Section 920—Lighting Standards and Towers

920.1 General Description

This section includes the requirements for the structural components of poles, towers, bases, anchor bolts, luminaires, and other attachments used for roadway, high mast, or other lighting.

In particular, the section covers the following:

- Steel lighting standards and towers
- Aluminum lighting standards
- Prestressed concrete standards
- Service cars
- Support and lowering assemblies
- Grounding

920.1.01 Related References

A. Standard Specifications

Section 105—Control of Work

Section 501—Steel Structures

Section 645—Repair of Galvanized Coatings

Section 865—Manufacture of Prestressed Concrete Bridge Members

B. Referenced Documents

ASTM			AASHTO
A 27/A 27M	A 153/A 153M	A 709/A 709M	M 222/M 222M
A 53/A 53M	A 193/A 193M	B 108	M 314
A 123/A 123M	A 588/A 588M		

MIL-W-83420

AISI 304

AISI 1020

AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals

920.2 Materials

Design lighting assemblies consisting of standard, tower, bracket arms, lowering assembly, and luminaire support and assemblies according to AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaire and Traffic Signals.

Submit to the Engineer the manufacturer's design calculations and shop drawings for each type of lighting standard or tower to be used.

920.2.01 Steel Lighting Standards and Towers

A. Requirements

1. Include the following in the makeup of lighting standards and towers:

- A pole and bracket arms as required on the Plans
- A steel base welded to the other end complete with bolts for use as an anchor base pole, or attached to an approved breakaway device, such as slip base, aluminum transformer base, breakaway couplings, etc., when so specified.

2. Steel Structures

   Use structural carbon or structural low alloy steel that meets the requirements of AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals. However, do not use ASTM A 588/A 588M (AASHTO M 222/M 222M) steel.

3. Steel Pipe

   Use steel pipe according to ASTM A 53/A 53M Grade B or approved equal. No hydrostatic test is required.

B. Fabrication

1. Roadway Standards

   Unless otherwise specified, do the following:

   a. Make the shaft or appropriate shape continuously taper with a base welded to the lower end.

   b. Construct the standard of steel at least 11 gauge (3.1 mm) thick to the dimensions required for the specified mounting height. Form the standard from one piece with one electrically welded longitudinal joint and no intermediate horizontal joints.

   c. After forming and welding, cold-roll the shaft longitudinally under sufficient pressure to flatten the weld and increase the physical characteristics of the metal in the shaft.

   d. Ensure that the shaft has a reinforced handhole with a cover, except where a transformer base is specified.

      1) Provide a 0.5 in (13 mm) approved grounding connector in the shaft or base.

      2) Equip the top of the shaft with a removable pole cap held securely in place.

      3) Galvanize the shaft with the hot-dipped method in ASTM A 123/A 123M.

2. Lighting Towers

   a. Make the shaft to meet the requirements of the roadway standard (Subsection 920.2.01.B.1).

   b. Construct the standard to continuously taper 0.14 to 0.40 in/ft (12 to 33 mm/m).

   c. Ensure that the standard has the necessary dimensions and metal quality to meet the requirements for the pecified mounting height.

   d. You may form the shaft in sections with each section having no more than two longitudinal welded seams.

   e. Use intermediate horizontal welds only at section joints.

   f. Make telescoped joints overlap at least 1-1/2 pole diameters, measured at the minimum diameter of the inner telescoping section.

   g. Have field welding done only by an approved certified welder who represents the manufacturer. Ensure the welding follows the requirements of Section 501.

   h. Repair any damage to spelter coating according to Section 645.

   i. Match-mark all sections of the shaft so that the tapered sections are assembled properly.

3. Post Top or Other Standards for Special Installation

   a. Make the post top and other standards meet the requirements for roadway standards (Subsection 920.2.01.B.1).

   b. Make the top diameter of the shaft 3 in (75 mm), or include a 3 in (75 mm) tenon, unless otherwise specified, to insert the shaft or tenon into the luminaire.

4. Anchor Base

   Do the following, unless otherwise specified:

a. Secure a steel base to the lower end of the shaft with two continuous electric welds. Ensure that the base develops the full strength of the adjacent shaft section to resist bending.

b. Where the Plans specify a frangible or breakaway base, attach the base to an approved breakaway device with an approved number and type of bolts.

c. Provide removable cast or pressed steel covers with each base. Appropriately attach each cover to the base.

