EXPECTED IMPLEMENTATION JANUARY 2015

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**MAST ARM, SPAN WIRE, AND POLE MOUNTING ASSEMBLIES.**
**(REV 10-10-14) (1-15)**

The following new Section is added after Section 654.

## SECTION 659
## MAST ARM, SPAN WIRE, AND POLE MOUNTING ASSEMBLIES

**659-1 Description.**

Furnish and install mounting assemblies for vehicular and pedestrian traffic signals, signs, cameras, detectors, and other devices in accordance with the Contract Documents.

**659-2 Materials.**

**659-2.1 General:** Use mounting assemblies listed on the Department's Approved Product List (APL). Meet the requirements of Section 603.

Fastening hardware such as bolts, nuts, washers, set screws, studs, u-bolts, cable and cable swags, must be provided by the mounting assembly manufacturer, must be SAE Type 316 or 304 stainless steel. Hardware (studs, bolts and u-bolts) must be a minimum of 5/16 inch diameter unless otherwise specified in this Section. SAE Grade 8 bolts and nuts are also acceptable. Metallic mounting assemblies must meet ASTM B117 for corrosion resistance.

Connections that provide an entrance to the interior of a traffic device must be weather-resistant.

All assemblies must be constructed to support the weight of any combination of signal indications with all accessories such as back plates and visors.

Connections between signal, disconnect and disconnect hanging hardware must be of the tri-stud design unless otherwise specified. Tri-stud washers must be a minimum 0.090 inches thick unless otherwise specified in this Section.

Surfaces that mate to vehicular and pedestrian traffic signals must have a standard circular 72 tooth serration connection (two inch I.D.) capable of providing positive positioning and alignment of the signal in 5 degree increments. The serrated teeth must be clean and sharp and at least 1/8 inch wide and 3/64 inch deep. The connection between the teeth of the signal and the upper bracket must be weather resistant.

Design mounting assemblies capable of providing adjustment in multiple directions for proper alignment of the attached traffic device and to prevent rotation around the vertical axis or misalignment after installation.

Studs may be cast directly into the aluminum during the casting process or tapped and locked with a locking material. In each case, a pull-out force must be provided. Messenger wire clamps must be extruded aluminum six inches long or cast U-bolt type as shown in Design Standards Index No. 17727.

Torque specifications must be included with all assembly installation instructions if torque specifications are specified by the manufacturer.

**659-2.2 Product Identification:** Mounting assemblies must be permanently marked with the name or trademark of the manufacturer, part number and date of manufacture. Identification must be cast into, or metal-marked on, the assembly in a legible manner. When the assembly is made up of multiple components, each component must be identified with the manufacturer's name or trademark.

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**659-2.3 Finish:** Unless otherwise specified, mounting assemblies and components must be supplied with a natural finish with mill scale removed in accordance with Military Standard MIL-PRF-24712A or AAMA 2603-02 and must meet the requirements of ASTM 3359 and ASTM D3363. Disconnect (interior and exterior) and disconnect hub must be powder-coat painted dull black (Federal Standard 595A-37038) with a reflectance value not exceeding 25 percent as measured by ASTM E97. All finished surfaces must have a smooth finish free from cracks, blow-holes, shrinks, excessive material, and other flaws.

**659-2.4 Mast Arm Mounting Assemblies:** Mast arm mounting assemblies must include the following components: mast arm saddle, swivel, attachment cables or bands, cable clamp mechanism, gusseted support tube, and top and bottom support arms. Aluminum mast arm mounting assemblies (clamps) must have a minimum yield strength of 16 ksi and a minimum ultimate tensile strength of 23 ksi in accordance with ASTM B26 or ASTM B108. Mast arm mounting assemblies must be designed to be attached to a mast arm by cables or bands.

**659-2.4.1 Saddle:** Aluminum saddles must have a minimum yield strength of 16 ksi and a minimum ultimate tensile strength of 23 ksi in accordance with ASTM B26 or ASTM B108. The saddle must be designed to be secured to the mast arm with no movement when 250 pounds of downward force is applied to the completed vehicular traffic signal assembly.

**659-2.4.2 Swivel:** Aluminum swivels must have a minimum yield strength of 16 ksi and a minimum ultimate tensile strength of 23 ksi in accordance with ASTM B26 or ASTM B108. The swivel must provide at least two connection devices to secure the support tube to the swivel and be configured to permit the support tube to pivot 360 degrees in a plane parallel to the mast arm. Any castings used to attach the support tube to the swivel must be manufactured from the same aluminum alloy as the swivel.

