

SECTION 13557

VARIABLE MESSAGE SIGN

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Install all Department-Furnished items including VMS, cabinet, controller and any additional equipment required for a complete and operational VMS assembly.
- B. Furnish and install VMS tubular support structures, sign connection hardware, catwalk, cabinet foundations and any additional equipment required for a complete and operational VMS assembly.
- C. Test the installed VMS. Adjust VMS viewing angle as required.

1.2 RELATED SECTIONS

- A. Section 01554: Traffic Control
- B. Section 02466: Drilled Caisson
- C. Section 02841: Traffic Barriers
- D. Section 02843: Attenuation/End Section
- E. Section 03152: Concrete Joint Control
- F. Section 03211: Reinforcing Steel and Welded Wire
- G. Section 03310: Structural Concrete
- H. Section 05120: Structural Steel
- I. Section 13551: General ATMS Requirements
- J. Section 13553: ATMS Conduit

- K. Section 13554: ATMS Junction Box
- L. Section 13555: ATMS Cabinet

1.3 REFERENCES

- A. AASHTO M 31M: Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- B. AASHTO M 32: Steel Wire, Plain, for Concrete Reinforcement
- C. AASHTO M 111: Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products
- D. AASHTO M 232: Zinc (Hot-dip Galvanized) on Iron and Steel Hardware
- E. AASHTO M 270: Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched and Tempered Alloy Structural Steel Plates for Bridges
- F. AASHTO M 284M: Epoxy Coated Reinforcing Bar
- G. AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals
- H. ASTM A 36: Carbon Structured Steel
- I. ASTM A 53: Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- J. ASTM A 123: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- K. ASTM A 153: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Hardware (nuts, washers, and anchor bolts)
- L. ASTM A 307: Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
- M. ASTM A 325: Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

- N. ASTM F 436M: Hardened Steel Washers (Metric)
- O. ASTM A 563M: Carbon and Alloy Steel Nuts
- P. ASTM F 593M: Stainless Steel Bolts, Hex Cap Screws, and Studs
- Q. ANSI/AASHTO/AWS D1.5: Welding Specifications
- R. National Electric Code (NEC)

1.4 SUBMITTALS

- A. Mill Certificates for all structural steel, Refer to Section 05120 Article Submittals.
- B. Shop Drawings for all structure steel, Refer to Section 05120 Article Submittals.
- C. Test results for all tests.

1.5 TESTING AND ACCEPTANCE

- A. Complete the Local Field Operations Test.
- B. Testing:
 - 1. Submit Local Field Operations testing plan to Engineer for approval prior to testing. Do not perform any testing until the Engineer has approved the testing plans.
 - 2. Submit documentation of successful completion of test to the Engineer for approval prior to final acceptance.
- C. Notify the Engineer at least two days in advance of the proposed date for the Local Field Operations Test. The Engineer has the right to witness such tests or to designate an individual or entity to witness such tests.

- D. Perform the following Local Field Operations Test as indicated, following the approved test plan. After all local installations are complete and the sign is functional, the Contractor will demonstrate to the Engineer all hardware, cables, and connectors have been properly installed and that all functions are in conformance with the requirements as stated in the Plans and Specifications. Contact Engineer twenty four hours in advance of local testing. Local testing is not complete until TOC personnel are able to verify the following:
1. Power supply voltages and the functionality of the fans and heaters for both the sign housing and controller cabinet.
 2. Accurate ambient light measurements are being read from the photocells (front, back and top).
 3. Accurate sign temperature readings are measured in the sign and controller cabinet.
 4. Sign diagnostic tests perform properly.
 5. Sign message can be displayed and blanked.
 6. Proper vertical and horizontal angle of the sign.
 7. Presence of dial-tone inside the cabinet.
 8. Sign status information can be remotely and accurately viewed from TOC.
 9. TOC can initiate sign diagnostic tests and display and then blank the sign message.
- E. Upon successful completion of such tests, deliver within three days, a written Completion Notice to the Engineer along with a copy of the test results.
1. Included in the first part of the Completion Notice will be a section specifically documenting any discrepancies.
 2. The Engineer will within ten days of receipt of the Completion Notice and test results, either accept or reject the Work (specifying, if rejected, the defect of failure in the Work) by delivery of written notice to the Contractor.
- F. In the event the Engineer rejects the Work, the Contractor will promptly commence to remedy the defect of failure specified in Engineer's notice.
1. Thereafter, the Contractor gives the Engineer a Completion Notice.
 2. In the event that the Engineer has not accepted the installation after this second round of tests, the Engineer may identify an independent; third party to specify what defects must be addressed in order for the Work to meet the Specifications.

- G. If Contractor fails to remedy any identified deficiencies in the Work within ten days of receipt of the Completion Notice The Engineer may authorize others to complete the work at the Contractors expense.

