



## SECTION 1091

### LIGHTING EQUIPMENT

#### 1091.1 Lighting Poles.

**1091.1.1 Pre-Approval.** Fabricators shall submit six copies of shop drawings and supporting calculations to Traffic. Submittals shall be approved by Traffic in writing prior to fabrication of the lighting poles. Shop drawings shall indicate complete design details required for pole fabrication, including material grades and thicknesses, welding and orientation of any longitudinal seams. Shop drawings shall provide pole installation and hardware details. Design details for all possible pole combinations shown on the plans may be submitted. All welding procedures shall be prepared by the manufacturer as a written procedure specification and shall be submitted with the shop drawings for approval. Approval of the weld procedures will be required before approval of the shop drawings. Shop drawings shall indicate the specific approved welding procedure to be used for each joint. Shop drawings and supporting stress calculations shall be signed and sealed by a registered professional engineer in the State of Missouri. Upon written approval, pre-approved drawings may be used on any project where the design conditions of the shop drawings are not exceeded.

**1091.1.2 Requirements.** Lighting poles shall be steel or aluminum in accordance with the contract and shall be of the same material and design throughout the project. Poles shall be of the type shown on the plans. The fabricator may furnish poles with other shapes, gages and dimensions meeting or exceeding those shown on the plans and specifications. The mounting height of the slipfitter above the pavement and the pole design numbers will be specified by numbers following the pole type designation. Clamps shall be provided for connecting bracket arms to poles to obtain the specified mounting height. All poles shall have removable raintight metal pole caps. All handhole covers and pole caps shall be attached to the pole with a chain constructed of the same material as the pole and shall be held in place by screws. The screws shall penetrate through the metal cap or cover and pole securely attaching the cap or cover to the pole. The chain shall be capable of supporting at least six times the weight of the cover or cap and be securely attached to the inside of the pole and of sufficient length to allow removal of the cover or cap for maintenance access. An aluminum or stainless steel identification tag with embossed or engraved letters and numbers shall be provided with all poles as shown on the plans. The tag shall be attached to the pole 6 inches above the top of the handhole or 18 inches above the base plate over the transformer base door. Shims may be used between the pole base or transformer base and the foundation for leveling purposes. Four copies of applicable pre-approved drawings shall be supplied with the poles and shall be provided to the engineer.

**1091.1.2.1 Type AT.** Each Type AT pole shall be provided with a transformer base in accordance with [Sec 901](#). A grounding conductor shall be attached to the ground lug in each transformer base as shown on the plans.

**1091.1.2.2 Type B and MB.** Each Type B and MB pole shall have a wiring handhole with a suitable metal cover near the base using a grounding lug inside the pole as shown on the plans. A grounding conductor shall be attached to the ground lug in each pole as shown on the plans.

**1091.1.2.3 Steel.** Steel lighting poles shall be round or octagonal shaft poles. The shaft section shall be fabricated from basic oxygen or open hearth steel sheet, No. 11 gage, as one

continuous shaft or as individual segments no less than 10 feet in length, joined together using electrically welded, intermediate, transverse, full penetration, circumferential joints. Each sheet shall be formed into a tube with one continuous-welded longitudinal seam. After manufacture, the material shall have a minimum yield strength of 48,000 psi, including the weld. Poles shall be manufactured with steel shoe bases or base plates attached to the lower end of the shafts and arranged for bolting to a transformer base or to a foundation. All base plates and shoe bases shall be equipped with four cast steel or cast iron nut covers in accordance with AASHTO M 103 or M 105 or four aluminum nut covers and shall have four galvanized or stainless steel screws for securing covers to the pole. Welding and fabrication of the assemblies shall be in accordance with the ANSI/AWS D1.1 *Structural Welding Code-Steel*. All poles, shoe bases, base plates and cast steel or cast iron nut covers shall be fully galvanized after fabrication.

**1091.1.2.3.1** For shoe base-type poles, each shoe base shall be a one-piece casting in accordance with AASHTO M 103, Grade 65-35 with four anchor bolt holes. Each shoe base shall consist of a collar, flange and gussets, all integrally cast. Ample fillet radii shall be provided at the juncture of these components to reduce the effects of stress concentration. The flange of the base shall be flat and continuous around the outside of the collar. The base shall telescope from the shaft and be secured by two continuous welds. One weld shall be on the inside of the base at the end of the shaft and the other weld shall be on the outside at the top of the base. The shoe base shall be arranged for bolting to a transformer base or to a foundation.

**1091.1.2.3.2** For base plate-type poles, the base plate shall be no less than 13 inches square and no less than 1 1/4 inches thick.

