

## **SECTION 649**

### **STEEL STRAIN POLES, STEEL MAST ARM AND MONOTUBE ASSEMBLIES**

#### **649-1 Description.**

The work in this Section consists of furnishing and installing steel strain poles, steel mast arm(s) and monotube assemblies in accordance with the details shown in the Contract Documents.

#### **649-2 Materials.**

Use Steel Strain Poles, Steel Mast Arm and Monotube Assemblies listed on the Department's Qualified Products List (QPL) for all standard configurations shown in the Design Standards.

Provide shop drawings and signed and sealed calculations, as needed, in accordance with Section 5 for configurations shown in the plans and denoted as special.

Use coating products listed on the QPL.

Use grouts meeting the requirements of Section 934 listed on the QPL.

Use water meeting the requirements of Section 923.

Use membrane curing compounds meeting the requirements of Section 925.

#### **649-3 Fabrication.**

Fabricate steel strain poles, steel mast arm and monotube assemblies and miscellaneous hardware in accordance with the Contract Documents. Galvanize all components in accordance with ASTM A 123 after cutting to the final dimensions and welding is completed. Use galvanizing methods which provide surfaces suitable for painting. Obtain all components for individual steel strain poles, steel mast arm and monotube assemblies from the same fabricator. Obtain the luminaire and bracket from other sources, when necessary.

Affix an aluminum identification tag which will be visible from the handhold or located inside the terminal box containing the information described in the Design Standards.

Before shipping, assemble steel mast arm and monotube assemblies including luminaire and bracket, to assure proper fit. The steel mast arm and monotube assemblies may be separated for shipment.

Ensure all components are protected from damage during shipping and handling by wrapping or other effective methods. Replace any component, which the Engineer determines is damaged beyond repair, at no additional cost to the Department. If components are wrapped for shipment, remove wrappings no later than five days after receipt of components or immediately if the wrappings become saturated. Post these instructions in brightly colored wording on the wrapper. Failure to comply with these instructions may lead to damage of the coating system and will be cause for the rejection of the component.

#### **649-4 Painting.**

**649-4.1 General:** Allow the components to cool completely after galvanizing and vent gases produced during cool down before painting.

When required by the Contract Documents, paint steel strain poles, steel mast arm and monotube assemblies, in accordance with Section 560 and these Specifications.

Meet the color requirement as specified in the Contract Documents. Provide the Engineer with two sample chips, 2 x 4 inches [50 x 100 mm], of the color and paint system proposed. Measure paint thickness, with either ASTM D 1005 or ASTM D 1186.

**649-4.2 Surface Preparation:** Prepare all galvanized surfaces to be painted in accordance with ASTM D 6386.

Test galvanizing thickness after completion of painting preparation obtaining a brush-off blast condition to ensure sufficient galvanizing remains on the substrate to meet the requirements of the Contract Documents. Correct any deficient areas to the satisfaction of the Engineer at no additional cost to the Department. Wipe all galvanized surfaces with a solvent in accordance with the Steel Painting Council (SSPC) SSPC-SP1 and allow to dry, before applying the paint system.

**649-4.3 Application of Two-Coat Paint System:** Prime all pits and imperfections by applying an epoxy primer with a brush. Apply one coat of primer, which when dry will attain a dry film thickness of 4.0 to 6.0 mils [100 to 150  $\mu\text{m}$ ]. Ensure the color of the epoxy primer contrast with the galvanizing and the finish paint.

Apply one coat of aliphatic polyurethane finish paint, which when dry will attain a dry film thickness of 2.0 to 4.0 mils [51 to 102  $\mu\text{m}$ ]. Acquire epoxy primer and aliphatic polyurethane from the same manufacturer.

**649-4.4. Powder Coat Paint System:** Coat the exterior of the structure with urethane or triglycidyl isocyanurate (TGIC) polyester powder to a minimum dry film thickness of 2 mils [50  $\mu\text{m}$ ]. Apply the coating electrostatically and cure by heating the steel substrate to a minimum of 350°F [177°C] and a maximum of 400°F [204°C].

### **649-5 Installation.**

Install foundations for steel strain poles, steel mast arm and monotube assemblies in accordance with Section 455. Do not install the steel mast arm pole, strain poles or monotube pole(s) until the foundation(s) have cured for a minimum of seven days. Before erecting the pole clean the top of the foundation of any laitance, oils, greases or any other deleterious materials. Erect strain poles in an orientation which considering the rake and the application cable forces will produce a plumb pole. Erect monotubes plumb at the time of installation. Plumb the pole supporting mast arm(s) after the mast arm(s), traffic signals and/or sign panels have been placed.

If the traffic signals and/or sign panels are not in place within two working days after the mast arm is erected, furnish and install a 3 by 2 foot [900 by 600 mm] blank sign panel on the bottom of each mast arm within 6 feet [1.8 m] of the mast arm tip and plumb the pole. Re-plumb the pole supporting mast arm(s) after installation of traffic signals and/or sign panel(s).

