

## **Section 4185. Highway Lighting Materials**

### **4185.01 DESCRIPTION.**

- A.** Furnish materials for highway lighting of the size and type specified.
- B.** When more than one unit of any item is required for installation, furnish units that are all the same make and design. Furnish apparatus and materials that meet the following:
  - Are new products of manufacturers regularly engaged in production of items of this type,
  - Are the manufacturer's latest approved design,
  - Carry the UL seal of approval, if listed, and
  - Are recommended by the manufacturer for the intended use.

### **4185.02 POLES AND SUPPORTS.**

#### **A. General.**

1. Furnish steel, aluminum, or wood poles of the size and type specified.
2. Each lighting pole is to include provisions for supporting the luminaire or luminaires. If furnishing metal poles, furnish poles consisting of:
  - A tapered round shaft, complete with a base, and removable pole top,
  - Nameplate or other identification displaying the manufacturer's name, type, height, and shop order number, and
  - Appurtenant supporting devices.
3. Dimensions and other details will be shown in the contract documents. Furnish poles and mastarms meeting the mounting height and mastarm length shown in the contract documents. Ensure the structural design of the light pole is based on the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.
4. The assembled lighting unit, consisting of the pole and all attachments including mastarms, luminaires, and breakaway base or slip base, as specified, complete and in place in the footing anchor bolts, is required to withstand windloading equal to a wind of 80 mph (130 km/h) without fracture or apparent deformation of components. Furnish poles in one section. Ensure each standard is designed for a luminaire dead load of 75 pounds (35 kg) and a projected area of 1.5 square feet (0.10 m<sup>2</sup>), except that in the case of twin mastarms, these values are applied to each mastarm.
5. Furnish castings incidental to poles that are smooth and clean, with all details well defined and true to pattern.
6. Furnish pole bases that telescope the pole shaft and are attached to the pole shaft by two welds (top and bottom) subject to approval of the Engineer. Ensure bases other than slip base poles have four anchor

bolt holes located 90 degrees apart in the bolt circle. If slip bases are furnished, ensure they have three anchor bolt holes located 120 degrees apart in the bolt circle, oriented as shown in the contract documents. For poles with mastarms, ensure the centers of two adjacent anchor bolt holes are on a line parallel with the neutral plane of the pole shaft with respect to one mastarm, designated as the standard mastarm.

7. Obtain a template from the manufacturer for placement of anchor bolts.
8. With the pole, furnish metal ornamental covers for the upper ends of the anchor or attachment bolts for breakaway base poles.
9. Provide a wiring handhole, no less than 4 inches by 6 inches (100 mm by 150 mm), with a weatherproof metal cover, for all metal poles not mounted on transformer bases, or as shown in the contract documents. Center the handhole on a point no less than 14 inches (350 mm) or no more than 18 inches (450 mm) above the bottom surface of the pole base mounting flange, and 90 degrees clockwise from the center line of the standard mastarm, as viewed from above. Ensure the pole shaft has a J-hook at the top for supporting cables.
10. Ensure each pole has an approved grounding lug. When a handhole is furnished, ensure the grounding lug is readily accessible through the handhole. Ensure grounding lugs for breakaway base poles are accessible from the bottom of the pole shaft.

#### **B. Anchor Bolt and Slip-Base Plate Fasteners for Lighting Poles.**

1. Furnish all bolts, nuts, and washers for pole attachment and anchoring according to the details in the contract documents. Ensure assembled fasteners are capable of withstanding the forces corresponding to a moment that will cause failure of the pole, transformer base, or other applicable mounting device.
2. Furnish anchor bolts that:
  - Meet the requirements of ASTM F 1554, Grade 105 (724 MPa),
  - Are full-length galvanized according to ASTM F 2329, and
  - Are Unified Coarse Thread Series with Class 2A tolerance.
3. Color code the end of each anchor bolt intended to project from the concrete in red to identify the grade.
4. If slip bases are furnished, furnish 1 inch by 4 1/2 inch (25 mm by 112 mm) bolts slip base plate that:
  - Are high-strength bolts meeting the requirements of ASTM A 325, and
  - Are fully mechanically galvanized to ASTM B 695, Class 50 55, Type 4 I.
5. Furnish washers that:

- Meet the requirements of ASTM F 436, and
  - Are galvanized.
6. Furnish nuts that:
- Meet the requirements of ASTM A 563, DH,
  - Are heavy hex, and
  - Are galvanized according to the requirements of ASTM A 153 F 2329, Class C, or ASTM B 695, Class 50 55, Type I.
7. Nuts may be over-tapped according to the allowance requirements of ASTM A 563. Nuts may be tapped oversize only enough to provide a finger free fit.

