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### REVISION OF SECTION 613

###  HIGH MAST LIGHTING

Section 613 of the Standard Specifications is hereby revised for this project to include the following:

**DESCRIPTION**

This work consists of furnishing, installing, and testing a complete high‑mast lighting system comprised of foundations, high‑mast steel lighting standards with mast head assembly and lowering device, an electrical control and distribution system, and all incidentals for high‑mast lighting in accordance with these specifications and in conformity with the details, grades, and locations shown on the plans or established.

**MATERIALS**

Before ordering any materials, the Contractor shall submit to the Engineer for approval three copies of a complete list of all of the high mast lighting equipment and materials which the Contractor intends to install. This list shall include, but is not limited to, the following:

1. Light standards, anchor bolts and grounding system;
2. Lowering device;
3. Luminaire mountings including aiming diagrams;
4. Luminaires, lamps, ballasts and shielding;
5. Aviation warning lights (if required);
6. Cables, splicing and termination devices;
7. Conduits, conduit bends and splices, and electrical bushings;
8. Fuseholders, fuses and cable disconnect devices;
9. Lighting Control Center including enclosure, breakers, switches, conductors, relays, lightning arresters and ground system;
10. Wiring and connection diagrams of all cabinets, circuits, luminaires, and controls;
11. Pull boxes and splice boxes;
12. Secondary Service Pedestals;
13. Caissons;
14. Concrete Foundation Pads.

The Contractor shall furnish three copies of all certificates of compliance supplied by the manufacturer of the equipment. This equipment includes, but is not limited to, the following:

1. Luminaire support and lowering system
2. High‑mast light standards
3. Electrical conductors and cable
4. Circuit breakers
5. Photoelectric cells
6. Luminaires, lamps, ballasts and shielding
7. Aviation warning lights (if required)
8. Grounding system (10 ohms or less)
9. Splice and pull boxes
10. Anchor bolts
11. Luminaire photometric data in IESNA format

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### HIGH MAST LIGHTING

(a) *Light Standards.* The high mast pole shall consist or round or multi-sided tapered steel tubes with standard tapered rate of 0.14 inches per foot. The pole sections shall telescope together a minimum of 1.5 times the bottom section top diameter at the point of overlap if the pole cannot be shipped in one piece. No field welding shall be permitted in the assembly of the pole.

Poles sections over 13.0 inches in diameter shall be fabricated of ASTM A-572, G grade 60 material possessing 60,000 psi minimum yield strength. Pole sections less than 13.0 inches diameter shall be fabricated of ASTM-A-595, Grade A material possessing 55,000 psi minimum yield strength.

The shaft of single unit poles shall be welded with backed up 100 percent penetration circumferential transverse welds. All circumferential transverse welds, except the base plate connection, shall be ground flush (+30 mils to -0 mil). Backup material must be contoured for full contacts, continuous and of the same material as the shaft.

Each shaft may have a maximum of two longitudinal electric welds with 60 percent minimum penetration. The weld shall have a smooth, uniform appearance.

Certified mill test reports shall be submitted before shop fabrication work begins.

All structural steel furnished, except as otherwise specified on the plans, shall meet the requirements of Section 509 of the Standard Specifications, galvanized inside and outside in accordance with the requirements of ASTM A‑123 and then treated as follows:

All galvanizing shall be performed in accordance with the requirements of ASTM A-123. All areas where galvanized coating has been damaged during handling and transporting shall be painted with one full brush coat of zinc‑rich paint meeting Military Specification DOD‑P‑21035A. The longitudinal welding along the light standard and the welding of the end attachments made during fabrication shall be performed prior to galvanizing.

The light standard and its accessories shall be manufactured of material of like appearance. The light standard cap, luminaire assembly, and its accessories need not necessarily match those of the light standard and its accessories if approved by the Engineer.

All miscellaneous bolts shall meet the requirements of ASTM A 325. All nuts, bolts, and washers supplied which are not galvanized shall have chemical properties of ASTM A 325, Type III.

