

ITEM 026010

Item 0260101 - STEEL MAST ARM ASSEMBLY

Item 0260102 - STEEL COMBINATION MAST ARM ASSEMBLY

DESCRIPTION

Work under this item shall consist of designing, fabricating and installing a mast arm assembly to carry traffic appurtenances (such as traffic signals, signs, antenna, etc.) of the type specified, on a prepared foundation, in accordance with the details shown on the plans, in accordance with these specifications and as ordered by the Engineer.

REFERENCED ITEMS

None

REQUIRED SUBMITTALS

Material Certificate of Compliance:

Submit 5 copies of material certificate of compliance for the steel mast arm and all associated hardware in accordance with the contract general requirements.

Shop Drawings:

Submit 5 copies of shop drawings for the steel mast arm and all associated hardware in accordance with the contract general requirements and with the design details approved and signed by a professional engineer licensed to practice in the State of Connecticut.

MATERIALS

The structural components of the mast arm, including luminaire arm, shall be made of steel with minimum yield strength of 36,000 psi. The non-structural components, such as caps and anchor bolt covers, may be made of steel or aluminum.

All structural steel greater than 0.5" thick with a minimum yield strength less than 50,000 psi shall meet the notch toughness requirements for ASTM A709, Grade 36F2. All structural steel greater than 0.5" thick with a minimum yield strength equal to or greater than 50,000 psi shall meet the notch toughness requirements for ASTM A709, Grade 50F2.

The anchor bolts shall conform to ASTM F1554, Grade 105. The nuts shall conform to ASTM A563, Grade DH. The washers shall conform to ASTM F436. The bolts, nuts and washers shall be galvanized in accordance with ASTM A153.

All steel components, including anchor bolts, shall be completely hot-dip galvanized, after fabrication, in accordance with ASTM A123 or ASTM A153, as applicable.

Bare copper grounding conductor shall be #8 AWG stranded bare copper wire conforming to the State of Connecticut Department of Transportation Standard Specifications for Roads, Bridges and Incidental Construction (Form 816) Article M.15.13. The grounding bolt shall be stainless steel with a hex head

CONSTRUCTION METHODS

The design and fabrication of the mast arm assembly, including its anchorage (into the foundation), shall conform to the requirements of AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals – 2001, including the latest interim specifications, amended as follows:

- The design wind speed shall be 120 mph. The computation of wind pressures in accordance with Appendix C is not permitted.
- The mast arms shall be designed to support fixed mounted traffic signals and signs. The wind drag coefficient for traffic signals and luminaires shall be 1.2.
- The mast arms shall be designed for fatigue category I. The mast arms shall be designed for the wind load effects due to galloping, natural wind gusts and truck-induced gusts. The luminaire arms shall be designed for the wind load effects due to natural wind gusts. The design pressure for the truck-induced gust shall be based on a truck speed of 65 mph. Vibration mitigation devices are not permitted.
- The vertical deflection of the free end of the arm due to the wind load effects of galloping and truck-induced gusts shall not exceed 8".
- The minimum design life for mast arms shall be 50 years.

Deleted: <#>SHAFT ¶
 ¶ The shaft shall be made from one length of sheet steel. There shall be one longitudinal weld. There shall be no intermediate horizontal joint or weld. The length of sheet steel shall be formed into a continuously tapered shaft, having a taper of approximately 0.14 inches per foot. The arm sizes shall be as shown on the plans.¶
 ¶ After the welding and cold-rolling, the shaft shall be placed under sufficient pressure to flatten the weld and increase the physical characteristics of the shaft so the metal. Cross-sectional shapes other than round will not be allowed. A hand hole reinforcing frame, complete with cover, shall be welded into the shaft a short distance above the base of the shaft to facilitate wiring. The hand hole opening shall be 6 inches by 10 inches complete with cover, welded to the shaft 8 inches above the base. There shall be a 1/2 inch tapped hole near the base of the shaft for a grounding bolt.¶
 ¶ The mast arm shall be supported to the shaft by an adjustable clamp to achieve correct arm orientation and clearance. This clamp shall support fixed mount signal heads and/or signs for design wind loads compliant with the most current AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signal," and all applicable revisions. [1]