5. Steel Bracket Arms

Do the following, unless otherwise specified:

a. Use the design dimensions from the Plans.

b. Ensure that the installed bracket connects securely with the shaft and has a smooth wiring raceway.

c. Use stainless steel bolts and nuts that meet the requirements of ASTM A 193/A 193M, Type B8C or AISI 304 to attach the bracket arm assembly.

6. Transformer Bases

Do the following, unless otherwise specified:

a. Use the dimensions on the Plans to build the bases.

1) Make top and bottom plates that meet the requirements of ASTM A 709/A 709M, Grade 36 (250), and are fabricated to receive the shaft, anchor bolts, and the foundation bolts.

2) Make the side panels meet the requirements of AISI 1020.

3) Create a base thick enough for the height of the standard.

b. Fit the base with a door that can be securely fastened.

7. Anchor Bolts

a. Provide bolts as follows:

Lighting standard	4 anchor bolts
Lighting tower	8 anchor bolts (minimum)

b. Use the size indicated on the Plans or as required by the manufacturer's shop drawings.

c. Use anchor bolts, nuts, and washers that meet the requirements of AASHTO M 314, Grade 55(370). Supplementary requirement S 1 of AASHTO M 314 also applies.

NOTE: Do not use Grade 105 (724).

d. Install anchor bolts with a leveling nut and a flat washer between the leveling nut and the base plate.

1) Use a template to install the bolts.

2) Place a flat washer on top of the base plate.

3) Lock a lock washer on top of the flat washer and secure the nut.

4) Fully grout the space between the shoe base and the top of the footing with non-shrink grout.

e. Galvanize threaded ends of anchor bolts, hexagonal nuts, flat washers, and lock washers according to ASTM A 153/A 153M and Plan details.

8. Finish

Unless otherwise specified, galvanize all steel lighting standards and towers, including pole, base, transformer base, and bracket arm assembly according to ASTM A 123/A 123M.

C. Acceptance

1. The Engineer reserves the right to make test and inspections as necessary to ensure compliance with these Specifications and to reject items that fail testing.

2. The Engineer will accept the steel lighting standards and towers based on:
    - The results of physical and chemical tests made by the Department.
    - The manufacturer's certification showing physical and chemical properties of the metal prior to forming.

D. Materials Warranty

General Provisions 101 through 150.

920.2.02 Aluminum Lighting Standards

A. Requirements

Include the following in making aluminum lighting standards:

1. A pole and bracket arms as required on the Plans.
2. An aluminum base welded or bonded to the lower end, complete with bolts for use as an anchor base pole or attached to an approved breakaway device such as an aluminum transformer base, breakaway couplings, etc., when so specified.

B. Fabrication

Use aluminum materials that meet the requirements of AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.

1. Roadway Standards
    a. Make the shaft with a continuous taper and weld, or bond a base to the lower end.
    b. Give the shaft a reinforced handhole with a cover, except when a transformer base is specified.
    c. Provide a 0.5 in (13 mm) approved grounding connection in the shaft or base.
    d. Equip the top of the shaft with a removable pole cap held securely in place with set screws.
2. Post Top or Other Standards for Special Installation

    Do the following, unless otherwise specified:

    a. Build the standard to meet the requirements for roadway standards (Subsection 920.2.01.B.1).
    b. Make the top diameter of the shaft 3 in (75 mm), or include a 3 in (75 mm) tenon to insert the shaft or tenon into the luminaire.
3. Anchor Base

    Do the following, unless otherwise specified:

    a. Secure the one-piece aluminum base to the lower end of the shaft by either:
        - Using two continuous welds.
        - Inserting the base at least 12 in (300 mm) into the shaft and bonding with a weatherproof structural epoxy adhesive that fully develops the required strength as specified by the design criteria.
    b. Ensure that the base develops the full strength of the adjacent shaft section to resist bending.
    c. When the Plans call for a frangible or breakaway base, attach the base to an approved breakaway device with an approved number and type of bolts, or use a base that is an approved breakaway type.
    d. Provide removable cast or pressed aluminum covers with each base. Appropriately attach each cover to the base.
4. Aluminum Bracket Arms
    a. Use the Plan design and dimensions.
    b. Ensure that the installed bracket arm connects securely with the shaft and has a smooth wiring raceway.

c. Use stainless steel bolts and nuts that meet the requirements of ASTM A 193/A 193M, Type B8C or AISI 304, to attach the bracket arm assembly.

