally distribute any and all sign communications protocols, operating systems, drivers, and documentation.

**700-4.16 Technical Assistance:** Ensure that a manufacturer's representative is available to assist the Contractor's technical personnel during pre-installation testing and installation.

Do not provide initial power to the sign(s) without the permission of the manufacturer's representative.

**700-4.17 Environmental Requirements:** The DMS must meet the requirements of NEMA TS4 2005, section 2.

**700-4.18 Pre-installation Field Testing:** Conduct pre-installation tests on all units at a Contractor-provided facility within the appropriate District. Perform the tests on each unit supplied to verify that no damage was done to any sign during the shipment and delivery process. Notify the Engineer a minimum of 10 calendar days before the start of any tests. Conduct all tests according to the approved test procedures detailed in this Section. Each DMS must pass the individual tests detailed below prior to installation.

**700-4.18.1 Material Inspection:** Examine each DMS carefully to verify that the materials, design, construction, markings, and workmanship comply with all applicable standards, specifications, and requirements.

**700-4.18.2 Operational Test:** Operate each DMS long enough to permit equipment temperature stabilization, and to check and record an adequate number of performance characteristics to ensure compliance with applicable standards, specifications, and requirements.

**700-4.18.3 Pre-installation Test Failure Consequence:** If any unit fails, the unit shall be corrected or another unit substituted in its place and the test repeated.

If a unit has been modified as a result of a failure, a report shall be prepared and delivered to the Engineer. The report shall describe the nature of the failure and the corrective action taken.

If a failure pattern develops, the Engineer may direct that design and construction modifications be made to all units without additional cost to the Department or an extension of the contract period.

**700-4.19 Installed Site Tests:** Conduct an approved, stand-alone equipment installation test at the field site. Test all stand-alone (i.e., non-network) functions of the field equipment using equipment installed as detailed in the Plans and as approved by the Engineer.

Complete approved data forms and turn them over to the Engineer for review and as a basis for rejection or acceptance. Provide a minimum notice of 30 calendar days prior to all tests to permit the Engineer or his representative to observe each test.

If any unit fails to pass its stand-alone test, correct the unit or substitute another unit in its place, then repeat the test.

If a unit has been modified as a result of a stand-alone test failure, prepare a report describing the nature of the failure and the corrective action taken and deliver it to the Engineer prior to re-testing the unit. If a failure pattern develops, the Engineer may direct that design and construction modifications be made to all units without additional cost to the Department or an extension of the contract period.

**700-4.20 System Testing:** Conduct approved DMS system tests on the field equipment with the master equipment including, at a minimum, all remote control functions. Display the return status codes from the sign controller for a minimum of 72 hours. Complete approved data forms and turn them over to the Engineer for review, and as a basis for rejection or acceptance.

Demonstrate the sign's ability to display the proper predefined message or remain blank when power is restored following an AC power interruption.

If the system test fails because of any subsystem component, repair that component or substitute another in its place, then repeat the test. If a component has been modified as a result of a system test failure, prepare a report and deliver it to the Engineer prior to retesting.

**700-4.21 Operational Testing:** After the system testing is successfully completed, conduct one continuous 72 hour, full-operating test prior to conducting the 60 day acceptance test. The Engineer will approve the type of tests to be conducted. Include in the tests all control, monitoring, and communications functions of the field equipment by the master equipment.

**700-4.22 Acceptance Testing:** Conduct a 60 day acceptance test after the successful completion of the approved 72 hour operational test. During the 60 day test period, limit downtime due to mechanical, electrical, or other malfunctions to a maximum total of five calendar days. If the equipment fails to operate for a total of five or more calendar days, testing will be restarted. The Engineer may select to pause and extend the 60 day test period by the number of days lost by failure and repair time in lieu of restarting the full 60 day test. The Engineer will furnish the Contractor with a letter of approval and completion stating the first and last day of the 60 day test period.

**700-4.23 Warranty:** Ensure that the DMS and HAR systems and equipment have a manufacturer's warranty covering defects for a minimum of five years from the date of final acceptance by the Engineer in accordance with 5-11 and Section 608.

**700-4.24 Method of Measurement.**

For DMS, the quantity to be paid will be each sign furnished, installed, complete in accordance with the details shown in the Plans, warranted, made fully operational, and tested in accordance with the specifications in this Section.

For DMS Support Structure, the quantity to be paid will be each structure furnished, installed, complete in accordance with the details shown in the Plans; including posts and supports, catwalks, handrails, footings, excavation, site grounding, painting, and incidentals necessary to complete the work.

**700-4.25 Basis of Payment.**

Price and payment will be full compensation for furnishing all materials and completing all work as specified in this section or shown in the Plans.