PART 2 PRODUCTS

2.1 VMS FOUNDATIONS

- A. Concrete: Class AA(AE) required. Refer to Section 03055.
- B. Reinforcing Steel:
 - 1. Deformed billet-steel bars conforming to AASHTO M 284M and M 31M (Grade 400) respectively.
 - 2. Coated.
 - 3. Spiral reinforcing steel must be #15 conforming to AASHTO M32 except minimum tensile strength of 58,000 psi.
- C. Anchor Bolts:
 - 1. Conform to AASHTO M270 Grade 36 and ASTM A 307 Specifications.
 - 2. Thread and galvanize the upper 12 inch: free running nuts, by hand, for the entire length of the threads.
 - 3. Galvanize the upper 14 inch of the anchor bolts, all nuts and washers, in accordance with the requirements of AASHTO M232.
 - 4. Hook dimension of 8 inch as shown in Standard Plans.
 - 5. Do not weld anchor bolts to reinforcing steel.
 - 6. Nuts: Conform to ASTM A 563 Specifications.
 - 7. Washers: Conform to ASTM F 436 Specifications.

2.2 BITUMOUS JOINT FILLER

- A. Prefomed material. Refer to Section 03152.

2.3 JUNCTION BOX

- A. Refer to section 13554.

2.4 VMS SUPPORTS

A. Structural Steel: General

1. Hot dip galvanize all structural steel after fabrication in accordance with AASHTO M 111. Structural steel may be metallized using electric arc sprayed zinc wire as an alternative.
2. Welding design and fabrication: In accordance with the ANSI/AASHTO/AWS D1.5 Specifications.
3. Use galvanized bolts, nuts, and washers in conformance with AASHTO M232. Lock washers required on all bolts.

B. Structural Tubing:

1. Use low carbon steel conforming to ASTM A 53 Grade B, except that its chemical composition requirements will be: carbon 0.25 percent, phosphorus 0.04 percent, manganese 1.35 percent, and silicon 0.05 percent (the other elements are to conform to ASTM A 53 Grade B).
2. Bolts: Conform to ASTM A 325 Specifications.
3. Nuts: Conform to ASTM A 563 DH Specifications.
4. Washers: Conform to ASTM F 436 Specifications. Lock washer: all bolts.
5. Galvanize bolts, nuts, washers: AASHTO M232.

C. All Other Structural Steel:

1. All other shapes and plates: Conform to AASHTO M 270M Grade 250.
2. Bolts: Conform to ASTM A 307 Specifications.
3. Stainless Steel Bolts: Conform to ASTM F593 Type 304 Specifications.
4. Nuts: Conform to ASTM A 563 M Specifications.
5. Washers: Conform to ASTM 436 M Specifications. Use lock washers on all bolts.
6. Galvanize bolts, nuts, washers: AASHTO M232.
7. Entire sign assembly with mounting brackets: Galvanize to AASHTO M111.

D. Welding design and fabrication: ANSI/AASHTO/AWS D1.5 specifications.

PART 3 EXECUTION

3.1 PREPARATION

- A. Type I Sign Design Criteria
 - 1. Dead Load: 4800 lb.
 - 2. Live Load: 510 lb.
 - 3. 100 mph wind load.
 - 4. Snow and ice loadings.
- B. Conform to the requirements of the National Electric Code (NEC), current edition.
- C. Load, transport, and install all state-furnished materials per the manufacturer's instructions and as shown in the plans.
- D. Provide foundation, VMS supports, junction boxes, ground rod, grounding lug, conduit, and all additional miscellaneous items required for a complete and operational VMS.
- E. Install all wiring, conduit, and junction boxes as shown on site plans and details.
 - 1. Field locate all conduits and junction boxes to avoid drainage areas and steep slopes whenever possible.
 - 2. Protect existing conductors while installing cables and conductors.
- F. Furnish and install all incidental items, such as wire nuts, grommets, tape connectors, and electrical nuts, necessary to make the VMS system complete.
- G. After installation, the exterior of all equipment: Free of all loose rust and mill scale, dirt, oil, grease and other foreign substances.
- H. Maintenance platforms required when the surrounding areas are not paved.
- I. Restore work area to the original condition or better after work is completed.

3.2 CONSTRUCTION SEQUENCE

- A. Construct foundations, establishing base plate elevations in accordance with project plans.
- B. Determine design height of both vertical supports, and length of horizontal support based on the 'as-built' foundation field survey. A prudent safety factor may be added to the vertical dimensions of each vertical support to assure ease of construction to vertical clearance requirements. Determine catwalk design dimensions based on survey data. Obtain Engineer's approval for all dimension changes.
- C. Fabricate structural supports and catwalk. Review shop-drawings and relate to survey information to assure consistency.
- D. Erect structure with sign.
- E. Remove shipping supports, connect all wiring and cables in a neat and orderly fashion, verify all parts are properly seated and functional and make final adjustments to sign horizontal and vertical angles. The Engineer reserves the right to order adjustments to the sign angle during the initial installation.