All structural components of light standards, bases, anchor bolts, lowering devices, luminaires, and other attachments to be used for high‑mast lighting shall be designed for a minimum of 100 mph wind velocity with gusts up to 130 percent in accordance with AASHTO 2001 or with the current edition of the "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals" as published by AASHTO, except as provided herein.

A detailed stress analysis of the light standard shall be furnished.

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The Contractor shall furnish shop drawings of the complete light standard assemblies to the Engineer in accordance with section 105.02 of the CDOT Standard Specifications., along with certification that all materials used in the fabrication are in accordance with this specification.

Review of shop drawings by the Engineer will not relieve the Contractor of responsibility for correctness of dimensions or for other errors, but rather constitutes acceptance by the Engineer of the construction and fabrication methods being proposed by the fabricator.

A grounding nut, sized to accommodate a #1/0 AWG stranded copper conductor, shall be located internally at the light standard base and within easy access of the service hand hole.

A service portal and cover shall be located as shown on the plans and shall be constructed to minimum size of 10 inches x 30 inches or larger and shall have fully welded rim type reinforcement. A hinged cover, 0.25 inches thick steel with a neoprene gasket shall be provided. The light standard shall be reinforced to maintain full light standard strength in the area of the portal. The service portal shall be constructed so that its location shall not interfere with the operation of the lowering assembly.

Base plate and anchor bolts shall be as specified by the light standard manufacturer. The manufacturer shall furnish a notarized certificate stating that the bolts are of adequate strength to resist the loading specified.

Each anchor bolt shall come complete with a minimum of three galvanized hex nuts or approved equal of the appropriate size. The anchor bolts shall be threaded, and the threaded portion shall be galvanized to coat the exposed portion plus 3 inches of the threaded end. Threads shall be full and sound, Type UNC. All galvanizing shall be in accordance with ASTM A 153. The anchor bolts shall be of sufficient length to develop the full strength of the bolt. Hooks or anchor plates may be provided to engage sufficient concrete mass to fully develop the strength of the anchor bolts.

Each high‑mast light standard shall include a luminaire support and lowering assembly as shown on the plans. Steel shapes, plates and pipe shall conform to the designations shown on the plans and shall be constructed of steel meeting the requirements for structural steel in these specifications or for steel meeting the requirements of ASTM A709 Grade 36. The support and assembly shall be galvanized in accordance with ASTM A 123. The light standard cap, luminaire support, and lowering assembly do not necessarily need to be constructed of the same material as the light standard.

The basic requirements for the luminaire supports and lowering device are as follows:

1. The lowering device shall consist of three main sub-assemblies; the headframe, lowering ring and winch assembly. All materials used shall be corrosion-resistant.
2. All fixtures utilized on the lowering device shall have passed an accelerated vibration test of at least 1 g.
3. The head frame shall consist of a one piece welded assembly with hot dipped galvanized finish after fabrication.