Payment will be made under:

Item No. 700- 7	Embedded Dynamic Message Sign – each.
Item No. 700- 8	Front Access Dynamic Message Sign –
each.	
Item No. 700- 9	Walk-in Dynamic Message Sign – each.
Item No. 700- 10-	Dynamic Message Sign Support Structure –
each.	

**700-5 Electronic Display Sign.****700-5.1 Description:**

All Electronic Display Signs (EDS) must meet the physical display and operational requirements for warning or regulatory signs described in the Federal Highways Administration (FHWA) Manual on Uniform Traffic Control Devices (MUTCD) and its companion document, the Standard Highway Signs Book (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 Regulatory Signs (ERS), Electronic Speed Feedback Signs (ESFS), and Blank-Out Signs (BOS).

**700-5.2 Material:**

EWS, 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. BOS are not required to include static sign attachment provisions.

Manufacturers seeking evaluation of their products must submit an application in accordance with Section 6 and include certification that shows they meet the requirements of the Section.

**700-5.2.1 Requirements common to all EDS.** All EDS must be designed to withstand the loads defined in the FDOT 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 Approved Products List (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 FDOT 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.** Cover the electronic display panel with a non-glare transparent polycarbonate face to protect and seal the dynamic display and other internal electronics. The polycarbonate face must be a minimum 90% ultraviolet (UV) opaque and resistant to fading and yellowing. Electronic displays incorporated within static signs must be mounted to the back of the static sign face. The top of polycarbonate face shall not be recessed more than 0.375 inches from the front of the static sign. The housing shall be National Electrical Manufacturers Association (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 light emitting diodes (LED) 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 2 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 percent 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 percent 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 percent intensity. Provide 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 will 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 SHS companion document. 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 electronic display must not be adversely affected by radio transmissions. 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 1 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 in order to meet or exceed visibility requirements. 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 FDOT 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 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 will 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.** AC powered signs must be capable of operation from 89-135 volts with a frequency of 60 Hz, plus or minus 3. Fluctuations in line voltage must have no visible effect on the appearance of the display.

**700-5.2.7 Electronic Warning Signs.** 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 (Federal Standard 595A-37038) with a reflectance value not exceeding 25 percent. EWS must utilize yellow LEDs with a peak wavelength of either 585 or 590 nanometers. EWS will have a minimum 1 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 will 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 1 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 will be blank. The speed detector will not activate alerts for vehicles outside the display cone of vision.

The speed detector must not be affected by normal radio transmissions, meet the requirements of FCC Part 90 and not require an FCC operating license. The speed detector will operate on 10.8 to 16.6 VDC and draw less than 3 amperes. The EWS will 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 speeds of approaching traffic between 10 and 99 mph with an accuracy of plus or minus 1 mph, 1,000 feet in advance of the sign.

**700-5.2.8 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 5 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.

**700-5.2.8.1 Foreground/Background Colors and Display Types.** Display Modules for all ERS will have a minimum 2 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.

**700-5.2.8.2 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.

**700-5.2.8.3 Scrolling Film Mechanism for Type 2 ERS.** The dynamic display for Type 2 ERS will utilize 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 will 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.

**700-5.2.8.4 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 will exactly match the characteristics of fonts and graphics defined in the MUTCD and SHS.

**700-5.2.8.5 Variable Speed Limit ERS Controller Communications.** ERS for variable speed applications must be equipped with a sign controller that includes a minimum of 1 Ethernet 10/100 Base TX 8P8C port.

**700-5.2.8.6 Configuration and Management Requirements for Variable Speed Limit 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 will 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 Florida Department of Transportation Traffic Engineering Research Laboratory at: <http://www.dot.state.fl.us/trafficoperations>. 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 FDOT SunGuide® software.

**700-5.2.8.7 ERS Battery Backup System.** AC powered signs must include a battery backup system that maintains full operation of the sign for a minimum of 2 hours in the event of utility power loss. Operation on battery backup can have no visible effect on the appearance of the display.

**700-5.2.9 Blank-Out Signs.** ERS designed for BOS applications must have a black exterior finish (Federal Standard 595A-37038) with a reflectance value not exceeding 25 percent. BOS will include a visor.

**700-5.2.10 Electronic Speed Feedback Signs.** The ESFS must be designed to alert road users of their speed as they approach the sign.

**700-5.2.10.1 ESFS Background/Foreground Colors.** The ESFS display background must be flat black (Federal Standard 595A-37038) with a reflectance value not exceeding 25 percent. ESFS must utilize amber LEDs with a peak wavelength of 590 nanometers. ESFS shall have a minimum 1-inch contrasting margin around illuminated characters or graphics.