**C. Mastarms and Accessories.**

1. When indicated in the contract documents, furnish single or twin mastarms as luminaire supports. The contract documents will show the horizontal span of the mastarm and the included angle between the center lines of twin mastarms. Such angles are defined as rotating from the standard mastarm, as viewed from above.
2. Furnish mastarms meeting the following requirements:
  - a. Aluminum tube or galvanized steel to match the pole, with smooth openings into the pole shaft to provide an electrical raceway.
  - b. Capable of accommodating a 2 inch (50 mm) slipfitter type luminaire.
  - c. **Type A mastarms:** no braces or truss members.
  - d. **Type B mastarms:** a single underbrace attached to the mastarm at no less than two locations.
3. Furnish mastarm bolts, nuts, and washers that are stainless steel and meet the requirements of [Article 4187.01](#).

**D. Breakaway (Transformer) Base.**

Furnish bases meeting the following requirements:

1. Cast aluminum meeting requirements of ASTM B 108, 356-T6 or B 26, 356-T6 aluminum alloy.
2. Compliance with AASHTO breakaway criteria.
3. Capable of withstanding an applied moment at the top equal to the design moment of the applicable pole, and no less than 35,000 foot-pounds (47,500 N·m).
4. Yields to an applied momentum of 1,100 pound-seconds (4.9 kNs) when tested with an automobile or 400 pound-seconds (1.8 kN-s) when tested with a solid mass. The manufacturer should conduct the tests and certify the results to comply with requirements of current AASHTO requirements for breakaway luminaire supports.

5. Equipped with a weatherproof access door with door opening area of no less than 100 square inches (0.065 m<sup>2</sup>), unless shown otherwise.

**E. Steel Poles.**

1. Furnish poles meeting the following requirements:
  - a. Shafts manufactured with a taper of approximately 0.14 inch per foot (12 mm/m) of length.
  - b. Steel that is no less than 11 gage (3.03 mm), with a minimum yield strength of 48,000 psi (330 MPa), after fabrication.
  - c. Steel galvanized according to ASTM A 123. Steel 1/8 inch (3 mm) thick or less shall be galvanized to comply with requirements for 1/8 inch (3 mm) thick steel as described in ASTM A 123.
2. Furnish Type A and B mastarms meeting the following:
  - a. Fabricated from standard weight, welded steel, 2 inch (50 mm) pipe meeting the requirements of ASTM A 53, Grade B, and galvanized according to ASTM A 123.
  - b. Underbrace for a Type B mastarm complying with requirements of the mastarm and connected to the mastarm by welded steel braces to form a truss type assembly.
  - c. Mastarm to shaft brackets that provide a water tight connection.

**F. Aluminum Poles.**

1. Furnish poles meeting the following requirements:
  - a. Fabricated from ASTM B 221 6063-T6 or 6061-T6 aluminum alloy tube or ASTM B 209 5086-H34 aluminum sheet.
  - b. Minimum nominal wall thickness of 3/16 inch (5 mm) unless indicated otherwise in the contract documents.
  - c. Shafts tapered approximately 0.14 inch per foot (12 mm/m) of length.
  - d. Castings of ASTM A 356/A 356M-T6 aluminum alloy meeting the requirements of Article 4187.01.
  - e. Approved dampening device included.
  - f. Blocked and paper-wrapped prior to shipment.
2. Furnish Type A and B mastarms meeting the following:
  - a. Fabricated from alloy complying with requirements for the pole shaft.
  - b. Types A and B mastarms fabricated from tubing or pipe with a minimum outside diameter of 2.375 inches (60.325 mm), and swaged, when required, to accommodate a 2 inch (50 mm) slipfitter type luminaire.
  - c. Welded braces used to connect the underbrace for a Type B mastarm to the mastarm in order to form a truss type assembly.