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1. The head frame shall incorporate six hoist cable sheaves. Each sheave shall have a minimum six inch diameter and the cable groove shall be machined with a circular cross section to match the cable diameter. The sheaves shall have oil impregnated, pressed in sintered bronze bushings. Each sheave shall be fabricated from steel and have a zinc electroplated finish per ASTM A633, including a yellow chromate dip.
2. The sheaves shall meet or exceed the requirement of the Wire Rope Technical Board. Wire rope cables that operate over the sheaves shall be 7 X 19 construction aircraft cable 3/16 inch diameter stainless steel. The cables shall meet MIL Spec W83420C and Federal Specification RR-W-410d.
3. The head frame shall incorporate a power cord roller assembly consisting of multiple rollers providing a minimum 7 inch bending radius for the cord. The design shall prevent the power cord from riding up the sides of the rollers and shall incorporate keeper bars on the end to secure the cord.
4. Three high strength aluminum latch barrels shall be provided on the head frame assembly. Each latch barrel shall be designed to hold the entire weight of the ring and luminaires. All cam surfaces of the barrel shall be internally located and not affected by environmental conditions such as icing. The latch barrel shall support the ring in a top latched position, unloading the transition assembly, wire rope cables and the winch, when the lowering device is not in operation.
5. Three one-piece stainless steel latch pins shall be provided on the ring. Each latch pin shall be capable of individually supporting the entire weight of the ring and luminaires. Each latch pin shall be capable of individual rotation. Indicating flags shall distinguish the latching/unlatching sequence, and shall be visible from ground level. The latching or unlatching shall impart no more than 1 g of force to any component of the system including the luminaires and lamps.
6. The ring shall be fabricated of #7 gauge steel (minimum) with a hot dipped galvanized finish. The assembly shall include the number of luminaire mounting arm brackets as shown on the plans from 2 inch (minimum) pipe of sufficient strength to support the luminaire and shielding. The mounting arms shall be hot dipped galvanized finished and shall bolt to the ring with stainless steel hardware.
7. A NEMA 3R aluminum junction box shall be provided that includes a weatherproof inlet on its exterior for testing of the luminaires and lamps at ground level. The enclosure shall be factory pre-wired with the appropriate number of Type ST cords for the luminaires and the appropriate size main power cord. The power cord shall be securely attached to the ring using cable clamps.
8. The centering system shall consist of roller contact, spring loaded, cast aluminum arms designed to protect the pole, luminaires and lamps from damage during raising a and lowering of the luminaire ring assembly. The centering system shall keep the ring concentric to the pole during raising and lowering operation. The centering arms shall be interconnected to prevent jamming of the system on the pole during high winds. The springs shall be stainless steel. The roller shall be non-marking.
9. The transition assembly shall be designed to prevent misalignment of the three hoist cables. The wire rope cables shall be attached to the transition assembly with properly sized wire rope thimbles and factory swaged fittings. The attachment shall prevent the wire rope cable from untwisting under load. The transition plate shall be fabricated of steel with zinc plated finish.
10. The internal winch assembly shall have an ultimate strength of five times the lifted load. The winch shall include a 30:1 worm gear reduction and an internal drag brake on the input shaft to prevent free spooling of the winch drum. The drum shall be supported on both ends and shall include a stainless steel cable keeper designed to aid the correct spooling of the winch cable. The winch drum shall be factory pre-wound with 5/16 inch diameter stainless steel high strength 7 X 19 construction aircraft cable.

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1. One drive motor assembly shall be provided per project. The drive motor assembly shall include a minimum 1 horsepower (hp) heavy duty reversing type electric motor with a stalled torque at least twice that required to operate the lowering device. The motor shall drive the winch through a torque limiter coupling to limit the driving force on the hoist and winch cables. The torque limiter shall be factory pre set. There shall be a back up shear pin designed to shear at torque level between 50% and 100% over the torque limiter setting. The drive motor assembly shall have a 20 foot cord with drum switch for remote operation. The drive motor assembly shall be supplied with a step down transformer to provide 120 volt to the motor.

(b) *Luminaires and Lamps.* The luminaire shall be of the IESNA full cutoff type distribution type, UL listed for wet locations and have the approval of the Engineer prior to ordering. IESNA Type II, III, IV and V distributions shall be as listed on the plans. The luminaire shall be provided with aiming and shielding features as detailed on the plans.

Luminaires shall have precision die cast aluminum housing. The bracket arm clamp shall attach to a 2 inch nominal pipe and allow for a plus or minus 3 degree adjustment for leveling the luminaire.

Luminaires shall pass a vibration fatigue test simulating “1 g” peak acceleration for at least 500 million cycles.

Asymmetrical luminaire distributions shall have an aimable reflector with 360 degree orientation markings. Luminaires shall be pre-aimed by the manufacturer according to the plans and labeled for corresponding pole number and position on the ring assembly.

The luminaire assemblies shall be constructed to allow "breathing" during the time of energizing and de‑energizing of the lamp.

**CONSTRUCTION REQUIREMENTS**

A trained representative of the High Mast Lighting System manufacturer shall be present to supervise the erection of all poles and assembly of the lowering devices to insure proper operation of the High Mast System including lowering device operation, correct placement and alignment of luminaires with respect to the roadway, shielding locations and assembly ring weight balancing. This trained representative shall conduct a training session to a representative of the agency responsible for maintenance on the proper operation and maintenance of the high mast system, after completion of the project.