Install nuts on anchor bolts to a snug condition. Install all other bolt, nut and washer assemblies using the turn-of-nut method described below or using galvanized direct tension indicators in accordance with the manufacturers instructions. When using the turn-of-the-nut method, bring all the fastener assemblies (bolts, nuts, and washers) of a steel connection to a “snug tight” condition to ensure that all parts of the connection are brought into full contact with each other. After all of the connection fastener assemblies are in “snug tight” condition, additionally tighten all fastener assemblies in the joint by the applicable amount of nut rotation specified in Table B below:

Table B			
Nut Rotation* From Snug Tight Condition			
Bolt Length Measured From Underside of Head to Extreme End of Point	Disposition of Outer Faces of Bolted Parts		
	Both Faces Normal to Bolt Axis	One Face Normal to Bolt Axis and Other Face Sloped Not More Than 1:20 (Bevel Washer Not Used)	Both Faces Sloped Not More Than 1:20 From Normal to Bolt Axis (Bevel Washer Not Used)
Up to and including 4 diameters	1/3 turn	1/2 turn	2/3 turn
Over four diameters but not exceeding 8 diameters	1/2 turn	2/3 turn	5/6 turn
Over eight diameters but not exceeding 12 diameters**	2/3 turn	5/6 turn	1 turn

\*Nut rotation is relative to bolt, regardless of the element (nut or bolt) being turned. For bolts installed by 1/2 turn and less, maintain a tolerance of  $\pm 30$  degrees; for bolts installed by 2/3 turn and more, maintain a tolerance of  $\pm 45$  degrees.  
\*\*No research work has been performed by the Research Council on Riveted and Bolted Structural Joints to establish the turn-of-nut procedure when bolt lengths exceed 12 diameters. Therefore, determine the required rotation by actual tests in a suitable tension device simulating the actual condition.

## 649-6 Grouting.

**649-6.1 Preparation:** Flush the top of the foundation with clean water to remove any dirt and debris. Immediately before grouting, saturate the concrete surfaces by ponding or by placement of saturated rags for a minimum period of two hours. Remove all freestanding water before beginning the grouting operation.

**649-6.2 Forming:** Use watertight non-absorbent forms with a form release agent applied to all interior surfaces. Maintain a 1 inch [25 mm] clearance between the forms and the base plate. Extend the form a minimum of 1 inch [25 mm] above the bottom of the base plate. Attach a head box with a 45 degree slope on the form for grout placement.

**649-6.3 Mixing:** Use only fresh unopened full bags of grout. Mix the grout in a clean, power driven mortar mixer or with a heavy duty drill (850 RPM maximum) using a commercial mixing paddle. Mix the grout in accordance with the manufacturer's instructions. Test the fluidity of the grout using the ASTM C 939 Flow Cone Method. Use grouts that meet the efflux time of 20 to 30 seconds. Do not remix grouts that have begun to set.

**649-6.4 Placing and Curing:** Pour the grout from only one side of the base plate through the head box until the grout has filled the entire form and extends a minimum of 1/4 inch [6 mm] above the bottom of the base plate. Do not allow the grout to overtop the base plate. Do not vibrate grout. Clean excess grout off the base plate after the grout has reached initial set (two to four hours). Cure the grout for a minimum of six hours by covering the entire grout surface with clean saturated rags. Remove the forms after verifying the grout is self supporting by penetration with a pointed masons trowel or other sufficient tool. Cure all exposed grout with a membrane curing compound.

## 649-7 Method of Measurement.

**649-7.1 General:** Measurement for payment will be in accordance with the following work tasks.

**649-7.2 Furnish and Install:** The Contract unit price each for steel strain poles, steel mast arm and monotube assemblies, furnished and installed, will include all materials specified in the Contract Documents, including the foundation, cover plates, caps, clamps, blank sign panel,

luminaire bracket, all labor, equipment, miscellaneous materials and hardware necessary for a complete and acceptable installation.

**649-7.3 Furnish:** The Contract unit price each for steel strain poles, steel mast arm and monotube assemblies, furnished, will include all materials, all shipping and handling costs involved in delivery as specified in the Contract Documents.

**649-7.4 Install:** The Contract unit price each for steel strain poles, steel mast arm and monotube assemblies, installed, will include the foundation, blank sign panel, all labor, equipment, miscellaneous materials and hardware necessary for a complete and acceptable installation. The Engineer will supply materials as specified in the Contract Documents.

**649-8 Basis of Payment.**

Price and payment will be full compensation for all work specified in this Section. Sign panels and/or signal assemblies will be paid for separately.

Payment will be made under:

Item No. 649-	Mast Arm Assembly - each.
Item No. 2649-	Mast Arm Assembly – each.
Item No. 649-	Steel Monotube Assembly - each.
Item No. 2649-	Steel Monotube Assembly – each.
Item No. 649-	Steel Strain Pole - each.
Item No. 2649-	Steel Strain Pole – each.