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- The length of the arm members, measured from the centerline of the pole to the tip of the arm, shall be in 5'-0" increments. The minimum arm length shall be 15'-0". The maximum arm length shall be 40'-0".
- The maximum luminaire arm length shall be 15'-0".
- The maximum diameter of the pole at its base shall be 18".
- The maximum diameter of the arm at the arm-pole connection shall be 15".
- The minimum wall thickness of the arm at the pole connection and the pole shall be .3125".
- The arm, luminaire arm and pole may be fabricated from either round or multisided tubular members. Multisided tubular members with other than 8, 12 or 16 sides are not permitted. The arm and luminaire arm shall be fabricated with a taper (change in diameter).
- A maximum of one slip-type field splice is permitted in the arm. Slip-type field splices are not permitted in the pole. The wall thickness of the pole and arm component members shall be uniform through out their length. The use of multiple plies (laminations) to obtain the required arm and pole thickness is not permitted. The use of shop fabricated stepped members is not permitted.
- The arm, luminaire arm and pole members may be fabricated with no more than 2 longitudinal seam welds.
- The longitudinal seam welds for the arm and the pole members shall have 60% minimum penetration, except longitudinal seam welds within 6" of the member ends shall be complete joint penetration groove welds. The longitudinal seam welds for the luminaire arm members shall have 60% minimum penetration, except longitudinal seam welds within 6" of the butt end of the member shall be complete joint penetration groove welds.
- A minimum of 25% of the partial joint penetration seam welds and 100% of the complete joint penetration seam welds shall be non-destructively tested. Partial joint penetration seam welds shall be

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non-destructively tested in accordance with the magnetic particle method. Complete joint penetration seam welds in members less than 5/16" thick shall be non-destructively tested in accordance with the magnetic particle method. Complete joint penetration seam welds in members greater than or equal to 5/16" thick shall be non-destructively tested in accordance with the ultrasonic method. Longitudinal seam welds within 6" of the ends of member less than 5/16" thick shall be non-destructively tested by the magnetic particle method on both the inside and outside surfaces.

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- The arm to transverse plate connection shall be made with a complete joint penetration groove weld with a backing ring attached to the plate with a continuous fillet weld. The pole to transverse baseplate connection (at the foundation) shall be made with a complete joint penetration groove weld with a backing ring attached to the plate with a continuous fillet weld. In combination mast arm assemblies with poles fabricated in 2 components, the connection plates, used to join the pole components, may be welded to the pole components with either a complete joint penetration groove weld with a backing ring attached to the plate with a continuous fillet weld or socket-type joint with 2 fillet welds. 100% of the complete joint penetration groove welds shall be non-destructively tested by the ultrasonic method. 100% of the fillet welds shall be non-destructively tested by the magnetic particle method.

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- The pole baseplate bolt circle diameter shall be 24".
- The minimum anchor bolt diameter shall be 2".
- The anchor bolts shall use embedded anchorage plates to transmit loads from the pole base to the concrete foundation. The use of hooked anchor bolts is not permitted. Welding to the anchor bolts is not permitted.

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The dimensions of the mast arm assemblies are shown on the traffic plans, elevations, cross-sections or in the special provisions. The arm, luminaire arm and pole lengths and the attachment heights shall be verified by the Contractor based on the finished grade at the site, top of foundation elevation, the locations of overhead utility cables and the traffic appurtenance mounting heights. If either the arm or pole length is inadequate, the Contractor shall notify the Engineer.

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The minimum vertical clearance from the top of the finished road to the bottom of the traffic signals shall be 16'-0". The maximum vertical clearance from the top of the finished road to the bottom of the traffic signals shall be 18'-0". The traffic signals shall be installed so that the bottom of all the signals for each approach is at the same elevation.

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The arm to pole connection shall be made with a ring stiffened built-up box. The luminaire arm to pole connection shall be made with either a built-up box or a ring stiffened built-up box. A minimum of 8 high-strength bolts shall be used to connect the arm flange plate to the built-up box connection plate. A minimum of 4 high-strength bolts shall be used to connect the luminaire arm flange plate to the built-up box connection plate. All fasteners and their components used in the connection shall be visible. The use of tapped holes in the plates of the connection is not permitted. A hole(s) shall be provided in the connection to allow wires to pass from the pole to the arm and luminaire arm. The sides of all other holes in the connection shall be ground smooth and the edges rounded by grinding to prevent the wires from chafing.