**G. Wood Poles.**

1. Furnish poles meeting the following requirements:
  - a. ANSI 05.1, Group D.

- b. Pressure treated with pentachlorophenol according to AASHTO M 133.
2. The size and class of wood poles will be specified in the contract documents.

**4185.03 LUMINAIRES.**

**A. Roadway Luminaire.**

1. Furnish roadway luminaire assemblies consisting of the following:
  - a. A weatherproof, die cast aluminum or aluminum alloy housing and slipfitter with internally mounted ballast.
  - b. A hinged, detachable, glass refractor manufactured from high-transmission-factor, highly shockproof, prismatic glass.
  - c. A snap-in aluminum reflector.
  - d. A high grade porcelain enclosed socket and terminal block with pressure type terminals for connecting leads entering from the mounting bracket or mastarm.
2. Fit a heat resistant gasket between the reflector and a shoulder in the socket support plate to seal the optical system at this point.
3. Furnish a slipfitter that consists of bracket clamps and provides for vertical adjustment and horizontal leveling of the luminaire. Arrange the slipfitter to accommodate a 2 inch (50 mm) standard pipe bracket.
4. Furnish a weatherproof, hinged, access door for quick access to the terminal block and mounting arrangement. Ensure exposed metal parts are made from nonferrous metal or stainless steel.
5. With the high pressure sodium lamp, furnish a regulated high-power-factor type ballast with starting current lower than operating current. Ensure it will maintain lamp wattage within 10% variation with a line voltage regulation of  $\pm 10\%$ , with no less than 90% power factor. Ballast for use with other light sources will be specified in the contract documents.
6. The contract documents will specify the luminaire according to the type of lamp to be used and its size in watts. Unless specified otherwise, furnish only the light sources for roadway luminaires listed in Table 4185.03:

**Table 4185.03-1: High Pressure Sodium Lamp**

400 Watt	ANSI Code S51WA-400
250 Watt	ANSI Code S50VA-250
200 Watt	ANSI Code S66MN-200
150 Watt	ANSI Code S55SC-150
100 Watt	ANSI Code S54SB-100
70 Watt	ANSI Code S62ME-70

Furnish high pressure sodium lamps for appropriate burning positions, as required by the luminaire.

## **B. Low Mounting Height Luminaires.**

1. Furnish complete low mounting height luminaires consisting of the following:
  - a. An optical train which includes a single piece, prismatic refractor mounted in an aluminum door assembly.
  - b. An asymmetric, specular processed aluminum reflector.
  - c. An anodized aluminum visor.
  - d. An attached or integral ballast housing.
  - e. A cast aluminum luminaire housing.
  - f. When specified, an adaptor mount and shield for sign lighting.
2. Furnish a door assembly equipped with noncorrosive metal pressure latches, hinges, and safety chain.
3. Furnish a luminaire housing complete with:
  - Captive neoprene and felt double gasketing,
  - A rear access hole in a gasketed aluminum cover plate, and
  - Tapped conduit entries as shown in the contract documents.
4. Furnish a refractor that meets the following:
  - a. Fabricated from molded, high-transmission-factor, thermal shock resisting, crystal glass.
  - b. Is of adequate size to properly house the specified lamp and to produce the required light distribution.
  - c. Inner and outer surface are covered with an array of reflecting and refracting prisms and diffusing flutes which are designed to provide an asymmetric light distribution.
5. With a high pressure sodium lamp, furnish a regulated high-power-factor type ballast with starting current lower than operating current. Ensure it will maintain lamp wattage within 10% variation with a line voltage regulation of  $\pm 10\%$ , with no less than a 90% power factor. The contract documents will specify the ballast for use with other light sources.
6. Ensure maximum luminous intensity (candela) output occurs at 60 degrees from the vertical. Ensure the unit provides a 180 degree horizontal spread in the maximum luminous intensity (candela) plane.
7. Ensure entire luminaire is designed to be attached to a wall outlet box mounted to a stud, a metal channel framing, or a sign lighting adaptor and shield. Unless specified otherwise in the contract documents, furnish the light source for the luminaire listed in Table 4185.03-2:

**Table 4185.03-2: High Pressure Sodium Lamp**

250 Watt	ANSI Code S50VA-250
150 Watt	ANSI Code S55SC-150
100 Watt	ANSI Code S54SB-100
70 Watt	ANSI Code S62ME-70
Furnish high pressure sodium lamps for appropriate burning positions, as required by the luminaire.	

