

**DIVISION 14  
LIGHTING****SECTION 1400  
ROADWAY LIGHTING****1400-1 DESCRIPTION.**

Furnish, install, connect, and place into satisfactory operating condition lighting at locations shown on the plans. Perform all work in accordance with the Specifications, the Plans, and the National Electrical Code.

This division is for methods, materials and equipment to construct and put in working order the proposed lighting; however, every fitting, minor detail, or feature may not be shown or described. The Contractor is assumed to be an expert in the trade, capable of understanding the intent of the plans and specifications and constructing the lighting and electrical system(s) in accordance with the best practice of the trade.

The contractor actually performing the work described in the specifications and the plans must have a license of the proper classification from the North Carolina State Board of Examiners of Electrical Contractors.

Have the licensed contractor available on the job site as necessary when work is being performed or when requested by the Engineer. Have this contractor maintain a set of project plans and specifications in his possession on the job site and a set of accurate "as built" plans. This contractor must be qualified to responsibly instruct and direct all employees regarding the electrical work.

**1400-2 MATERIALS.****(A) General:**

All materials used in the work are to be new materials unless noted elsewhere in the plans and specifications. References on the plans or in the special provisions to any proprietary device, product, material, fixture, form, type of construction, etc. by make or catalog number, with or without the words "or approved equal", is to be taken as establishing a standard of quality, and is not to be construed as limiting competition. In such case, the Contractor may use any material, equipment or type of construction which has written approval as being an acceptable equal to that named for the particular use intended by the specifications and plans.

Provide materials that are labeled or listed by an acceptable organization, which is defined as an organization that maintains periodic inspection of the production of the materials and verifies, by the labeling or listing procedure, that the materials comply with appropriate standards of performance or are suitable for use in a specified manner. Provide Underwriters' Laboratories (UL) labeled and listed materials when such labeling and listing is available for such materials.

Make sure that materials are in compliance with requirements for use of domestic products, as specified in other sections of the specifications.

**(B) Conduit:**

Use conduit and duct which is either metallic or non-metallic as noted on the plans or in the specifications.

Use rigid galvanized steel conduit for metallic conduit and duct per UL 6 "Rigid Metallic Conduit" with rigid full weight galvanized threaded fittings. Do not use aluminum conduit bodies with steel conduit fittings.

Use rigid PVC (polyvinyl chloride) heavy wall approved for non-metallic conduit and duct for above ground and underground use without concrete encasement per UL 651 "Rigid Non-Metallic Conduit".

**(C) Wire:**

Use stranded copper conductors unless specifically noted otherwise on the plans or these special provisions. Use wire and cable which conforms to IPCEA specifications and has marks for identification (manufacturer's name, type insulation, and gauge of conductor) and the UL label.

Use wire insulation rated at 600 VAC or greater.

Use the following types of wiring unless noted otherwise on the plans:

Service Lateral	- UL Type USE
Control System RHW or THHN	- UL Type THW or
Feeder Circuits in Conduit	- UL Type USE
Branch Circuits in Light Standards	- UL Type NM Cable
Equipment Grounding Conductor	- Solid MHD, Bare or Insulated
Grounding Electrode Conductor	- ASTM B-2

Feeder circuits in conduit with #8 conductors and smaller may consist of a cable assembly rated UL Type UF. Use #6 AWG for the grounding electrode conductor unless noted larger on the plans.

**(D) Grounding and Bonding Equipment:**

Use Ground Rods which are 5/8" (15.9 mm) diameter x 8' (2.4 m) copper clad steel and which have a one piece silicone bronze clamp with a socket or hex head screw. Make sure that all grounding and bonding equipment conforms to UL Standard 467, "Electrical Grounding and Bonding Equipment".

**(E) Fuseholders:**

Provide fused overcurrent protection in the base of each light standard, and other locations as noted. Use a fuseholder that is rated 600 VAC, 30 amp minimum, waterproof, and constructed so that the fuse will be disconnected from the line side power every time the fuseholder is opened. It may be made of molded plastic or rubber and have insulating boots. Use terminals which are specifically rated for the size and number of conductors required.

Use fuses which have 5000 amp minimum interrupting capacity at the supply voltage, are rated 10 amp or as noted on the plans, and are not glass type unless specified different in the plans and specifications. Use the same type fuse in all fuseholders on a project unless specified differently at specified locations.

Use fuseholders that have been specifically designed as breakaway devices in fiberglass standards and standards with breakaway bases. Use fuseholders that have been designed to disconnect line side power without damage to the terminals or conductors every time sufficient pulling force is placed on the line and load side conductors.

**(F) Hardware:**

Use mounting or attachment hardware including bolts, nuts, washers, straps, clamps, and hangers which is made of stainless steel, hot dipped galvanized or of equal corrosion resistance. Use bolts which are minimum length and are not less than 1 nominal size smaller than the opening being utilized.

**(G) Lamps:**

Use lamps which conform to ANSI specifications, are of the type and wattage indicated on the plans or specifications, are rated for a minimum of 24,000 hours life, have a mogul base, and have special coatings for premium efficiency and color rendition. Clearly mark the installation date on the base. Provide and install lamps for all luminaires furnished on the project.