The Contractor shall document and record in the lighting control cabinet voltage and ampere readings. These readings shall be taken ahead of the contactor and below the contactor, and at the base of each light standard with the entire system in operation.

The Contractor shall construct the caisson type foundation at each location according to the details shown on the plans. Exact location and elevation of the top of the foundations will be approved by the Engineer.

All foundations shall be constructed to not less than the minimum dimensions shown on the plans. The size and number of conduit bends will be installed in each foundation as indicated on the plans. The caged anchor bolt assembly shall be placed in the foundation so that it remains plumb and with the projection set as specified by the pole manufacturer. Anchor bolts shall be "caged" in a manner specified by the manufacturer and approved by the Engineer. The bolt circle shall be centered over the foundation. The top elevation of the foundation shall be set accurately and leveled.

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All soil removed from the foundations and not required for backfill shall be disposed of as directed by the Engineer.

Drilled Caisson Type. The foundation construction shall conform to Section 503, Drilled Caissons. All irregularities in the cylindrical surface of the uncased holes outside of the nominal diameter shall be filled with concrete at the Contractor's expense. Forming of the top one foot will be required.

Light standards shall be installed as shown on the plans. The assembled lighting standard shall, under dead load and at equal ambient temperatures, be as near to true vertical alignment as practical. Adjustment shall be accomplished by use of leveling nuts, located on the anchor bolts below the base plate in accordance with instructions furnished by the light standard manufacturer.

After erection and alignment of the light standard, the space between the foundation and the base plate shall be filled with grout. A weep hole shall be installed at this time using a 1 inch PVC conduit as directed by the Engineer.

The end of this 1 inch conduit shall be fitted with a screen to keep foreign objects from entering the light standard base.

Luminaires and ballast assemblies shall be securely fastened to the 2 inch mast arms located on the luminaire ring and each light shall be adjusted so as to hang vertically when erection is complete. The Contractor shall be responsible for the correct placement and alignment of the luminaires with respect to the roadway.

Wherever the electrical cable passes through any metal or pulley, a grommet or other approved device shall be used to protect the cable from abrasion.

All splices required for distribution of power from portable cable to the individual ballasts shall be made in the junction box. Two conductors shall be routed to each ballast from the splice made in the junction box. These conductors may be of a smaller size, but not smaller than #12 AWG or than cable required elsewhere within the system to facilitate their installation.

Each luminaire support assembly shall be equipped with an approved lightning arrester and installed in an approved electrical manner. The "line leads" of the arrester shall be spliced to the "hot" portable cable conductors within the junction box. The "ground lead" of arrester shall be connected to the ground conductor of the portable cable at which point a positive ground connection is made with the luminaire support assembly. This positive ground may be accomplished by the use of a grounding lug attached to the luminaire support but not to the junction box. All splices and connections shall be internal to the system and not exposed to the elements. The arrester furnished shall be securely attached to the junction box or luminaire support assembly and not allowed to "hang loose."

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A fused switch or breaker shall be installed at the base of the light standard as shown on the plans and be of appropriate size. The switch shall be used to switch power on and off to the twist lock disconnect for the portable power cable and the receptacle for the lowering mechanism.

All surfaces except cast iron, galvanized, ASTM‑A588 (weathering) steel luminaires, ballasts and lighting control centers shall be painted in accordance with subsections 509.24 and 509.29, unless otherwise specified.

Welding shall be in accordance with the latest edition of AWS Specification D1.1 and the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

All transverse butt welds and the weld connecting the pole to the base plate shall be inspected by the Fabricator using radiographic methods in accordance with AWS D1.1 Section 6.

Exposed metal parts of the luminaire support system shall be electrically connected to the grounding conductor of the portable cable.

**METHOD OF MEASUREMENT**

Lowering Device shall include the luminaire support and lowering assembly including the headframe, lowering ring winch assembly and associated hoist cables. It shall also include all labor and testing required for a fully operational system.

**BASIS OF PAYMENT**

**Pay Item Pay Unit**

Light Standard Steel High Mast Each

Lowering Device Each