#### **1091.1.2.4 Aluminum.**

**1091.1.2.4.1** Aluminum lighting poles shall be round shaft poles. Each shaft shall be manufactured as a two-piece pole by the spun drawn method from seamless extruded aluminum tubing, ASTM B 221, Alloy 6063-T6 and shall have a nominal wall thickness for the lower section of 0.250 inch and a nominal wall thickness for the upper section of 0.188 inch. The one-piece shaft for 30-foot mounting height shall have a nominal wall thickness of 0.188 inch, except those with twin-truss type arms shall have a nominal wall thickness of 0.250 inch. Shoe base-type poles shall be manufactured with heavy cast aluminum shoe bases attached to the lower ends of the shafts. Each shoe base shall be a permanent mold casting in accordance with ASTM B 108, Alloy 356.0-T6 and shall be free from cracks, pits and blowholes. The shoe base shall be arranged for bolting to a transformer base or to a foundation. The base shall have four anchor bolt holes, shall be equipped with four cast aluminum bolt covers and shall have four stainless steel fasteners for securing covers to the shoe base. Each shoe base shall consist of a collar, flange and gussets, all integrally cast. Ample fillet radii shall be provided at the juncture of these components to reduce the effects of stress concentration. The flange of the base shall be flat and continuous completely around the outside of the collar. The base shall telescope from the shaft and be secured by two continuous welds. One weld shall be on the inside of the base at the end of the shaft and the other weld shall be on the outside at the top of the base. The base and shaft shall be welded in the T4 temper with filler alloy 4043 and precipitation heat treated, artificially aged, to the T6 temper by an approved method after welding. Welding shall be in accordance with Article 6.9 of AASHTO's *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*.

**1091.1.2.4.2** At the fabricator's option, the shafts for aluminum lighting poles may be formed from one piece of aluminum sheet, ASTM B 209, Alloy 5086-H34, having one continuous weld. The one-piece shaft for the 30-foot mounting height shall have a 9-inch diameter at the base and a nominal wall thickness of 0.135 inch. Shafts for 35 to 55-foot mounting heights shall have a 13.4-inch diameter at the base and a nominal wall thickness of 0.135 inch for both

sections. Each shoe base shall be a permanent mold casting having an integral cast aluminum riser and shall be in accordance with ASTM B 108, Alloy 356.0-T6 and shall be free from cracks, pits and blow holes. The integral riser shall be designed to slip-fit into the pole shaft a sufficient distance to develop the full strength of the pole. The riser shall be bonded to the shaft with a structural epoxy adhesive that shall develop the strength of the pole. The epoxy shall develop a minimum of 1,200 psi in shear when tested in accordance with ASTM D 1002. The shoe base shall have four anchor bolt holes, shall be equipped with four cast aluminum bolt covers and shall have four stainless steel fasteners for securing the covers to the shoe base. Each shoe base shall consist of a collar, flange and gussets, all integrally cast. The flange of the shoe base shall be flat.

**1091.2 Transformer Bases.** Transformer bases shall be permanent mold castings in accordance with ASTM B 108, Alloy 356.0-T6 and shall be free from cracks, pits and blow holes. The transformer base shall be designed to accommodate and provide access to electrical equipment. The base shall have internal lugs for mounting on a foundation and shall be designed for bolting to the base plate of the lighting pole using flat and lock washers. A grounding lug shall be provided in each base. The access opening shall have a hinged fiberglass or plastic door with a tamper-resistant fastening device. The outside of the door shall be imprinted or adequately labeled with the warning, "DANGER - HIGH VOLTAGE". No direct payment will be made for transformer bases.

**1091.3 Circular Steel Pile Foundations.** Circular steel pile foundations, the steel connector plate and steel closure plate shall be of the dimensions shown on the plans. The slotted hole may be saw cut or flame cut. All sharp edges shall be ground smooth. The steel connector plate and steel closure plate shall be welded to the steel pile foundation. The foundation assembly shall be fully galvanized after fabrication. Bolts shall project no less than 1/4 inch nor more than 5/8 inch beyond the nut when properly tensioned. Flat and lock washers shall be used for attachment.

**1091.4 Steel H-Pile Foundations.** Steel H-pile foundations and steel connector plates shall be of the dimensions shown on the plans. The steel connector plates shall be welded to the H-pile foundation. The foundation assembly shall be fully galvanized after fabrication. Bolts shall project no less than 1/4 inch or more than 5/8 inch beyond the nut when properly tensioned. Flat and lock washers shall be used for attachment.

**1091.5 Screw Anchor Foundations.** Screw anchor foundations and steel connector plates shall be of the dimensions shown on the plans. The slotted hole may be saw cut or flame cut. All sharp edges shall be ground smooth. The steel connector plates shall be welded to the screw anchor shaft. The foundation assembly shall be fully galvanized after fabrication. Bolts shall project no less than 1/4 inch nor more than 5/8 inch beyond the nut when properly tensioned. Flat and lock washers shall be used for attachment.