**4185.04 GROUND RODS.**

- A. Furnish approved, copper clad, steel rods of the diameter and length designated in the contract documents.
- B. Unless designated otherwise, furnish rods of a minimum nominal 5/8 inch (16 mm) diameter, and a minimum length of 12 feet (3.6 m) for control stations and 8 feet (2.4 m) for installations at lighting units.
- C. Include pressure type clamps and bonding jumpers as required. Unless shown otherwise in the contract documents, furnish bare solid conductor copper wire, No. 6 AWG or larger, bonding jumpers.

**4185.05 CONTACTORS.**

- A. Lighting contactors may be housed within control cabinets as shown in the contract documents.
- B. Meet the following requirements for contacts:
  - 1. Two pole, single throw, magnetically held, normally open relays rated at 480 volts AC or greater.
  - 2. Double break, self cleaning type with interrupting ratings as shown in the contract documents.
  - 3. Material designed for lighting ballast loads and requiring no maintenance, such as filing, burnishing, or dressing at any time the contactor is in service.
  - 4. A permanent instruction contained within the cabinet housing stating, "Contacts shall not be filed, burnished, or dressed".
  - 5. Movable contact holders of one piece, molded construction. Opening action obtained by free fall from gravitational forces or by use of noncorrosive springs. The Contractor may use pivots of the hardened, knife edge type.
- C. Meet the following requirements for operating coils:

1. A 60 hertz frequency supply.
2. Removable from the front of the contactor assembly without disturbing other components or wiring.
3. Each designed to prevent any expansion, bubbling, or melting that would render the remainder of the unit inoperative in event of a coil burnout.

**4185.06 PHOTO-ELECTRIC CONTROL.**

Furnish controls meeting the following requirements:

- A. Weatherproof.
- B. Fits the standard 3 prong EEI/NEMA twist-lock socket.
- C. Operates with a 60 hertz frequency control circuit.
- D. Designed so that any failure under normal conditions will cause the lighting circuits to be energized.
- E. All ratings in compliance with the control requirements of the contactor.
- F. Time delay type set to turn on at 2.0 footcandles (20 lux) and off at 6.0 footcandles (60 lux).

**4185.07 CONTROL CABINETS.**

- A. Furnish cabinets meeting the following requirements:
  1. Type 304 stainless steel minimum 14 gage, or 0.125 inch (3.17 mm) aluminum, weatherproof NEMA Type 3R enclosures.
  2. Full-sized door gasket.
  3. Drip shield.
  4. Top-mounted 3 prong photo-electric control socket.
  5. Insect-proof breather.
  6. Labyrinth type breather drain.
  7. An internal back panel for component mounting.
  8. Door with a single external padlock handle to operate a door latch. Latch mechanism to include no less than two approved roller latches.
  9. Cabinet size adequate to provide access to all components for maintenance and replacement without disturbing other components or wiring.

10. Unless detailed otherwise in the contract documents, space provided for no less than one line (main) circuit breaker and four branch circuit breakers, one contactor, two surge suppressors, and a test switch.
  11. Each pole-mounted cabinet equipped with pole mounting brackets, conduit, and hubs.
  12. Each pad-mounted cabinet equipped with a removable bottom plate and an internal flange with hold-down clamps for attachment to a concrete base.
- B.** The contract documents will show the location, type, and other details of control cabinets.
- C.** Include the following appurtenances:
1. A line circuit breaker that may also serve as main disconnect means.
  2. A photo-electric control.
  3. Two surge suppressors.
  4. A maintained contact, three position switch (with all functions labeled as shown in the contract documents) to provide a means of overriding automatic operation of the lighting system for testing purposes.
- D.** The contract documents will show the quantity and ratings of circuit breakers and other details of individual installations.