**659-2.4.3 Saddle Attachment Cables and Bands:** Mast arm saddle attachment cables must be 3/16 inch minimum diameter, Type 316 or 304 stainless steel aircraft type wire strand cable. The swage at the ends of the cable (used to tighten the cable against the saddle) must be Type 316 or 304 stainless steel with a minimum 3/8 inch diameter thread. The swage must permit use of a wrench to prevent rotation while tightening the nut at the end of the swage. If the attachment cable does not have swaged clamp screws at each end (double-ended), the unclamped end of the cable must be sintered, welded, or otherwise secured without adhesives to prevent unraveling of the cable. Banding must use two Type 304 or 201 series stainless steel 3/4 inch wide bands and Type 316 stainless steel buckles (clamp screws). De-burr the edges of the bands.

**659-2.4.4 Cable Clamp Mechanism:** Aluminum mast arm mount components used to secure the cable to the saddle must have a minimum ultimate tensile strength of 23 ksi per ASTM B26 or 30 ksi per ASTM B221.

**659-2.4.5 Gusseted Support Tube:** Gusseted tubes used in mast arm mounting assemblies must be extruded aluminum having a minimum yield strength of 31 ksi and a minimum ultimate tensile strength of 35 ksi as per ASTM B221. A gusseted hollow design must be used to provide for the routing of necessary wiring. The tube cross-sectional area's principal moments of inertia must average, at a minimum, that of a 1-1/2 inch standard aluminum Schedule 40 pipe and the cross-sectional metal area must not be less than that of a 1-1/2 inch Schedule 40 pipe. The bottom portion of the tube that supports the vertical load of the hanging device must be threaded using National Pipe Thread Taper (NPT), National Pipe Thread Straight (NPS) or be non-threaded U-bolt secured. Threaded support tubes that are fully slotted must have

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an aluminum insert in the 3/4 inch slot extending a minimum of 1/2 inch beyond the threaded section. To provide easy installation of wiring, the tube must have a minimum 0.562 inch wire entrance slot running the full length of the tube, or either stopping a minimum of 8 inches above the threaded or U-bolt secured end. Edges of slot must be supported with internal gusseting. The tube interior and slot must be free of sharp edges that may damage wiring. Provide an easily installed and removable UV stabilized seal to completely fill the wire entrance slot after installation.

**659-2.4.6 Top Support Arm:** The top support arm of the mounting assembly must be of one-piece solid construction and capable of holding the signal head firmly in place. Aluminum top support arms must have a minimum ultimate tensile strength of 30 ksi and minimum yield strength of 18 ksi per ASTM B26, or be die cast with a minimum ultimate tensile strength of 27 ksi and a minimum yield strength of 24 ksi.

A one or two piece top arm is acceptable. For a one piece top arm, use at least two 1/4 inch minimum diameter Type 316 or 304 stainless steel set screws to secure its position on the support tube. When a two-piece top arm is used, hardware required to connect components of the top arm must be 3/8 inch minimum diameter, Type 316 or 304 stainless steel.

The top support arm must have three 1/4 inch - 20 UNC-2B threaded holes to accept bolts for a tri-stud washer and gasket, or at least one imbedded or tapped and locked 5/16 inch - 18 threaded stud within the industry's standard 72 tooth serrated circular design that facilitates 5 degree increment positioning. Provide 0.090 inch thick (minimum) Type 316 or 304 stainless steel washers, nuts, and lock washers for attaching signal heads. A rubber washer, with dimensions similar to the large stainless steel washer, must be provided for traffic signals. When mast arm clamps are used to support illuminated signs with tri-stud arrangements, a rubber washer with dimensions similar to the steel washer must also be used.

**659-2.4.7 Bottom Support Arm:** The bottom support arm must be hollow to allow the routing and enclosing of all signal wiring. Aluminum bottom support arms must have a minimum ultimate tensile strength of 30 ksi and minimum yield strength of 18 ksi per ASTM B26, or be die cast with a minimum ultimate tensile strength of 27 ksi and a minimum yield strength of 24 ksi. Plastic bottom arm covers must be constructed of ABS with a UV inhibitor and be strong enough to contain the signal cable in the bottom arm cavity without bending during installation and warping over time.