3.3 VMS FOUNDATIONS

- A. Excavation
 - 1. Perform per Section 13551, General ATMS Requirements.
- B. Anchor Bolts:
 - 1. Provide anchor bolt template during installation of anchor bolts. Fabricate the bolt template of 1/4 inch thick minimum steel plate, similar to anchor plate details. Match drill to each base plate.
- C. Earthwork
 - 1. Place compacted embankments prior to drilling.
 - 2. Drill Caisson forms 6 inch minimum below ground surface. Place compacted backfill before erecting post.

D. Bitumous filler at concrete joints. Refer to section 03152.

3.4 VMS SUPPORTS

A. Structural Tubing:

1. Provide handholes for tubular overhead frame one side only.
2. Locate inserts at the bottom of the mast arm where shown on the Standard Plans. Weld 1 1/2 inch diameter insert in each hole. Thread inserts before galvanizing and provide galvanized plugs.
3. During sign erection, the post will be racked as necessary with the use of leveling nuts to make the sign panels level. At final position, both top and bottom anchor bolt nuts are to be wrench tightened against the base plate.

B. All Other Structural Steel:

1. One sign-mounting bracket is required at each sign Z bracket. See sign fabricator's drawings for number and location of Z brackets.
2. Pre-tension steel rod to 11,000 lbs.
3. During sign erection, rake post as necessary with the use of leveling nuts to make the variable message sign level. At final position both top and bottom anchor bolt nuts are to be wrench tightened against base plate.
4. Sign placement on horizontal member may be adjusted up to 3/8 inches upward for VMS platform to match catwalk elevation.

C. Earthwork:

1. Place and compact backfill prior to erecting supports.

3.5 VMS CABINET

A. Cabinet Foundation

1. Concrete: A(AE) required. Refer to Section 03055.
2. Trowel finish and level top surfaces, prior to cabinet installation. Level top surfaces of cured concrete by grinding.

B. Bolts, Nuts, and Hardware

1. Furnish and install 3/4 inch x 8 inch anchor bolts to secure cabinet. Cabinet anchor bolts: minimum pullout strength 11,000 lb.

2. Expansion anchor bolts to secure framing strut to foundation: 1/2 inch diameter embedded 6 inch minimum in foundation, with shear capacity of 2500 lb and tension (pullout) capacity of 2600 lbs. Locate expansion anchors a minimum of 3 inch from any edge of concrete.
3. Provide stainless steel, galvanized, or zinc plated bolts, nuts, hardware.
 - a. Steel as specified. ASTM A 307.
 - b. Galvanized as specified. ASTM A 123.
 - c. Zinc plated as specified. ASTM B 766.
4. Provide all bolted connections with lock washers, nuts, or other approved means to prevent the connection nuts from backing off.
5. For framing struts, provide commercially available 12-gauge, u-shaped stainless steel product with 1/2 inch diameter pre-drilled holes, to attach transformers, breaker enclosures, disconnects, or other electrical equipment to cabinet foundation. Provide strut with cross-section dimensions 1 7/16 inch x 1 7/16 inch minimum.
6. Verify bolt pattern and foundation dimensions prior to foundation construction.

C. Conduit

1. Install all conduit in base of cabinet in a 12 inch x 18 inch rectangle centered in the cabinet base. Conduit may be aligned in alternate pattern than shown in plan. Refer to plans for the number, size, and orientation of all conduits entering the junction boxes.
2. Conduit (typical) from cabinet to Type I junction box
One-1 1/2 inch from cabinet to disconnect
One-1 1/2 inch from disconnect to Type I junction box
3. Conduit (typical) from cabinet to Type II junction box
Two-3 inch
Four-2 inch
4. Conduit (typical) stubbed out of Type II junction box
Two-3 inch
Four-2 inch
One-3 inch(spare)
5. All exposed conduit: metallic.
6. Install bushings on metallic conduit ends at top of concrete bases if wire or cable is installed. Install end bells on non-metallic conduit if wire or cable is installed.
7. Provide 1 inch minimum spacing between conduit in cabinet base. Cap conduit at both ends until used. Stub conduit 3 inch above the concrete base.

- D. Orient the cabinet such that the front door is on the opposite side of the cabinet from the VMS to allow maintenance personnel facing the front door of the cabinet to also face the VMS. Orient the cabinet such that the door that accesses the front face of the control equipment is adjacent to the Type II junction box.

- E. Disconnect and Transformer
 - 1. Install struts as per Section 13555, ATMS Cabinet.
 - 2. Install disconnect and transformer on the side of cabinet that faces away from the nearest traffic. If wall blocks access to disconnect, then install the disconnect and transformer on the opposite side of cabinet.
 - 3. Install 0.67 inch spacers with each expansion anchor between the foundation and disconnect/transformer. Maintain a 0.67 inch gap between the disconnect/transformer and the foundation.
 - 4. Ground the transformer to the control cabinet ground terminal.
 - 5. Install disconnect and transformer per manufacturer's instructions.

- F. Identify all field terminals.

- G. For junction box installation, see section 13554.

END OF SECTION