The mast arm assembly shall be designed and fabricated to allow the arm to be adjusted 5° in a horizontal plane.

A J-hook shall be welded to the inside of the pole at the top for wire handling and support.

The mast arm pole shall have a handhole centered 1'-3" from the top of the baseplate. The handhole shall be located away from traffic. The handhole shall be reinforced with frame having a minimum 4" wide by minimum 6" high clear opening. The handhole shall be provided with a cover connected to the frame with stainless steel screws. The cover shall also be attached to the frame with a stainless steel chain. The inside bottom of the frame shall have a hole tapped for the stainless steel grounding bolt.

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The mast arm shall be supplied with pole and arm caps and anchor bolt covers. The caps and covers shall be attached to the mast arm with stainless steel screws.

Prior to fabrication, the Contractor shall submit working drawings and design computations to the Engineer for review in accordance with Article 1.05.02 of the State of Connecticut Department of Transportation Standard Specifications for Roads, Bridges and Incidental Construction (Form 816). An individual set of working drawings and computations shall be prepared for each mast arm. A single set of drawings and computations for multiple mast arms is not permitted.

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Working drawings shall be submitted on 11" x 17" (Ledger/Tabloid) sheets with an appropriate border and title block. Design computations, procedures and other supporting data shall be submitted on 8 1/2" x 11" (Letter) sheets.

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The working drawings and design computations shall be sealed by a Professional Engineer, licensed in the State of Connecticut, who shall also be available for consultation in interpreting his computations and drawings, and in the resolution of any problems which may occur during the performance of the work. Please note that each working drawing must be sealed.

The design computations shall include, but not be limited to the following:

- the project number, town and mast arm identification number
- computations for projects in Customary U.S. units shall be provided in Customary U.S. units. Computations for projects in metric units shall be provided in both Customary U.S. units and metric units.
- references to design specifications, including interim specifications, and the applicable code section and articles
- description/documentation for all computer programs used in the design
- drawings/models of the structure, components and connections, with dimensions, loads and references to the local and global coordinate systems used (as applicable), to facilitate review of the results
- results of all group loads and load combinations

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The working drawings shall include complete details of all mast arm components. The drawings shall include, but not be limited to the following:

- the project number, town and mast arm identification number
- reference to the design specifications, including interim specifications
- reference to the design specifications design criteria, such as design wind speed, minimum design life, fatigue category, vehicle speed, etc.

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- material specifications for all components
- material designations for the arm and pole, with an explanation of the alpha numeric characters (equivalent thickness, in inches (in millimeters), shall be provided for gage numbers)
- non-destructive weld testing requirements
- details of the location of the longitudinal seam welds in the arm, luminaire arm and pole
- a plan view of the anchor bolt layout relative to the orientation of the arm(s)
- anchor bolt dimensions, including embedment and projection
- permanent camber
- mast arm installation procedure, including the method to plumb the mast arm pole, and the method to tighten the anchor bolts, including bolt lubrication requirements

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After fabrication and prior to shipping, aluminum identification tags shall be attached to the arm and pole members with self-tapping tamper resistant screws.

The mast arm shall be installed according to the manufacturer's specifications.

After erecting the mast arm, the mast arm shall be electrically grounded by attaching the bare copper grounding conductor to the inside of the handhole frame with a stainless steel bolt and to the ground rod with a ground clamp. The rigid metal conduit shall be electrically grounded by attaching the bare copper grounding conductor to the insulated bonding bushing and to the ground rod with a ground clamp.

The traffic appurtenances shall be located and mounted on the arm as shown on the cross-sections. Holes, if required for wires, shall be located adjacent to the appurtenances and shall be drilled in the bottom of the arm. A rubber grommet shall be installed in each hole to protect the wires from chafing.

After installation of the traffic appurtenances, the anchor bolts nuts (leveling and top anchor nut) and washers shall be in full contact with the top and bottom surfaces of the pole baseplate and the centerline of the pole shall be plumb. The top

nuts shall have full thread engagement. The distance from the bottom of the leveling nuts to the top of the foundation shall not exceed 1".

After plumbing the pole, non-shrink grout shall be placed to seal the opening in the baseplate to prevent the entrance of insects and animals.

The last character of the mast arm identification number shall be stenciled with black paint on the pole of each mast arm. The character shall be 3" high and placed approximately 1' above the top of the baseplate facing the centerline of the roadway.