#### **4185.08 HANDHOLES.**

**A. Precast Handholes.**

1. Ensure the body of the precast handhole meets requirements for Class 1500D (75D) concrete pipe.
2. For the handhole cover, furnish a heavy duty cast iron frame and lid that sits inside the pipe end.
3. The contract documents will show handhole locations and other details.

**B. Preformed Handholes.**

Furnish handholes meeting the following requirements.

1. Constructed to the dimensions shown in the contract documents.
2. Constructed with mortar consisting of sand, gravel, and polyester resin reinforced by a woven glass fiber mat or of resin mortar and fiberglass.
3. Constructed to withstand a load of 20,000 pounds (9,000 kg).
4. Each handhole equipped with a bolt-down cover of the same material.

5. Lock down bolts of stainless steel with penta head.

#### **4185.09 JUNCTION BOXES.**

##### **A. Preformed Junction Boxes.**

Furnish boxes meeting the following requirements:

1. Constructed to the dimensions shown in the contract documents.
2. Constructed with mortar consisting of sand, gravel, and polyester resin reinforced by a woven glass fiber mat or of resin mortar and fiberglass.
3. Each junction box equipped with a bolt-down cover of the same material.
4. Stainless steel screws.

##### **B. Cast Iron Junction Boxes.**

1. Furnish boxes meeting the following requirements:
  - a. Cast iron boxes and covers galvanized according to ASTM A 153.
  - b. Boxes classified by the manufacturer as meeting the requirements for NEMA 4, Watertight.
  - c. UL approved boxes.
  - d. Apply applicable provisions of Article 370 of the current NEC.
  - e. Raised buttons (blind drilled, tapped, and fitted with screws as specified) of the specified size and location cast into the surface of the box floor and cover for grounding purposes.
  - f. Neoprene gaskets used.
2. The contract documents will show locations and other details.

#### **4185.10 CONDUIT AND FITTINGS.**

##### **A. General.**

1. The type, size, and location of all conduit will be indicated in the contract documents. Do not substitute types of conduit material.
2. Furnish weatherproof fittings of identical or compatible material to the conduit. Use standard factory elbows, couplings, and other fittings when possible.
3. Limit the inside radius of all field bends to no less than 6 times the internal diameter of the conduit. Bend so as not to kink, flatten, or otherwise significantly reduce the effective cross sectional area of the conduit.

##### **B. Rigid Steel Conduit.**

Furnish conduit meeting the following requirements:

1. Compliance with ANSI C80.1.

2. Identified with the manufacturer's name and trade mark and the words "rigid steel conduit" or "rigid metal conduit."
3. Weatherproof expansion fittings with galvanized, malleable iron, fixed and expansion heads jointed by rigid steel conduit sleeves. As an option, the fixed head may be integral with the sleeve, forming a one piece body of galvanized malleable iron.

**C. Rigid Aluminum Conduit.**

Furnish conduit meeting the requirements of ANSI C80.5.

**D. Plastic Conduit and Fittings.**

Furnish conduit and fittings meeting the following requirements:

1. PVC Schedule 40 and 80 plastic conduit and fittings meeting the requirements of NEMA TC-2, TC-3, and UL 651 for Schedule 40 heavy wall type.
2. Solvent welded, socket type fittings, except where indicated otherwise in the contract documents.
3. Threaded adaptors for jointing plastic conduit to rigid metal ducts.
4. Compliance with applicable requirements of NEMA TC-3 and UL 514 and the manufacturer's recommendation for all materials and methods for attaching and making fittings. Obtain the Engineer's approval.

**4185.11 CONNECTOR ASSEMBLIES.**

Details of connector assemblies will be shown in the contract documents. Furnish connectors with complete instructions, assembly devices, and silicone lubricant for all mating surfaces. Meet the following requirements for the type specified:

**A. Type Y-1 Connector.**

1. Furnish fused Y-1, quick disconnecting type tap connectors consisting of:
  - a. Two spring loaded, fully annealed copper contacts of 90% minimum conductivity suitable for gripping a 13/32 inch by 1 1/2 inch (10.3 mm by 38 mm) midget fuse, two terminal lugs, a bolt, and a locknut.
    - One contact adapted to be crimped to the cable and retained securely within a rubber load side tap housing.
    - The second contact preassembled and retained in a rubber Y-insert-body with provision for connecting the terminal lugs securely in place.
  - b. A permanently marked, load side tap housing, a Y-insert-body, and a Y-housing, each made of water resistant synthetic rubber. Ensure the load side housing:
    - Provides a section to form a watertight seal around the cable,
    - Has an interior arrangement to suitably receive and retain one fuse contact,
    - Is constructed to retain the fuse when disconnected, and