**(H) Duct and Conduit Sealer:**

Use duct and conduit sealer or mastic which is a putty-like compound and:

- is permanently non-hardening, non-oxidizing, and non-corrosive to metals, rubber, plastic, lacquer and paints,
- is readily workable for thumbing into openings and forming into seals around wires inside conduits and openings around conduits,
- has a service temperature range of minus 30°F (-1°C) to 200°F (93°C)
- is clean, non-poisonous and non-injurious to human skin,
- seals against water, dust and air and shall adhere to wood, glass, plastics, metal, rubber, and painted surfaces.

**(I) Pull Lines:**

Place pull lines specifically designed for pulling a rope in all empty conduits and electrical duct so that electrical circuits can be installed in the future. Use pull lines which are 2 ply with a tensile strength of 240 pounds (1067.6 N) minimum and resistant to tangling, rot, and mildew.

**1400-3 SUBMITTALS.****(A) Catalog Cuts:**

Submit for approval catalog cuts and/or shop drawings for materials proposed for use on the project. Allow forty (40) days for review of each submittal. Do not deliver materials which have not been approved to the project. Submit eight (8) copies of each catalog cut and/or drawing and show for each the material description, brand name, stock-number, size, rating, manufacturing specification and the use for which it is intended. Three (3) copies of approved submittals will be returned to the Contractor.

Present a catalog cut or drawing for all components of each contract item. Present the submittals neatly arranged in the same order as the contract bid items.

**(B) Certifications:**

In accordance with Article 106-3, furnish a Type 3 - "Manufacturer's Certifications" for light standards, high mounts and lowering devices and a Type 6 - "Supplier's Certifications" for conductors. Submit certifications when the above materials are delivered to the project.

Type 3 or Type 6 Certifications may be requested for any or all of the other material which does not have a name plate showing sufficient information to verify that the material was manufactured to the requirements of these specifications.

**(C) Samples:**

Random samples will be taken of the various items for the purpose of verifying conformance with specifications. The selection of the items to be sampled and the taking of the samples will be done by the Engineer.

Failure to meet specification requirements by 2 samples of any material will be sufficient reason for rejection of all materials from the same lot.

Upon request, there will be reimbursement for the actual verified cost of such material taken as samples, including any handling charges less any discount allowed on the invoice, but with no percentage added, and such material will thereafter become the property of the Department.

**(D) As-Built Plans:**

Submit two complete sets of "as-built" plans for review upon completion of the work, showing the location of all buried electrical circuits, with pavement crossings dimensioned from fixed objects or from survey stations.

Include in the as-built plans the title (No. 1), index (No. 1A), summary of quantities (No. 3), and all of the layout and detail (E) sheets of the project with all changes indicated. After review and approval, place one set of these as-built plans in a waterproof envelope and file in each Control Panel.

Submit one set of as-built plans to the Design Services Unit.

Show the light standard foundations that are relocated (by permission of the Engineer) on the as-built plans in their final locations.

Keep a daily record of the location of all items in order to ensure the accuracy of the as-built plans.

**(E) Warranties:**

Turn over warranties from each manufacturer of electrical materials and equipment pertinent to the complete and satisfactory operation of the system prior to the acceptance of the project. Indicate on each warranty so furnished its expiration date and make sure that it is not less than those provided as a customary trade practice.

**(F) Computations and Welding Procedures:**

Submittals of structural design computations and drawings showing material and welding specifications as required in other sections of the specifications, such as High Mount Standards, may require ten (10) weeks for review.

**1400-4 CONSTRUCTION METHODS.****(A) Location Surveys:**

All light standards, high mount foundations, and electrical duct will be located unless indicated differently elsewhere in the specifications. Mark the proposed location of circuits, circuit markers, control systems, service poles, junction boxes, luminaires, and all other components for approval prior to installation. The top of foundation elevations will be provided unless indicated differently.

The plan locations of the light standards and high mounts may be adjusted in order to be behind guardrail, to avoid obstructions, or to avoid undesirable foundation conditions. Have location changes approved prior to construction. Have longitudinal relocations of luminaires of more than 10 feet (3 m) or lateral relocations of more than 2 feet (0.6 m) approved by the Design Services Unit.

Verify project dimensions on the site, actual measurement always taking precedence over scaled plan dimensions, with every part of the work fitted to actual conditions at the site.

**(B) Damage to Facilities:**

Take all precautions necessary to avoid damage to existing underdrains and other buried facilities located in certain areas. Hand trenching may be required to avoid damage to the underdrains, storm sewer systems and other facilities. Construct light pole foundations which have a minimum horizontal clearance of 10 feet (3 m) to storm sewers or other underground installations which might affect the foundation stability. Make lateral and longitudinal changes in pole locations in the field to provide the required clearance, as directed.

Trenching and construction operations may require the removal of or result in damage to existing shoulders and paved ditches. Restore all disturbed portions of the project to their original condition or as approved.