The end of the bottom support arm that attaches to the support tube must have a 1-1/2 inch steel coupling imbedded and cast directly into the part during the solidification of the aluminum, or a 1-1/2 inch NPT or NPS pipe thread cut directly into the casting. For non-threaded versions, the arm must allow the support tube to sit a minimum of 2 inches into an arm pocket and be secured to the arm with minimum 5/16 full U-shape U-bolt to distribute the load evenly to the lower arm casting.

The end of the bottom support arm that connects to the signal must have either three equally spaced and plumb imbedded 5/16 inch Type 316 or 304 stainless steel threaded studs located in the center of the 72 tooth serrated circular design, or three 1/4 inch – 20 UNC-2B tapped holes to accept bolts for a tri-stud washer.

**659-2.4.7.1 Arms with Steel Coupling:** If a threaded steel coupling is imbedded into the casting, the bottom arm must be aluminum alloy 319.0-F in accordance with ASTM B26, with a minimum ultimate tensile strength of 23 ksi, meeting all standards listed in ASTM B26, including chemical composition listed in Table 1 and material mechanical

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properties listed in Table 2. The end of the bottom support arm must have at least two 1/4 inch diameter Type 316 or 304 stainless steel set screws to secure its position on the support tube.

**659-2.4.7.2 Threaded Arms:** If threads are cut directly into the casting, the bottom arm must be aluminum alloy 535.0-F in accordance with ASTM B26, with a minimum ultimate tensile strength of 35 ksi and elongation of 9.0% in a two inch section, meeting all standards listed in ASTM B26, including chemical composition listed in Table 1 and material mechanical properties listed in Table 2. As an alternative, the arm can be die cast in aluminum with a minimum ultimate tensile strength of 27 ksi and a minimum yield strength of 24 ksi. The end of the bottom arm must have at least two 1/4 inch minimum diameter Type 316 or 304 stainless steel set screws to secure its position on the support tube.

**659-2.4.7.3 Non-threaded Arms:** Lower arm must be aluminum 356 having a minimum ultimate tensile strength of 30 ksi and meeting all standards listed in ASTM B26, including chemical composition listed in Table 1 and material mechanical properties listed in Table 2. The arm must have a locator tab to receive the support tube and be secured by a U-bolt.

**659-2.5 Span Wire Mounting Assemblies:** Span wire mounting assemblies must include a span wire clamp, a hanging device such as a drop pipe, adjustable hanger with extension bar or a cable hanger, messenger clamp, disconnect hanger, and multi-brackets.

**659-2.5.1 Span Wire Clamp:** Span wire clamps must be aluminum alloy with a minimum ultimate tensile strength of 32 ksi and minimum yield strength of 22 ksi in accordance with ASTM B28 or ASTM B108.

**659-2.5.2 Drop Pipe:** Drop pipe hangers must be galvanized 1-1/2 inch steel aluminum having a minimum yield strength of 35 ksi and a minimum ultimate tensile strength of 42 ksi in accordance with ASTM B221 and have NPT on each end for assembly.

**659-2.5.3 Adjustable Hanger:** Adjustable hangers must be aluminum alloy 535.0-F in accordance with ASTM B26 with a minimum ultimate tensile strength of 35 ksi and elongation of 9.0% in a two inch section, meeting the chemical composition listed in Table 1 and material mechanical properties listed in Table 2 in ASTM B26.

**659-2.5.4 Cable Hanger:** Provide cable hangers constructed of a 1/4 inch minimum, seven-wire stand cable, manufactured with a Class A zinc coating in accordance with ASTM A475.

Use a minimum of two cable clamps (sized to fit the size cable used) to secure the looped cable to itself after threading through the upper catenary clamp using a guy wire thimble.

Use a minimum of two cable clamps (sized to fit the size cable used) to secure the looped cable to itself after threading through the lower messenger clamp and guy wire thimble.

Use Type 316 or 304 stainless steel for guy wire thimbles, washers, clevis pins and bushings (sleeve) for the catenary and messenger clamp pin attachment holes.

**659-2.5.5 Extension Bar:** Extension bars used to extend the length of the adjustable hanger must be T6061-T6 extrusion aluminum having a minimum yield strength of 35 ksi and a minimum ultimate tensile strength of 42 ksi in accordance with ASTM B221.