**1091.5.1** Fabricators for screw anchor foundations shall submit four copies of shop drawings to Traffic. Shop drawings shall indicate complete design details required for fabrication, including material grades, dimensions, thicknesses and welding. Shop drawings shall provide installation procedures and indicate the maximum torque ratings of the foundations.

**1091.5.2** Submittals shall be approved by Traffic in writing prior to fabrication. Upon written approval, pre-approved drawings may be used on any project where the design conditions of the shop drawings are not exceeded.

**1091.6 Bracket Arms.** Bracket arms shall be similar in design to those shown on the plans, arranged for 2-inch slipfitter luminaire mounting, and shall be attached to the poles as shown on the plans. Bracket arms shall be of the same material as the pole. Bracket arm mounting plates shall match the shape of the pole. A one-inch pipe nipple shall be welded in place in the

wire entrance hole on the mounting plate. The welds shall be placed on the side of the plate away from the pole. Flat and lock washers shall be used for attachment.

### **1091.7 Luminaires.**

**1091.7.1 Roadway.** High pressure sodium luminaires for roadway lighting shall be of the enclosed type with lamps burning in a horizontal position and for the type of circuit specified. Type III medium distribution, semi-cutoff light distribution shall be set in accordance with the manufacturer's recommendations unless otherwise directed by the engineer, or shown on the plans. Each luminaire shall have an aluminum housing with two 2-inch slipfitters or one 4-bolt slipfitter or one 2-inch slipfitter with a longitudinal leveling system and an internal ballast kit designed for that fixture. The housing shall have a natural aluminum or gray baked enamel finish. Reflectors shall have an alzak aluminum finish with reverse flange. The refractor shall consist of prismatic or flat heat-resistant glass in a cast aluminum holder. Plastic refractors shall not be used. The holder shall be secured to the luminaire by means of a hinge and an automatic latch. All metal parts, such as springs on the latches and hinges, U-bolts and screws shall be made from non-ferrous metal or stainless steel. All parts of the luminaire shall be fabricated from corrosion resistant material. The lamp size shall be as specified in the contract. A standard identification marker, in accordance with the latest version of ANSI C136.15, shall be included with the lamp. Lamps shall have a rated life no less than 20,000 hours for 400-watt, 15,000 hours for 250-watt and 12,000 hours for 150-watt lamps, based on ten hours per start. Wiring inside the luminaire housing shall be protected by suitable heat resistant insulating material. The reflector-refractor optical assembly and the ballast shall form a single unit. The optical system (reflector, bottom refractor, lamp socket and lamp) shall be a sealed chamber with provisions for filtered ventilation. Ventilation shall permit intake and exit of air into or from the chamber as a result of expansion or contraction of air in the chamber due to lamp heat. The ballast shall be pre-wired to the lamp socket and to a terminal board such that only the connection of the supply leads to the ballast primary terminals is necessary. A pipe stop shall be included in the assembly to locate the luminaire properly on the bracket arm. Ballasts shall be of the regulator type and shall operate satisfactorily throughout a voltage range of  $\pm 10$  percent of the nominal primary voltage rating. The change in lamp wattage over this range shall not exceed the manufacturer's recommendations. The ballast shall start and operate the lamp satisfactorily to a minimum temperature of -20 F. The ballast shall have a power factor of no less than 90 percent.

**1091.7.2 Underpass.** Luminaires for underpass lighting shall be high-pressure sodium. The luminaires shall consist of a pre-wired unit for wall mounting, with raintight cast aluminum housing, cast aluminum door with integral cast guard, heat-resistant glass prismatic refractor, asymmetric aluminum reflector and socket for horizontal lamp position, complete with 150-watt lamp and 240-volt or 480-volt ballast as required. Type IV short distribution, non-cutoff light distribution shall be set in accordance with the manufacturer's recommendations, unless otherwise directed by the engineer or shown on the plans. The door shall have a stainless steel hinge along the bottom, stainless steel latches at the top and non-ferrous metal or stainless steel safety chains. Provisions shall be made for attaching the unit directly to a wall or to an outlet box stud with non-ferrous metal or stainless steel hardware. Ballasts for underpass luminaires shall be in accordance with [Sec 901](#). The ballast power cables shall be individually fused with in-line fuse holders between the line and load, in the junction box or the luminaire housing if no junction box is shown on the plans. The fuse rating shall be three amps unless otherwise shown on the plans.

**1091.7.3 Navigation.** All lanterns shall be weatherproof and operate on a 120-volt system. Lanterns shall be of the fresnel lens-type and shall be fabricated from a corrosion-resistant material. Each lantern shall provide an LED or a standard service lamp with at least four standby lamps controlled by a lampchanger mechanism capable of illuminating the standby lamp after each lamp burnout. Mounting brackets and all accessories shall be provided with

each lantern. A swing arm and retrieval chain shall be provided for main channel lanterns to hold the fixture in proper operating position. The swing arm and retrieval chain shall be capable of being locked in both the upright and inverted positions. Mounting brackets shall be fully galvanized or stainless steel, and all hardware shall be stainless steel.

