

**649 GALVANIZED STEEL STRAIN POLES, MAST ARMS AND MONOTUBE ASSEMBLIES.**

**(REV 10-15-12) (FA 11-15-12) (7-13)**

ARTICLE 649-2 (Page 799) is deleted and the following substituted:

**649-2 Materials.**

Use pole assemblies as shown in the Design Standards when standard mast arm assemblies or standard strain pole assemblies are required by the Contract Documents. Obtain strain poles, mast arm, and monotube assemblies 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.

Use coating products meeting the requirements of Section 975.

Use grouts meeting the requirements of Section 934 and listed on the Department's Qualified Project List (QPL).

Use water meeting the requirements of Section 923.

Use membrane curing compounds meeting the requirements of Section 925.

ARTICLE 649-5 (Pages 801 – 802) is deleted and the following substituted:

**649-5 Installation.**

Install foundations for strain poles, mast arm and monotube assemblies in accordance with Section 455. Do not install the strain poles, mast arm pole, or monotube pole until the foundation has achieved 70% of the specified 28-day concrete strength and verifying test results have been provided to the Engineer. Determine concrete strength from tests on a minimum of two test cylinders prepared and tested in accordance with ASTM C31 and ASTM C39. Before erecting the pole, clean the top of the foundation of any laitance, oils, grease 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 arms after the mast arms, traffic signals 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 foot by 2 foot blank sign panel on the bottom of each mast arm within 6 feet of the mast arm tip and plumb the pole. Re-plumb the pole supporting mast arms after installation of traffic signals and sign panels.

Install ASTM A325 bolt, nut and washer assemblies in accordance with the following. 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 to a snug-tight condition, tighten nuts in accordance with the turn-of-nut method in 460-5, Table 460-7. Maintain uniform contact pressure on the faying surfaces during snugging and turn-of-nut 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.

Installation steps are as follows:

- 1) Verify that the nuts can be turned onto the bolts past the elevation corresponding to the bottom of each in-place leveling nut and be backed off by the effort of one person on a 12 inch long wrench, without employing a pipe extension on the wrench handle.
- 2) Clean and lubricate the exposed threads of all anchor bolts. Clean and lubricate the threads and bearing surfaces of all leveling nuts. Re-lubricate the exposed threads of the anchor bolts and the threads of the leveling nuts if more than 24 hours has elapsed since earlier lubrication, or if the anchor bolts and leveling nuts have become wet since they were first lubricated.
- 3) Turn the leveling nuts onto the anchor bolts and align the nuts to the same elevation.
- 4) Place structural plate washers on top of the leveling nuts; one washer corresponding to each anchor bolt.
- 5) Install the base plate onto the leveling nut washers, place structural plate washers on top of the base plate; one washer corresponding to each anchor bolt, and turn the top nuts onto the anchor bolts.
- 6) Tighten top nuts to a snug-tight condition in a star pattern. A star tightening pattern is one in which the nuts on opposite or near opposite sides of the bolt circle are successively tightened in a pattern resembling a star. For an 8 bolt circle with bolts sequentially numbered 1 to 8, tighten nuts in the following bolt order: (1, 5, 7, 3, 8, 4, 6, 2).
- 7) Tighten leveling nuts to a snug-tight condition in a star pattern. The distance from the bottom of the leveling nuts to the top of the concrete must not exceed one anchor bolt diameter.
- 8) Before final tightening of the top nuts, mark the reference position of each tip nut in a snug-tight condition with a suitable marking on one flat with a corresponding reference mark on the base plate at each bolt. Then incrementally turn the top nuts using a star pattern until achieving the required nut rotation specified in Table A. Turn the nuts in at least 2 full tightening cycles (passes). After tightening, verify the nut rotation. Do not exceed the Table A value by more than 20 degrees.
- 9) Tighten each retainer or jam nut until it is in firm contact with the top surface of the anchor bolt nut then while preventing the anchor bolt nut from rotating, tighten the jam nut until it is snug tight.

Table A	
Anchor Bolt Diameter (in.)	Nut Rotation from Snug-Tight Condition
$\leq 1 \frac{1}{2}$	1/3 turn
$> 1 \frac{1}{2}$	1/6 turn