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Installation of conductors may require trenching through existing guardrail locations. The Trenching may be done beneath the guardrail in a manner that will not disturb the guardrail installation or the Contractor may remove short sections of guardrail to facilitate mechanical trenching. Reinstall all removed guardrail by the end of the day's work. Permission is required prior to removal of any guardrail. Repair any damage to the guardrail installation or to the galvanizing of the material as directed.

Repair all trenched, excavated, or otherwise damaged earth surface areas by shaping, smoothing, seeding, and mulching the damaged areas as required by the Specifications and as directed.

### **(C) Existing Utilities:**

Water, sewer, telephone, fire alarm, traffic signal, and power lines may be located in the same area that lighting standards and circuits are to be installed.

Locate these lines before operations are begun. Field changes approved by the Engineer may be made to provide clearance required by the National Electrical Safety Code.

Foundations or other construction which is installed in conflict with existing utilities will not be acceptable. Remove this construction and repair damage to utilities at no cost to the Department.

### **(D) Operation of Equipment:**

Use a bucket truck to raise workmen into position to install and/or adjust luminaires and lamps after the initial setting of the standards. Taking down the light standard to check or make adjustments at the top is not allowed.

### **(E) Conduit Installation:**

Install conduit continuous, watertight, free of kinks, and make all runs with as few couplings as standard lengths will permit. Do not exceed a total angle of 270° (3-90° bends) between outlets unless otherwise approved. Conduit bodies with covers and neoprene gaskets may be used to facilitate the installation of the wires at locations indicated on the plans.

Provide protection at all times against the entrance of water or other foreign matter into the conduit. Plug or cap conduit when work is temporarily suspended, including nightly stoppage of work.

Clean all conduit before installation, and upon completion of the system. Snake an approved cleaner with a diameter not less than 85% of the nominal diameter of the conduit through each conduit prior to installing the wire.

Install the conduit in such a manner that temperature changes will not cause elongation or contraction that might damage the system. Provide expansion fittings where conduit crosses structure expansion joints.

Avoid short radius bends in non-metallic conduit to prevent "burn-through" of the pulling cable or conductors during pulling operations.

Install caps or plugs on stub-outs for future use made of the same material as the conduit. Where non-metallic conduit is joined to metallic conduit, use a non-metallic female threaded adapter. Install bushings on all conduit ends projecting into panels, boxes, or other enclosures. Provide pull lines in all conduits for future installation of circuitry. Coat field cut threads and other uncoated metal or damaged galvanizing with organic zinc repair paint.

Securely fasten conduit. For the spacing of fasteners, do not exceed 4' (1.2 m) for 1 1/2" (38.1 mm) conduit and larger or 6' (1.8 m) for 1 1/4" (31.8 mm) conduit and smaller. Use fasteners that are hot dipped galvanized or stainless steel. Provide backs

with all conduit straps installed on flat surfaces. Rotary-impact drills may be used for installing expansion anchors in concrete. Do not use powder explosion type units.

Do not install underground conduit until the area has been brought to final earth grade. Give careful attention to the vertical and horizontal alignment of the conduit to provide the smoothest installation.

**(F) Wiring Methods:**

Do not pull wire through a conduit system until the system is complete and has been cleaned. Use approved wire pulling lubricants. Pull wires into conduit at a slow steady pace and give careful attention to assure that no wire is damaged.

Color code all conductors per the NEC (grounded neutral- WHITE; grounding - BARE or GREEN) and use phase conductors which are BLACK and RED. Approved marking tape, paint, or sleeves may be used in lieu of continuous colored conductors for No. 8 AWG and larger. Do not mark a white conductor in a cable assembly any other color. However, a white, red, or black conductor may be stripped at all accessible points and used as a bare equipment grounding conductor.

Joints, taps, and splices will only be permitted at locations indicated on the plans and by the following methods.

Locations in junction boxes and bases of standards:

- (1) Cut and remove the insulation only as far as necessary to make a secure mechanical and electrical connection. Use connectors which are a removable type (split-bolt, set screw, wire nut, etc.) and covered with self-vulcanizing rubber tape applied in half-lap layers, to give a smooth covering of not less than 2 times the thickness of the original insulation. Over the rubber tape, apply half-lap at least two layers of vinyl plastic tape. Use rubber tape which is a self-fusing type putty in tape form that can be wrapped, stretched, or molded around irregular shapes for smooth insulation build-up. Use vinyl plastic tape which is 7 mil (0-220°F [-17 - 104°C]) ultraviolet, abrasion, moisture, alkali, acid and corrosion resistant.
- (2) Install a manufactured mechanical or compression connector with factory made waterproof insulating boots in accordance with procedures and using tools as specified by the manufacturer.

**(G) Grounding Electrodes:**

Install grounding electrodes at each junction box, and control system as shown on the plans. Where installed in earth, drive them flush with the ground after installation of the clamp and conductor.

**(H) Equipment Mounting:**

Mount equipment securely at locations shown on the plans in conformance with the dimensions shown and make vertically plumb and level. Install fasteners as recommended by the manufacturer and space evenly. Utilize all mounting holes and attachment points for attaching enclosures to structures.