5. Transformer Bases

a. Form the base of cast aluminum that meets the requirements of ASTM B 108, Alloy A03560, T6 to dimensions on the Plans. Use aluminum as the primary material.

b. Make the top so it can receive the anchor base bolts and the bottom so it can receive the anchor bolts.

6. Anchor Bolts

Use bolts as described in Subsection 920.2.01.B.7.

7. Finish all aluminum lighting standards, including pole, base, transformer base, and bracket arm assembly in a natural aluminum color, unless otherwise specified.

C. Acceptance

1. The Engineer reserves the right to make test and inspections as necessary to ensure compliance with these Specifications and to reject items that fail tests.
2. The Engineer will accept the aluminum lighting standards and towers based on:
   - The results of physical and chemical tests made by the Department
   - The manufacturer's certification showing physical and chemical properties of the metal prior to forming the standard

D. Materials Warranty

General Provisions 101 through 150.

920.2.03 Prestressed Concrete Lighting Standard

A. Requirements

1. Make the prestressed concrete lighting standard of the design and dimensions in the Plans. Make the standard with machines in steel forms by the centrifugal spinning process to ensure maximum density.
2. Use a manufacturing method that produces a smooth cable raceway throughout the length of the standard.

Make the raceway between 1.5 to 2 in (38 to 50 mm) in diameter when measured at the top of the standard.

B. Fabrication

1. Use materials and manufacturing methods according to Section 865 with the following exceptions:

a. Concrete: Use Class AAA concrete with a maximum aggregate size of 3/8 in (10 mm) and a maximum slump of 0.5 in (15 mm) after the spinning process.

b. Detension: You may detension the standards after 24 hours under a low-temperature steam process.

However, if the standard does not reach a compression strength of 3,500 psi (25 MPa) in this 24-hour period, the Inspector will reject the standard.

c. Finish: Ensure that the standard has a smooth, uniform finish from a water carborundum mechanical process that removes the laitance and surface content revealing the aggregate.

2. Bases

a. Furnish the standards with an anchor base or a precast butt base.

NOTE: If using the precast butt base, cast it as an integral part of the standard during the spinning process. Make a conduit entrance as shown on the Plans.

b. Make the bolt-down anchor base have a cast steel anchor base that meets the requirements of ASTM A 27/A 27M, Grade 70-36 (485-250).

c. Secure the base to the primary pole reinforcement so it is strong enough to transmit the required loads to the anchor bolts.

3. Bracket Arms

a. You may make the bracket arm assembly of aluminum or steel that meets the requirements shown herein.

b. Galvanize the steel bracket arm assembly according to ASTM A 123/A 123M.

C. Acceptance

1. The Engineer reserves the right to make test and inspections as necessary to ensure compliance with these Specifications and to reject those items failing such tests.
2. The Engineer will accept these standards based on tests made by representatives of the Department during the manufacturing process.
3. Give sufficient notice to the Engineer prior to manufacture to arrange for the required inspection.

D. Materials Warranty

General Provisions 101 through 150.

920.2.04 Service Car

A. Requirements

1. Use a power-driven hoisting device suitable for safely servicing any level of the lighting tower.
2. Furnish shop and working drawings or illustration sheets as needed according to Section 105.
3. Transfer to the Engineer all guarantees on materials and equipment that the manufacturer normally furnishes, together with all operating instructions and service manuals.

   Include in the guarantees the provision that they are subject to such transfer.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Submit guarantees on materials and equipment.

920.2.05 High Mast Luminaire Support and Lowering Assembly

A. Requirements

1. This assembly shall be a mechanical device capable of supporting the luminaire assembly at the required operating position and raising and lowering the assembly to ground level for servicing.
2. Furnish shop and working drawings or illustration sheets according to Section 105.
3. Transfer to the Engineer all guarantees on materials and equipment that the manufacturer normally furnishes, together with all operating instructions and service manuals.

   Include in the guarantees the provision that they are subject to such transfer.

B. Fabrication

1. Use AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals to build the assembly.
2. Support Head Frame

   Use a head frame with three supports for the suspension cables and a pulley for the power cable.

a. Place the suspension supports 120 degrees apart. Place the power cable pulley midway between two suspension supports.

b. Attach two pulleys to the inside of each support, one at each end. Construct the pulleys so that the suspension cables ride freely in the groove of the pulleys.