- Has a section to provide a watertight seal between itself and the Y-insert-body at the point of disconnection.
2. Ensure the Y-insert-body retains the second fuse contact and provides a watertight seal for the load side housing at the point of disassembly. Ensure the Y-housing provides sections to form a watertight seal around two cables and for Y-insert-body. When both through legs of the connection are not to be used, furnish an insulated plug with the same diameter as the cable to maintain an equivalent watertight seal.

## **B. Type Y-2 Connector.**

1. Furnish unfused Y-2, quick disconnecting type tap connectors consisting of:
  - a. A copper pin to be crimped to the cable and a spring loaded copper receptacle, both of 90% minimum conductivity, two terminal lugs, a bolt, and a locknut. The receptacle and the crimping portion of the pin are to be fully annealed. The pin is to be adapted to be retained securely within a rubber load side tap housing. The receptacle is to be preassembled and retained on a rubber Y-insert-body with provision for bolting the terminal lugs securely in place.
  - b. A permanently marked load side tap housing, a Y-insert-body, a Y-housing, each made of water resistant synthetic rubber. Ensure the load side housing:
    - Provides a section to form a watertight seal around the cable,
    - Has an interior arrangement to suitably receive and retain the pin, and
    - Has a section to provide a watertight seal between itself and the Y-insert-body at the point of disconnection.
2. Ensure the Y-insert-body retains the receptacle and provides a watertight seal for the load side housing at the point of disconnection and a watertight seal for the Y-housing at the point of disassembly. Ensure the Y-housing provides sections to form a watertight seal around two cables and for the Y-insert-body. When both through-legs of the connection are not to be used, provide an insulated plug with the same diameter as the cable to maintain an equivalent watertight seal.

## **C. Type Y-3 Connector.**

Furnish semi-permanent Y-3 tap connectors consisting of:

1. Three terminal lugs (each provided with a mounting hole by which all lugs are bolted securely together), a bolt, and a locknut.
2. A tap housing and a Y-housing, each made of water resistant synthetic rubber. Ensure the tap housing: 1) provides a section to form a watertight seal around the cable; and 2) includes a section to provide a watertight seal between itself and the Y-housing at the point of disassembly. Ensure the Y-housing provides sections to form a watertight seal around two cables and for the tap housing. When all legs

of the connection are not to be used, provide an insulated plug with the same diameter as the cable to maintain an equivalent watertight seal.

**D. Type L-1 Connector.**

Furnish fused L-1, quick disconnecting in-line connectors consisting of:

1. Two spring loaded, fully annealed copper contacts of 90% minimum conductivity suitable for gripping a 13/32 inch by 1 1/2 inch (10.3 mm by 38 mm) midget fuse. Both contacts are to be adapted to be crimped to the cable and retained securely within rubber housings.
2. A permanently marked, load side and line side housing, each made of water resistant, synthetic rubber. Ensure each housing:
  - Provides a section to form a watertight seal around the cable,
  - Has an interior arrangement to suitably receive and retain the fuse contact, and
  - Has a section to provide a watertight seal between the two housings at the point of disconnection.

**E. Type L-2 Connector.**

Furnish L-2, unfused, quick disconnecting in-line connectors consisting of:

1. A copper pin and a spring loaded copper receptacle, both fully annealed and of 90% minimum conductivity, to be crimped to the cable. Both the pin and receptacle are to be adapted to be retained securely in rubber housings.
2. A permanently marked, load side and line side housing, each made of water resistant, synthetic rubber. Ensure each housing:
  - Provides a section to form a watertight seal around the cable,
  - Has an interior arrangement to suitably receive and retain the pin or receptacle, and
  - Has a section to provide a watertight seal between the two housings at the point of disconnection.