**(I) Concrete Foundations:**

Use concrete foundation dimensions verified in accordance with the details shown on the plans or approved drawings. Construct concrete foundations in accordance with Section 825 of the Standard Specifications. Use class "A" concrete, meeting the requirements of Section 1000 of the Standard Specifications and reinforcing steel which conforms to the requirements of Section 1070 of the Standard Specifications.

Perform foundation excavations which conform to the applicable provisions of Section 410 of the Standard Specifications. Construct the sides of the excavation to conform as nearly as practicable to the required dimensions. Place concrete against undisturbed soil unless otherwise permitted. If large discontinuities in the required

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configuration of the excavation are created by the removal of boulders or due to any other causes, backfill the excavation and compact as provided for in Section 410 of the Standard Specifications. Reexcavate the foundation to the proper dimensions.

Form foundations with prefabricated cardboard forms down to 6" (152.4 mm) min. below top of ground. Shoring, if used to stabilize the sides of the excavation, must be approved prior to its use.

Set the top of foundation elevation relative to the surrounding ground surface as shown on the plans. Chamfer corners at the top of foundation. Give exposed vertical concrete surfaces an ordinary surface finish and exposed horizontal concrete surfaces a float finish. Use non-shrinking grout, approved prior to its use, between the top of foundation and bottom of mounting base if indicated on the plans or other sections of the specifications. Provide drainage ("weep") holes through the grout so that water will not accumulate on top of the foundation or inside the standard.

Do not erect standards before test cylinders representing the foundation concrete have attained a minimum compressive strength of 3000 psi (20.7 MPa). Do not remove forms until the concrete has properly cured, and in no case less than 24 hours after the concrete has been placed.

Arrange anchor bolts symmetrically about the center of the foundations, brace securely, and hold in the proper position and alignment. Install electrical conduits of the size and number required by the circuits in the concrete as shown on the plans. The number of conduits shown on the plans is a guide only, with the actual number required being based on the number of circuits to be installed at the foundation being constructed; however, in no case should less than 2 conduits be installed.

Recess the tops of foundations which will have breakaway devices attached below normal grade. To avoid vehicle undercarriage snagging of any substantial remains of a breakaway support (when it is broken away), the edge of the foundation or top of anchor bolt should not extend more than four inches (4") (101.6 mm) above a sixty inch (60") (1524 mm) chord aligned radially to the centerline of the highway and connecting any point, within the length of the chord, on the ground surface on one side of the foundation to a point on the ground surface on the other side.

### **1400-5 INSPECTIONS.**

Maintain responsibility for having each electrical system inspected and approved by the electrical inspector having jurisdiction in the area in which the systems are located. Furnish written verification, prior to the final acceptance of the project, that the inspector has approved the electrical systems. Inspection by local authorities will neither eliminate nor supersede, the inspection by the Engineer to ensure compliance with the plans and specifications.

Comply with all local ordinances and regulations. Apply for and obtain all permits and/or licenses required by local regulation.

Have all work inspected and approved before concealment. An inspection will be made during the progress and after the work has been completed. It will also include an inspection made at night to determine the optical qualities of each luminaire. Adjust all luminaires having unsatisfactory qualities as directed.

Provide the necessary personnel and equipment for aiming luminaires during nighttime inspections by the Engineer.

### **1400-6 PERFORMANCE TESTS.**

Prior to acceptance, operate the lighting system, including automatic control equipment and all other apparatus, without interruption or failure attributable to poor workmanship or defective material for 2 consecutive weeks. All lights and equipment will be inspected for normal operation. Make all necessary repairs or replacements.

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Conduct the performance test at the same time for all lights which are energized from the same utility company service point.

Performance tests of individual circuits or groups of lights will not be acceptable.

Arrange with the power company to provide the electric power necessary. Separate payment will not be made for labor, materials, equipment, and incidentals required for performing the tests.

After all wiring has been installed and connected in the proposed permanent manner, but prior to the above operation period, give each feeder circuit conductor an insulation resistance test by the Engineer. Exceed 5 megohms after charging for 30 seconds at 500 VAC or 1000 VDC for the insulation resistance for each conductor

If the insulation resistance test of any conductor indicates a value of less than 5 megohms, locate the fault. If the fault is in a conductor between terminal connections, replace the conductor. If the fault is at a terminal connection, repair or replace the terminal device as directed. Have satisfactory insulation resistance on all wiring prior to beginning the 2 week operation test.

### **1400-7 IDENTIFICATION.**

Identify each component of the lighting/electrical system as indicated on the plans. Use a method of identification which includes an approved paint, adhesive label, heat shrink label or embossed concrete. Label conductors on components requiring identification at each terminal, circuit breaker, light standard, high mount standard, control system, junction box, and underpass panel.

Label each circuit conductor at each terminal and access point with the circuit number indicated on the plans.

Identify light standards and high mount standards by the control system and location number indicated on the plans. Put the identification on the front side of the standard facing the traffic at a height of 6 feet (1.8 m) above ground level. Identify control systems and underpass panels on the exterior of the front panel.

### **1400-8 LOCKS AND KEYS.**

Supply all access doors to control cabinet enclosures with locks that meet the Engineer's approval. Key all locks alike and furnish 8 keys to the Engineer.