METHOD OF MEASUREMENT

This work will be measured for payment by the number of steel mast arm assemblies of the type and size specified, completed and accepted in place.

BASIS OF PAYMENT

This work will be paid for at the contract unit price each for "MAST ARM ASSEMBLY" or "COMBINATION MAST ARM ASSEMBLY" of the type and size arm specified, complete in place, which price shall include all equipment, materials, tools and labor incidental to the design, fabrication and installation of the mast arms at the locations specified on the plans.

<u>PAY ITEM</u>	<u>DESCRIPTION</u>	<u>PAY UNIT</u>
0260601	Mast Arm Assembly	EA
0260602	Combination Mast Arm Assembly	EA

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¶ Install the mast arm shaft baseplate onto the leveling nuts and tighten the anchoring nuts loosely.¶

¶ "Rake" the unloaded mast arm back by adjusting the nuts as necessary, to an amount equal to the estimated final mast arm deflection.¶

¶ Tighten up the anchoring nuts to a "snug-tight" condition while insuring that the leveling nuts are always in firm contact with the baseplate. A "snug-tight" condition is defined as the tightness attained by the full effort of a man using a spud wrench.¶

¶ Check all nuts for looseness after the traffic lights and other loads are in place, paying special attention to the leveling nuts on the tension bolts. Retighten any loose nuts to a "snug-tight" condition.¶

¶ Grout underneath the baseplate.¶

¶ Each mast arm shall be effectively grounded, using a 5/8-inch by 10-foot ground rod with #8 AWG solid, bare, tinned copper wire attached to the pole by a stainless steel bolt and to the ground rod by a square head bolt clamp.¶

¶ The opening between the concrete foundation and the mast arm base shall be grouted and neatly finished with a non-shrink non-staining grout conforming to the requirements for Article M.03.01-12 of The State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges and Incidental Construction, Form 816, 2004.¶

... [2]

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Deleted: shaft, arm, hand hole cover, pole cap, ornamental anchor bolt covers, ground wire, luminaire bracket assembly (for Combination Mast Arm Assembly), miscellaneous hardware, labor, tools and work incidental thereto

1. SHAFT

The shaft shall be made from one length of sheet steel. There shall be one longitudinal weld. There shall be no intermediate horizontal joint or weld. The length of sheet steel shall be formed into a continuously tapered shaft, having a taper of approximately 0.14 inches per foot. The arm sizes shall be as shown on the plans.

After the welding and cold-rolling, the shaft shall be placed under sufficient pressure to flatten the weld and increase the physical characteristics of the shaft so the metal. Cross-sectional shapes other than round will not be allowed. A hand hole reinforcing frame, complete with cover, shall be welded into the shaft a short distance above the base of the shaft to facilitate wiring. The hand hole opening shall be 6 inches by 10 inches complete with cover, welded to the shaft 8 inches above the base. There shall be a 1/2 inch tapped hole near the base of the shaft for a grounding bolt.

The mast arm shall be supported to the shaft by an adjustable clamp to achieve correct arm orientation and clearance. This clamp shall support fixed mount signal heads and/or signs for design wind loads compliant with the most current AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signal," and all applicable revisions.

A device shall be provided near the top, inside the shaft, to relieve the strain on the cable feeding the signals. The pole cap shall be secured by means of setscrews.

Where shown on the plan, there shall be provided a steel tapered bracket for luminaire. The luminaire bracket shall be the single arm type for brackets 10 feet and under in length and truss type for brackets 12 feet and longer. The truss type shall consist of an upper and lower member securely jointed by means of a vertical strut. The upper and lower members shall be two (2) inches I.P.S. steel pipe without ornamental steel scroll. The length of the luminaire bracket shall be as shown on the plans. The brackets shall be mounted to the pole by means of a bolted plate so that the angle for the arm may be adjusted in the field.

2. ANCHOR BASE

A one-piece cast steel anchor base of adequate strength, shape, and size shall be secured to the lower end of the shaft by two continuous electric arc welds. The base shall telescope the shaft, and one weld shall be on the inside of the base at the end of the shaft, while the other weld shall be on the outside at the top of the base. The two welds shall be approximately two (2) inches apart, and the design shall be such that the welded connection shall develop and full strength of the adjacent shaft section to resist bending action.

The base shall be provided with four holes to receive the anchor bolts, and four tapped holes for attaching the anchor bolt covers.