**4185.12 WIRE AND CABLE.**

Wire and cable construction types, conductor sizes, and working voltage ratings will be specified in the contract documents.

**A. Single Conductor Wire and Cable.**

Furnish wire and cable meeting the following requirements:

**1. Insulation.**

- Rated for 600 volts.
- Thermosetting, cross linked polyethylene meeting the requirements of ICEA S-66-524 (NEMA WC-7).
- Thickness meeting the requirements of Table No. 3-1 Column "A".
- Unless specified otherwise in the contract documents, comply with applicable requirements of UL Standard No. 44.
- UL listed for use at conductor temperatures of 167°F (75°C) or higher in wet or dry locations.

**2. Wire and Cable.**

- Bear required UL labeling repeated throughout their length.
- UL Listed Type USE-2 per UL Standard 854 and Type RHH or RHW-2 per UL Standard 44.

**3. Conductors.**

- Annealed copper meeting the requirements of ASTM B 3.
- Sizes smaller than No. 8 AWG, may be solid or stranded.
- Sizes No. 8 AWG and larger are to be stranded and are to meet the requirements of ASTM B 8, Class B.

**B. Aerial Power Cable.**

Furnish cable consisting of an assembly of individually insulated conductors with a messenger cable. The insulated conductors may be either laid about the messenger or secured to the messenger with a flat binding strip. Meet the following requirements:

**1. Conductors.**

Stranded aluminum or steel reinforced aluminum (ACSR).

**2. Messenger.**

Steel or ACSR. If using steel, use steel protected with copper, aluminum, or zinc coating.

**3. Binding strip.**

Copper, bronze, or steel. If using steel, use steel protected with copper, aluminum, or zinc coating.

**4. Insulation.**

Meet the requirements of [Article 4185.12, A](#).

**C. Thermoplastic Wire and Cable.**

Use only where specified in the contract documents. Use conductors that meet the requirements of UL Standard No. 83 and are UL listed for Type THW or Type THHN (THWN).

**D. Control Cable.**

**1.** Use only where specified in the contract documents. Furnish cable consisting of either:

- An assembly of conductors individually covered with polyethylene insulation, or
- Polyethylene insulation with polyvinyl chloride jacket together with suitable fillers covered overall with polyester tape and a polyvinyl chloride jacket.

**2.** Ensure the cable complies with requirements for Type B Control Cable as described in ICEA S-61-402 (NEMA WC-5).

**E. Flexible Cord.**

Use cord that is UL listed for Type SO and complies with applicable requirements of UL Standard No. 62 (Table 3.14).

**F. Bare Copper Ground Wire.**

1. Use soft drawn wire meeting the requirements of ASTM B 3, or medium hard drawn wire meeting requirements of ASTM B 2.
2. For direct burial installation, use solid wire for sizes smaller than No. 4 AWG and stranded wire for sizes of No. 4 AWG and larger. For installation in raceways or ducts, use solid wire for sizes smaller than No. 8 AWG and stranded wire for sizes of No. 8 AWG and larger. Ensure stranding meets the requirements of ASTM B 8, Class B.

**4185.13 SURGE SUPPRESSOR.**

Furnish suppressors meeting the following requirements:

- A. Metal oxide varistor type suppressor, suitable for 120/240 volt single-phase line voltage, with a UL1449 Category B3 voltage rating of 500 volts (line-neutral).
- B. Single-pulse (8/20 microsecond) maximum surge current rating of 50,000 amperes.
- C. NEMA 1 enclosure included that is suitable for mounting inside a lighting control cabinet.
- D. Each line fused and a visual indication light installed to show power and suppression status.

**4185.14 TEST SWITCH.**

Furnish switches meeting the following requirements:

- A. Heavy duty maintained contact, three position switch.
- B. 600V, 10 amperes, double break type contact.

**4185.15 CIRCUIT BREAKER.**

Furnish breakers meeting the following requirements:

- A. Rated for 240 volts and 480 volts, with minimum interrupting ratings of 25,000 amperes, symmetrical, at 240 volts, and 18,000 amperes, symmetrical, at 480 volts.
- B. Thermal magnetic trip mechanism with a trip-free toggle operator.
- C. Frame and trip ratings as shown in the contract documents.