### **1400-9 ELECTRICAL SERVICE.**

Coordinate all work to ensure that electrical power of the proper voltage, phase, frequency, and ampacity is available to complete the project. Contact the utility company, make application, pay all deposits and other costs to provide necessary electrical service. The Contractor will be reimbursed for the actual verified cost of any utility company charges.

The Engineer will provide authorization to the Contractor for electrical service to be obtained in the name of the Department and for the monthly power bills to be sent directly from the utility company to the Department. The Department will be responsible for direct payment of monthly power bills received from the utility company.

### **1400-10 TERMINOLOGY.**

The terms "high mast" and "high mount" are used synonymously in these specifications and the plans.

The term "by others" means work to be accomplished and paid for under contract items other than those clearly pertaining to the work specified or shown. Work "by others" may be included in this contract for the Contractor to provide, or it may be provided under another contract or by someone other than the Contractor.

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Abandon means that the materials will not be used in the final completed form of the work. Remove all abandoned materials from the project or terminate at least 18" (457.2 mm) below subgrade so that they will not be in conflict with the finished project.

### 1400-11 CONSTRUCTION PHASING.

Accomplish lighting work along with other roadway construction in the appropriate phases as indicated in the Traffic Control Plans and these specifications.

### 1400-12 COMPENSATION.

There will be no direct payment, except where specifically noted in the sections titled "Samples" and "Electrical Service", for the work required in the preceding sections of this division. Payment of the contract unit prices for the various items in the contract will be full compensation for all work required.

## SECTION 1401 HIGH MOUNT STANDARD

### 1401-1 DESCRIPTION.

Furnish and install a high mount standard 75' (22.9 m) or greater in height with a lowering device and portable drive unit including the drive, winch, wiring, cables, brackets, hardware transformer, power cord, storage case, and operating manuals.

### 1401-2 MATERIALS.

#### (A) High Mount Standard:

The standard may be either a multisided or round tubular member. Furnish 8 copies of completely detailed drawings and 1 copy of the complete design computations for each height of standard for approval prior to fabrication. Have the drawings show all details relating to pole, access hole, base, anchorage, and lowering device. Show references to ASTM specifications or to other material specifications for each type of material used on the drawings. Make sure that all drawings are clearly identified with a drawing number and signed and dated by the manufacturer's authorized representative. .

Show clearly full and complete information regarding location, type, size, and extent of all welds on the drawings. For groove welds, indicate the particular detail and process to be employed in production of the work. For prequalified joints, use of the Bridge Welding Code letter classification designation of the joint (B-Lzb-S etc.) will satisfy this requirement.

Note the total weight in avoirdupois (pounds) and metric (kilograms) on the drawings for each component and the total assembly.

The Contractor's attention is directed to the fact that it will take approximately 10 weeks to secure approval after submission of the complete drawings and computations.

Have the design of the support including base plate and anchorage conform to AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals" except the welding design and fabrication which must be in accordance with Article 1072-20 of the Standard Specifications. The support is to be designed for a wind velocity as required by AASHTO unless noted otherwise on the plans.

Fabricate the support in accordance with the details shown on the approved shop drawings and with the requirements of the specifications.

Fabricate the support of steel and hot-dip galvanize it after fabrication has been completed.

Have the galvanization conform to ASTM A153 for fasteners and to ASTM A123 for other structural steel.

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Have all welding of steel components conform to the Standard Specifications with the following exception. Partial penetration longitudinal groove welds on shaft sections having a minimum throat of 60% of the thickness of material being joined will be acceptable provided the qualification requirements of the Bridge Welding Code are met. However, full penetration will be required on longitudinal groove welds within 6 inches (152.4 mm) of circumferential welds and in areas where a shaft section telescopes over another shaft section. No field welding of any part of the assembly will be permitted.

Allow easy access to all components in the base of the standard with a handhole with a hinged and lockable door. Allow for opening of the door without the use of special tools or wrenches. Make the handhole large enough for removal of the circuit breaker and the hoist gearbox and winch assembly (minimum 9" x 18" [228.6 mm x 457.2 mm]). Make the door hinge and lock mechanism sturdy enough to prevent vandalism and to prevent freeze-up or binding due to corrosion or too-tight fit. Achieve locking with a conventional "pad-lock". Built in locks or latching mechanism for the door will not be acceptable.

### **(B) Lowering Device:**

Furnish eight (8) copies of completely detailed drawings of the lowering device with manuals describing the assembly, erecting and operating procedures. Include precise instructions on stringing the cables and leveling the carrier ring.

On each high mount lighting standard have a device to lower the luminaires from the operating position at the top of the standard to a service position approximately 3' (0.9 m) above the base of the standard. Include on the device a head-frame, carrier ring, and winch assembly. Design the lowering device for the number of luminaires as shown on the plans, each weighing and each having a projected area as specified in the section titled "High Mount Luminaires".

Mount the head frame on the standard with a slipfitter and set screws and have sheaves or rollers for the lifting and power cables. Also have sockets to automatically secure the carrier ring in the raised position and have a hood on the entire assembly for protection from the weather. Attain latching and unlatching by alternately raising and lowering the carrier ring.