3. TAPERED MAST ARM

The mast arm shall be made of only one length of sheet steel for arms up to 38 feet in length and two lengths from 40 feet to 44 feet of not less than #7 manufacturers' standard gage. Only one longitudinal weld shall be permitted. There shall be no intermediate horizontal joint or weld. The length of sheet steel shall be formed into a continuous taper shaft having a taper of approximately 0.14 inch per foot. After the welding and cold-rolling, the mast arm shall be placed under sufficient pressure to flatten the weld and increase its physical characteristics so that the metal will have minimum yield strength of 55,000 p.s.i.

The mast arm shall be supported to the shaft by an adjustable clamp to achieve correct arm orientation and clearance. This clamp shall support fixed mount signal heads and/or signs for design wind loads compliant with the most current AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signal," and all applicable revisions.

Each mast arm shall be drilled in the field on the bottom surface for wire outlet holes and signals positioned at the location indicated on the signal plans. Rubber grommets shall be provided and installed by the contractor at each field-drilled hole to protect the signal conductors from chafing. The wiring for service for the luminaire shall be furnished and installed by the Connecticut Light and Power Company.

A steel removable cap shall be attached to the end of the arm by a setscrew. For each required signal, a clamp and clevis with 3/4 inch diameter hole shall be furnished.

4. JUNCTION BOX

Each mast arm Assembly shall be equipped with a "junction box" installed near the top of the shaft closer to the mast arm. This Junction Box shall be "Model No. HP221507" as manufactured by "Hennessy Products Inc." or approved equal.

5. FINISH

The pole, mast arm, luminaire bracket and all hardware shall be hot-dip galvanized, conforming to the requirements of ASTM A123 and, if indicated on the plans or directed by the Engineer, shall also be painted according to:

1. Tnemec process Series 1075, Endura-Shield II, or approved equal
2. Tnemec process Series 1072, Fluoronar, or approved equal

Color of the finished product shall be BLACK or as approved by the Engineer.

6. WIRE ENTRANCE FITTING

All steel mast arm assemblies shall include wire entrance fittings. The number and size of wire entrance fittings shall be as required to accept the cables shown on the plans.

7. MAST ARM ASSEMBLY INFORMATION

As described below, the mast arm assembly information shall be included on the shaft in the form of stamping on the top of the baseplate, or by riveting an aluminum tag on the shaft.

- oName of manufacturer
- oYear of manufacture
- oASTM designation of mast arm steel
- oDiameter and gauge thickness of the pole
- oHeight of the pole

8. SHIPPING

The mast arm assembly shall be completely wrapped with a foam packing to prevent the surface from getting damaged during the shipment and installation.

The recommended installation procedure is as follows:

Install the mast arm shaft baseplate onto the leveling nuts and tighten the anchoring nuts loosely.

"Rake" the unloaded mast arm back by adjusting the nuts as necessary, to an amount equal to the estimated final mast arm deflection.

Tighten up the anchoring nuts to a "snug-tight" condition while insuring that the leveling nuts are always in firm contact with the baseplate. A "snug-tight" condition is defined as the tightness attained by the full effort of a man using a spud wrench.

Check all nuts for looseness after the traffic lights and other loads are in place, paying special attention to the leveling nuts on the tension bolts. Retighten any loose nuts to a "snug-tight" condition.

Grout underneath the baseplate.

Each mast arm shall be effectively grounded, using a 5/8-inch by 10-foot ground rod with #8 AWG solid, bare, tinned copper wire attached to the pole by a stainless steel bolt and to the ground rod by a square head bolt clamp.

The opening between the concrete foundation and the mast arm base shall be grouted and neatly finished with a non-shrink non-staining grout conforming to the requirements for Article M.03.01-12 of The State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges and Incidental Construction, Form 816, 2004.

The luminaire brackets for combination mast-arm assembly shall be erected perpendicular to the centerline of the roadway. The mounting height shall be a nominal 30 feet measured from the center of the light source to the pavement directly below.

It shall be the Contractor's responsibility to establish the angle for the mast arm based on the actual location of the foundation.

For mast-arms with luminaire brackets, the brackets shall be erected perpendicular to the centerline of the roadway. The mounting height of the bracket shall be a nominal 30 feet when measured from the center of the light source to the pavement directly below.