**659-2.5.6 Disconnect Hanger:** Attach signal heads to the disconnect hanger in a manner that removal does not disconnect or disturb the wiring leads terminated inside the signal head assembly. The disconnect hanger must be supplied with the following as a minimum:

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a) Wired screw type/compression terminal block and wiring rated at 600 $V_{AC}$ Root Mean Square (rms) with 12 or 18 circuits. The terminal block must be easily accessible for connection of the field wiring. Attach the terminal block to the disconnect with Type 316 or 304 stainless steel or brass fastening hardware.

b) Weather resistant grommets in each signal cable entrance of the disconnect hanger to prevent insect and animal access and to protect the signal cable from chafing.

c) A two inch opening in the top of the disconnect hanger with an integral serrated area (or 1-1/2 inch NPT threaded top section) to interface with the hanger method employed above it.

d) A securable door that allows access to all areas of the interior. The door securing device must be Type 316 or 304 stainless steel and captive. Hinge or groove pins for the door must be Type 316, 304, 303, or 302 stainless steel.

**659-2.5.7 Multi-Brackets:** Top and bottom (multi) brackets used in the assembly of span wire mounted multi-directional signals must be constructed of aluminum having a minimum yield strength of 13 ksi and a minimum ultimate tensile strength of 23 ksi per ASTM B26.

Top brackets must be of one-piece hollow design, with a cross-sectional diameter of at least 1-1/2 inch I.D. for receiving signal wires. The wall thickness must be at least 3/16 inch. Each top bracket (2- way, 3-way, and 4-way) must have a two inch diameter hole (with integral serrated boss as specified above) in the top side of the bracket for receiving a 1-1/2 inch entrance fitting. The underside of the top bracket must have a covered hole of at least three inches in diameter for the installation of the signal wires.

Bottom brackets must be of one-piece solid construction and must hold the signal heads firmly in place.

For the five section cluster configuration, provide 3/8 inch thick Type 316 or 304 stainless steel tri-stud washers and nylock nuts with lock washers to secure the top and lower signal sections of the cluster to the top multi bracket. Washer distortion must not occur after assembly of the five section cluster. Multi-brackets must include all fastening hardware necessary to attach to the signal.

**659-2.6 Pole (Pedestal and Post) Mounting Assemblies:** All trunnions, brackets, and suspensions used in mounting vehicular and pedestrian signals to concrete, steel, aluminum, or wood poles must be an aluminum alloy cast fitting, pipe or equivalent as approved by the Engineer. The aluminum alloy must have a minimum ultimate tensile strength of 35 ksi in accordance with ASTM B221, ASTM B85, or ASTM B26.

Pole side-mount brackets used for pedestrian signals may be constructed of polycarbonate material.

**659-2.7 Mounting Assemblies for Signs, Cameras, Detectors, and Other Traffic Control Devices:** Mounting assemblies or assembly components used for signs, cameras, detectors, and other traffic control devices must be constructed of the same material, and meet the same mechanical and chemical properties as mounting assemblies for signals.

**659-2.8 Miscellaneous Mounting Components:** Miscellaneous mast arm, span wire, and pole mounting components and accessories included with assemblies must meet the mechanical properties for its associated main assembly components or be listed separately on the APL. Mounting assemblies not approved with a specific primary device (such as a camera, detector, etc.), must be approved and listed separately on the APL.

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**659-3 Installation.**

Install all mounting assemblies in accordance with the manufacturer's recommendations.

**659-4 Warranty.**

Ensure mounting assemblies have a manufacturer's warranty covering defects for a minimum of three years from the date of final acceptance in accordance with 5-11 and Section 608. The warranty must include providing replacements, within 10 calendar days of notification, for defective parts and equipment during the warranty period at no cost to the Department or the maintaining agency.

**659-5 Method of Measurement.**

The Contract unit price per assembly for each mounting assembly, furnished and installed, will include all materials specified in the Contract Documents and all labor, equipment, and miscellaneous items necessary for a complete and acceptable installation.

No separate payment will be made for mounting assemblies for new installations. All incidentals required by the Plans for new installations, including mounting hardware, will be included in cost of the new signal, sign, camera, detector, or other traffic control device.

**659-6 Basis of Payment.**

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

Payment will be made under:

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| Item No. 659- 1 | Mast Arm, Span Wire and Pole Mounting Assemblies - each |