Use sheaves which are non-corrosive materials with bronze bushings and stainless steel shafts. Provide suitable retainers to assure that the cables stay in correct position.

Have slipfitter tenons equally spaced for mounting the luminaires on the carrier ring. Have the carrier ring automatically latched to the head frame when raised into position by suitable pins and sockets which will prevent the luminaires from swaying, turning, vibrating, or otherwise moving out of proper position. Include on the carrier ring spring loaded roller arms to guide the ring during raising and lowering operations. Use springs made of stainless steel and rollers made of nylon. Mount a weatherproof junction box on the ring for connection of individual luminaire circuits to the electrical power supply cable. Include in the junction box a flanged inlet for connection of the power supply cable. Use an inlet and cable connector which is of the locking type and weatherproof.

Use a winch assembly which is a self-locking worm-gear type designed for operation with a portable power unit. Have the winch drum automatically reverse the lay of the hoist cable and not allow uneven build-up or tangling.

Provide a terminator for joining the hoist cable and 3 suspension or lifting cables. Provide the means to compensate for variations in the lengths of the 3 lifting cables. Use hoist and lifting cables made of stranded high strength stainless steel extra flexible aircraft type. Use hoist and lifting cables which meet structural requirements of Military Specification MIL-W-83420D and have the center strand not protruding more than .06 inch (1.5 mm) after the cable is cut.

Use a power supply cable which is rated for suspension and has approved strain relief fittings at each end. At the base of the standard, provide a locking type plug with

waterproof cover to connect to a short power supply cable stubbed from the circuit breaker panel.

**(C) Portable Drive:**

Supply a portable drive unit with a heavy duty reversible electric motor with torque limiter type drive of adequate capacity complete with a grounding type cord, suitable couplings for attaching the unit to the winch assembly, and a sturdy storage container for the unit and accessories involved. Provide one portable drive unit for the completed project. Provide a drive unit with a lever switch controller with clearly marked UP and DOWN positions. Connect the controller to the drive unit with a cord of sufficient length to let the operator stand a minimum of 15' (4.6 m) from the base of the high mount during lowering or raising operations.

Shop assemble the portable drive unit and remove all rough edges. Use mounting or adjustment bolts which allow hand tightening.

Provide a complete unit which includes a durable metal storage case with all equipment and instructions for operation. Use a case which is the approximate size as shown on the plans, has a continuous hinge on the lid, and has sturdy carrying handles on each end. Furnish a hasp with padlock as shown on the plans. Construct the case with 16 gauge formed and welded steel with bracing to prevent warping. Paint the inside and outside with a durable quality paint. Provide an identification label as noted in the plans on the storage case.

**(D) Circuitry:**

Install an enclosed circuit breaker in the base of the high mount standard. Use a breaker which is rated 480 VAC, 2 pole, 30 ampere unless noted otherwise on the plans.

Provide a supply cord originating from the circuit breaker with a female twist lock connector for testing the luminaires at ground level, during lowering operation using the portable drive unit, and when in the raised position during normal night operation.

Provide a junction box mounted on the lowering ring with a flanged inlet to accept the female twist lock connector from the supply cord. Use plugs, flanged inlets, and connectors for the supply cable and drive unit which allow grounding and are weatherproof.

Install the wiring for each high mount luminaire separately from the luminaire to the junction box. Series or loop circuitry is not allowed.

Provide a transformer, branch circuit breaker, and receptacle as a power source for the portable drive.

Provide an equipment grounding conductor in the supply cable. Include an equipment grounding conductor in the wiring for each luminaire.

**(E) Operation:**

Demonstrate the operation of the lowering device by raising and lowering the carrier ring with luminaires a minimum of five (5) times for each high mast. Include in this demonstration latching and unlatching at the top and connection of test cables at the bottom. Twisting of the cables, failure of the carrier ring to latch or unlatch, unlevelness of the carrier, or hang-up of guide arms will be sufficient reason not to accept the lowering device.

**1401-3 CONSTRUCTION METHODS.**

Use suitable blocking and slings to prevent warping of the high mount standard during storage and transportation. Assemble all parts and string all cables in strict accordance with the manufacturer's instructions.

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Make sure that the top of the standard is not out of plumb more than one half of one percent of its height.

Include assembly instructions and any special tools, blocks, washers, etc. in the portable drive storage case.

Remove all dirt, stains, marks, etc. prior to erecting the high mast.

**1401-4 MEASUREMENT AND PAYMENT.**

The quantity of high mount standards with lowering devices to be paid for will be the actual number of standards which have been installed and accepted. High mount lighting standards with lowering device, measured as provided above, will be paid for at the contract unit price each for "\_\_\_\_\_ High Mount Standard" of the appropriate height.

The quantity of portable drive units with storage cases to be paid for will be the actual number of portable drive units which have been furnished and accepted. Portable drive units with storage case, measured as provided above, will be paid for at the contract unit price each for "Portable Drive Unit".