Provide cable guides and retainers to keep the suspension cables and power cable inside the pulleys.

c. Supply a hood for the support head frame to protect against weather for all working components at the pole top. Ensure that the hood adequately ventilates the pole.

3. Luminaire Mounting Ring

a. Equip the inner portion of the ring with approved roller-contact, spring-loaded centering arms. The arms center the luminaire ring while ascending or descending the pole, protect the pole and luminaires, and prevent jamming during the raising and lowering operations.

Make the rollers for the centering arms of a water-resistant, non-marking composition material.

b. Design the mounting ring to symmetrically mount the number of luminaires indicated on the Plans.

1) Provide a weatherproof junction box and terminal board terminating the power cable and connecting the luminaire wiring.

2) Provide a weatherproof power receptacle to test the luminaires when the ring is in the lowered position.

4. Non-Latching Device Design

a. If the design does not have a latching device at the top of the pole, position the luminaire mounting ring tightly against the support head frame.

NOTE: Use a positive, visible indication that the required force has been applied.

b. Make sure the luminaire mounting ring and support head frame can hold the luminaire mounting ring in place and prevent rotation while in the raised position.

5. Latching Device Design

a. Use a latching device at the top of the pole to latch all three suspension points and support the total weight of the ring including luminaires.

b. Place all moving parts of the latching device in the luminaire mounting ring.

NOTE: Use a positive, visible indication of the latching position.

6. Miscellaneous Hardware

Use non-corrosive miscellaneous fittings, fasteners, and hardware for the support head frame and luminaire mounting ring. Use an approved means for locking nuts.

7. Hoisting Systems

a. Ensure that each pole has three suspension cables and one hoisting cable.

b. Use cables that have 7 strands of 19 wires each, made of stainless steel aircraft cable according to MIL-W-83420, Type 1, Composition B.

c. Use at least 0.2 in (5 mm) diameter suspension cables and at least a 0.25 in (6 mm) diameter hoisting cable.

d. Anchor the ends of the pole's suspension cables to the top of the suspension cable bracket assembly. Pass the other ends through the pulleys on the support head frame and attach to the luminaire mounting ring.

e. Secure the hoisting cable at the bottom center of the suspension cable bracket assembly. Attach the other end to the drum of the motor-driven winch.

Prevent future twisting and eliminate any tension developed during initial installation of the hoisting cable system.

f. Use a worm-gear reducing winch with a reduction ratio that is self-locking in both raising and lowering operations.

   Completely enclose the worm-gear in a lubricating reservoir.

g. Make the winch operable with either an electric drill motor or a NEMA frame motor as described in Lowering Device Power Supply Unit.

h. Provide a hand crank for raising and lowering.

i. Include a cable guard/retainer for the winch drum. This will force the cable away from the ends of the drum for spooling and prevent the cable from coming off the drum.

j. Design the entire hoisting system so that power cable, suspension cables, and hoisting cable may be replaced from the ground.

8. Lowering Device Power Supply Unit

   a. Use a lowering device power supply unit that is either an electric drill motor or a NEMA frame motor.

      1) Equip both motors with a factory-set torque limiter. Power each from a weatherproof outlet or receptacle located in the service area of the pole.

      2) You may use a stepdown transformer to supply the required motor voltage.

   b. Make the transformer an integral part of the power supply unit, when required.

   c. Attach and lock in place the drill or motor at the pole handhole. Provide a remote control system that works from at least 20 ft (6 m) away.

9. High Mast Power Cable

   a. Use extra-heavy duty power cable in a jacket that resists oil and sunlight. Include in the cable the number and size of copper insulated conductors required on the Plans.

   b. Securely connect the power cable to the luminaire mounting ring and the suspension cable bracket assembly so it will not damage the cable and supports only its own weight.

10. Pole Disconnect

   a. Furnish each pole with a molded case circuit breaker in a NEMA enclosure of the size and type specified on the Plans.

   b. Make the breaker accessible through the pole handhole. Get the breaker from the manufacturer of the raising and lowering device.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Submit guarantees on materials and equipment.

920.2.06 Grounding

A. Requirements

General Provisions 101 through 150.

B. Fabrication

1. Connect the power system ground to the pole.
2. Include a grounding conductor with the high mast power cable and connect it to the luminaire mounting ring.
3. Ground the pole disconnect to the pole.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

General Provisions 101 through 150.