**1091.8 Control Stations.** Control stations shall consist of all equipment and material necessary for the distribution of secondary electrical power as shown on the plans. Control stations will be specified by the secondary voltage.

**1091.8.1 Cabinets.** Control cabinets shall be of sufficient size to house all equipment as shown on the plans. All equipment such as circuit breakers, switches, contactors, fuses, photoelectric controls and terminal blocks shall be installed on the panel as shown on the plans. Control cabinets shall have a control panel constructed of the same material as the cabinet. Cabinets shall be NEMA 4, dust-tight, watertight and constructed of 0.125-inch minimum reinforced sheet aluminum alloy and be of clean-cut design and appearance. All hinges, catches and other hardware shall be non-ferrous metal or stainless steel. Cabinets shall have a No. 2 Corbin cabinet lock and provisions for locking with a padlock. Two keys for cabinet locks shall be furnished by the contractor. Mounting shall be as shown on the plans.

**1091.8.2 Lightning Arrestors.** Lightning arrestors shall be of the rated voltage as shown on the plans.

**1091.8.3 Photoelectric Controls.** Photoelectric controls shall be of the cadmium-sulfide or solid-state type operating on 120 volts or 240 volts, as shown on the plans and shall operate on a line supply of 50 to 60 hertz. The load capacity of the photoelectric cell relays shall be a minimum of 1,000 watts. Photoelectric cells shall operate a lighting system through mercury load relays or contactors as shown on the plans. The photoelectric cell circuitry shall be designed to be normally closed at night. The photoelectric cell shall be configured such that in the event of failure, the lights shall be on. The turn-on range shall be adjustable from 1.0 to 3.0 footcandle. A turn-on setting of 1.0 footcandle and a turn-off setting of 2.0 footcandles shall be made at the factory. The photoelectric cell shall have a time delay to avoid operation due to lightning and transient light. A suitable bracket for mounting the photoelectric cell shall be provided. The photoelectric cell shall be mounted into a three-prong twist lock socket. All top mount photoelectric controls shall face an open sky and side mount photoelectric controls shall face north. Each photoelectric control unit shall include a lightning arrestor. Test switches used with photoelectric controls shall be three-position switches or two single-pole breakers as shown on the plans. Test switches shall be clearly labeled and mounted in the control cabinet.

**1091.8.4 Contactors.** Contactors shall be NEMA Type 1 enclosed, magnetic-type, two-pole, single phase for 600 volts, 60-hertz service. The operating coil shall be designed for 120-volt or 240-volt operation as shown on the plans. The contactor shall be electrically held, have the minimum rating and shall be housed in the control cabinet as shown on the plans. Mercury load relays shall be two-pole, normally-open, mercury contact, magnetic-type with load capacity as shown on the plans.

**1091.8.5 Circuit Breakers.** All circuit breakers shall be molded-case thermal-magnetic circuit breakers. The number and trip rating of circuit breakers shall be as shown on the plans. All breakers shall be designed for panel mounting with cable connections on the line and load sides.

**1091.8.5.1 Type A Circuit Breakers.** Type A circuit breakers shall have a minimum of 18,000 amps alternating current interrupting rating at 240 volts alternating current and 14,000 amps alternating current interrupting rating at 480 volts alternating current. Breakers

shall be full-size and designed to accept wire sizes up to 2/0 AWG. Terminals shall be provided for the wire sizes as shown on the plans.

**1091.8.5.2 Type B Circuit Breakers.** Type B circuit breakers shall have a minimum of 10,000 amps alternating current interrupting rating at 240 volts alternating current. Type B circuit breakers shall have a nominal size no greater than one inch wide by 4 inches high by 3 inches deep. Terminals shall be configured for the wire sizes as shown on the plans. If the breaker terminals are not designed for the required wire sizes, suitable terminal adapters, connectors or terminal blocks shall be used to convert the wire sizes.

**1091.9 Power Supply Assembly.**

**1091.9.1** Disconnect cabinets shall be NEMA 4, dust-tight and watertight. The operating handle shall have full cover interlock to prevent the door from opening when the breaker is on. The enclosure shall have provisions for padlocking the enclosure and for padlocking the switch in the on or off position.

**1091.9.2** Meter boxes shall be NEMA 3R or NEMA 4.

**1091.10 Cable Splicing.**

**1091.10.1** Splice blocks shall be designed for the wire size used, shall have one port per wire and the wires secured with set screws. The set screw holes shall be protected with removable plugs.

**1091.10.2** Resin splice kits shall consist of a protective plastic case designed for the type of connector used, filled with a resin insulating compound mixed in accordance with the manufacturer's recommendations.