Payment will be made under:

"\_\_\_\_\_ High Mount Standard" .....Each  
Portable Drive Unit .....Each

**SECTION 1402  
HIGH MOUNT FOUNDATION**

**1402-1 DESCRIPTION.**

Construct a concrete foundation for a high mount standard 75' (22.9 m) or greater in height, including concrete, reinforcing steel, placing of the anchorage assembly, conduits, forms, shoring, excavation, backfilling, and grouting.

**1402-2 MATERIALS.**

Use materials which are new and in accordance with Section 1400-4(I).

**1402-3 CONSTRUCTION METHODS.**

Construct concrete foundations in accordance with the details in the plans and Article 1400-4(I). The dimensions of the foundations and the corresponding quantities of concrete and reinforcing steel are given for the purpose of obtaining bid prices only. Actual dimensions to be used in constructing the foundations will be furnished, in writing, as provided below. The Engineer will make a subsurface investigation at each foundation site. Provide access to each foundation site for this purpose. Provide access sufficiently in advance of foundation construction to permit the subsurface investigation to be made without causing an unreasonable delay in the construction operation. Based on actual soil conditions, the Engineer will then determine and furnish to the Contractor any changes in the depth of the foundations, or changes in other dimensions.

Provide a three foot (3') (0.9 m) level work area around each high mount foundation with cut and fill slopes extended to final grades as directed.

**1402-4 MEASUREMENT AND PAYMENT.**

The quantity of foundations to be paid for will be the number of cubic yards (cubic meters) of concrete necessary to construct foundations in accordance with the dimensions authorized by the Engineer.

The quantity of foundations, measured as provided above, will be paid for at the contract unit price per cubic yard (cubic meter) for "High Mount Foundations".

Payment will be made under:

High Mount Foundations ..... Cubic Yard (Cubic Meter)

**SECTION 1403  
HIGH MOUNT LUMINAIRES**

**1403-1 DESCRIPTION.**

Furnish and install luminaires, including lamps and ballasts, for high mount standards 75' (22.9 m) and greater in height.

**1403-2 MATERIALS.**

Provide luminaires consisting of a die cast aluminum ballast housing a cast aluminum slipfitter housing, and cover which do not weigh more than 65 lbs. (29.5 kg) and have an effective projected area not more than 2.0 square feet (0.19 square meters).

Provide ballast capable of operating a 1000 watt high pressure sodium lamp from a source with a nominal voltage as shown on the plans with a tolerance of ±10%.

Provide slipfitter housing suitable for use with 2 inch (50.8 mm) horizontal mounting, adjustable for leveling, and which secures the mounting assembly to prevent twisting of the luminaire about the bracket.

Use an optical assembly which contains a porcelain enclosed mogul socket with spring loaded center contact and lamp grips and has an insulated outboard lamp grip to protect the lamp from damage due to vibration. Position the socket for base up lamps.

Use symmetrical or asymmetrical lighting patterns as shown on the plans.

Provide complete photometric, assembly, and electrical data for each type luminaire proposed. Include in the data candlepower distribution and isofotcandle graphs, assembly drawings with replacement part numbers, and electrical schematic with ballast input/output voltage/amperage/wattage ratings.

**1403-3 CONSTRUCTION METHODS.**

Lamp all high mount fixtures just prior to testing the system. Mark the date of installation with the code on the base of each lamp.

Level and secure each luminaire in all directions. Careful attention should be given to aim the main beams and house-side outputs of all asymmetrical units in the direction indicated on the plans. Securely terminate the wiring for each luminaire and include an equipment grounding conductor to bond the housing to the supply cord grounding conductor.

**1403-4 MEASUREMENT AND PAYMENT.**

The quantity of luminaires for high mount lighting standards to be paid for will be the actual number of luminaires of each size and type which have been installed and accepted.

The quantities of luminaires, measured as provided above, will be paid for at the contract unit price each for "High Mount Luminaires \_\_\_\_" of the appropriate wattage and type.

Payment will be made under:

High Mount Luminaires \_\_\_\_ .....Each

**SECTION 1404  
LIGHT STANDARDS**

**1404-1 DESCRIPTION.**

Furnish and install light standards less than 75' (22.9 m) high complete with bracket arm(s) on the foundation, including the impact attenuation device (breakaway base) as shown on the plans.

**1404-2 MATERIALS.**

Provide a standard which meets the design criteria of the AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals".

Provide a standard designed to support an ellipsoidal shaped luminaire, which has a center of gravity not more than 18" (457.2 mm) from the end of the support, with a minimum weight and projected area and a bracket arm length as indicated on the plans or in the specifications.

Make sure that each lighting standard has a grounding lug either in the standard near the base or in the transformer base. Locate it within 6" (152.4 mm) of the hand hole.

Deliver standards with a smooth uniform finish, free of disfiguring scratches or dents, and with suitable protection for further handling during erection.

Wrap or package each light standard as recommended by the manufacturer to prevent damage during shipping and handling. Repair or replace, at the option of the Engineer, any standards with abraded finishes or other damage.

Furnish either aluminum or steel standards and arms; however, use the elected material throughout the project.

Galvanize steel components after fabrication. Use galvanization which conforms to the requirements of ASTM A123 for tubes, plates, and bars, and to ASTM A153 for hardware.