**700-5.2.10.2 Speed Detector.** The ESFS will 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 will

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 will detect when the posted speed is exceeded by 1 mph and then activate the alert. When the alert is activated, the display will flash at a rate of 50 to 60 cycles per minute. When no advancing traffic is detected, the display will be blank. The speed detector will not activate alerts or display speeds for vehicles outside the display’s cone of vision and not be affected by normal radio transmissions. 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 VDC. The ESFS must be capable of measuring speeds of approaching traffic between 10 and 99 mph with an accuracy of plus or minus 1 mph, 1,000 feet in advance of the sign.

**700-5.2.11 Environmental Requirements.** The electronic display must meet the environmental requirements in Section A615 and be designed and constructed in a manner that prohibits fogging, frost, or condensation from forming within the dynamic portion of the sign.

**700-5.2.12 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 3 years.

**700-5.3 Installation.**

For EDS within the clear zone, meet the crash testing requirements of NCHRP 350 OR MASH 2009.

**700-5.4 Method of Measurement.**

The contract unit price per assembly for electronic display sign, furnished and installed, will include the static sign panels, electronic display, support structure, foundation, housing, cabinet, controller, speed detector, hardware, electrical connection, and labor necessary for a complete and accepted installation. When the electronic display sign is ground mounted, the contract price will include the support structure and foundation. All other mounting will include the hardware necessary to complete the attachment to the support structure; the span wire, monotube, or mast arm structure will be paid separately.

When a solar panel is specified in the Contract Documents, the contract price will include the solar panel and batteries.

**700-5.5 Basis of Payment.**

Price and payment will be full compensation for all work specified in this Section.

Payment will be made under:

Item No. 700- 11- Electronic Display Sign, per assembly.

**700-6 Sign Beacon.**

**700-6.1 Description.**

Furnish and install flashing beacon assemblies as shown in the plans.

**700-6.2 Materials.**

Use flashing beacon assemblies and components listed on the APL. Ensure equipment is permanently marked with manufacturer name or trademark, part number, date of manufacture, or serial number. Flashing beacon assemblies incorporating a circular traffic signal must meet the design and functional requirements set forth in

MUTCD Chapter 4L. All circular beacons must have a minimum nominal diameter of 12 inches and meet the requirements of A650-3 of the MSTCSD. All beacons must use a light-emitting diode (LED) light source. Beacons designed for use with school zone signing must include a means of calendar scheduling to program days and times of operation.

**700-6.2.1 Vehicle Activated Beacon:** Vehicle activated beacons will utilize a vehicle detection system listed on the APL.

**700-6.2.2 Pedestrian Activated Beacon:** Pedestrian activated beacons will utilize a pedestrian detector listed on the APL.

**700-6.2.3 Cabinets, Housings, and Hardware:** Flashing beacon cabinets must be currently listed on FDOT's APL or meet the applicable criteria of A676 of the MSTCSD.

All housings, other than pole-mounted cabinets, must be powder coated dull black (Federal Standard 595A-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.

Flashing beacon assemblies must allow installation on 4.5 inch outer diameter posts.

Ensure all exposed assembly hardware including nuts, bolts, screws, and locking washers less than 5/8 inch in diameter, is Type 304 or 316 passivated stainless steel and meets 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.

**700-6.2.4 Electrical Specifications:** Provide equipment that operates on solar power or a nominal voltage of 120 volts alternating current (VAC). If the device requires operating voltages of less than 120 VAC, supply the appropriate voltage converter. Solar powered beacon systems must be designed to provide 10 days of continuous operation without sunlight and must automatically charge batteries and prevent overcharging and over-discharging. Solar powered systems must include a charge indicator and AC/DC battery charger.

**700-6.2.5 Environmental Specifications:** All electronic assemblies must 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. All electronic equipment must comply with Federal Communications Commission, Title 47 Subpart B Section 15.

### **700-6.3 Installation.**

Install equipment according to the manufacturer's instructions. Flashing beacons installations must meet MUTCD Chapter 4L. Install beacons used for school signs in accordance with Design Standards.

For EDS within the clear zone, meet the crash testing requirements of NCHRP 350 or MASH 2009.

### **700-6.4 Warranty.**

Ensure all flashing beacons have a manufacturer's warranty covering defects for a minimum of five years from the date of final acceptance in accordance with 5-11 and Section 608. Ensure the manufacturer will furnish replacements for any part or

equipment found to be defective during the warranty period at no cost to the Department or maintaining agency within 30 calendar days of notification.

**700-6.5 Method of Measurement.**

The contract unit price for sign beacon, furnished and installed, will consist of the flashing beacon(s), cabinet, housing, controller, hardware, and labor necessary for a complete and accepted installation. Signal cable from the cabinet to the sign(s) will be paid separately under the applicable item for signal cable. When solar power is specified in the Contract Documents, the contract price will include the solar panel, batteries, and electronics.

**700-6.6 Basis of Payment.**

Price and payment will be full compensation for all work specified in this Section.

Payment will be made under:

Item No. 700- 12- Sign Beacon, per assembly.