Use connecting bolts, washers and nuts compatible with the transformer base as recommended by the light standard manufacturer and which comply with these special provisions and details shown in the plans.

Use anchor bolts, washers, nuts and shims which comply with the specifications and details shown in the plans as recommended by the light standard and transformer base manufacturer(s).

Furnish anchor and/or connecting bolt covers and pole top caps with standards as indicated on the plans.

Provide pole hardware - Nuts, bolts, and washers for aluminum standards from 18-8 stainless steel or aluminum alloy 2024-T4. Provide nuts, bolts, and washers for steel standards from 18-8 stainless steel or steel conforming to ASTM A307. Submit drawings for approval which show material specifications for each component.

Use bracket arms for each standard which are the length shown on the plan sheet and of the same material as the standard.

Provide light standards with an approved impact attenuation feature (breakaway base) complying with one of the following descriptions.

- (a) A cast aluminum transformer base
- (b) A frangible base insert or adapter; normally cast aluminum
- (c) A breakaway or progressive shear base
- (d) A slip base

Use the same type of breakaway device throughout the entire project that complies with AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals". Include in the device protection for wiring and conduit at the base of the standard in the form of a special heavy formed material secured in place.

**1404-3 CONSTRUCTION METHODS.**

Locate and number the light standards as shown on the plans.

Do not lay the standards on the ground without proper blocking and protection to prevent warping and discoloration. Protect them from damage by other construction work, including landscape mulching and fertilizing operations.

**Section 1404**

Securely mount the standards on the anchor bolts and plumb with nuts torqued according to the manufacturer's recommendation.

Mounting height is defined as vertical distance from luminaire to surface of pavement of heaviest traveled lane in area illuminated by the luminaire. A tolerance of ±1'-6" (± 0.46 m) from the required mounting height will be permitted. If this tolerance is exceeded, furnish and install an acceptable standard within this tolerance.

**1404-4 MEASUREMENT AND PAYMENT.**

The quantity of light standards to be paid for will be the actual number of light standards with arm assemblies of each mounting height and bracket arm type and length which have been installed and accepted.

The quantity of light standards, measured as provided above, will be paid for at the contract unit price each for "Light Standards, \_\_\_\_\_" of the appropriate mounting height and arm type and length.

Payment will be made under:

Light Standards, \_\_\_\_\_ .....Each

**SECTION 1405  
STANDARD FOUNDATION**

**1405-1 DESCRIPTION.**

Furnish and install all materials necessary to construct concrete foundations for light standards, including concrete, reinforcing steel, anchor bolts, nuts, forms, excavation, and backfilling.

**1405-2 MATERIALS.**

Use new materials which are in accordance with Article 1400-4(I).

**1405-3 CONSTRUCTION METHODS.**

The foundation design shown on the plans is based upon placing foundations into undisturbed soil or fill of at least medium density. The Engineer will stake each location and determine the top of foundation elevation unless indicated differently elsewhere in the specifications. The foundation type and depth will be determined by the plan details in accordance with the final soil and slope conditions at each location.

Pour the pedestal portion concrete monolithic with the barrier portion on light standard foundations, which are an integral part of a barrier. Construct the barrier portion as specified in other sections of the specifications and plans, and continuous through the foundation.

Where rock creates a conflict with construction of the standard foundations, an alternate foundation may be constructed if approved.

**1405-4 MEASUREMENT AND PAYMENT.**

The quantity of standard foundations to be paid for will be the actual number of foundations for each height and type of standard which have been completed and accepted.

The quantity of foundations for standards, measured as provided above, will be paid for at the contract unit price each for "Standard Foundations, \_\_\_\_\_" of the appropriate type.

The quantity of bedrock foundations to be paid for will be the actual number of alternate foundations for bedrock locations for standards of the appropriate type which have been installed and accepted.

Alternate foundations for rock locations will be paid for at one and a half (1.5) times the contract unit price each for "Standard Foundations, \_\_\_\_\_" of the appropriate type which would have been installed if rock had not been encountered.

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The provisions of Article 104-4 of the Specifications, which pertain to adjustments in contract unit prices for overrunning or underrunning pay items, will not be applicable to pay items covered by this section.

Payment will be made under:

Standard Foundations, \_\_\_\_\_ .....Each

**SECTION 1406  
LIGHT STANDARD LUMINAIRES**

**1406-1 DESCRIPTION.**

Furnish, install, and place into satisfactory operation, luminaires on the bracket arm complete with all lamps, ballasts, wiring inside standard from circuit conductors to luminaire, in-line fuses, ground rod, and ground wiring at the pole on light standards less than 75' (22.9 m) in height.

**1406-2 MATERIALS.**

Use luminaires which are ellipsoidal shaped with a center of gravity not more than 18" (457.2 mm) from the end of the luminaire support, do not weigh more than 55 lbs. (24.9 kg), and have a maximum effective projected area of 1.2 square feet (0.11 square meters).

Use luminaires that are UL listed and labeled.

Use luminaires which have a refractor holder latch on the street side, ballast, starter, and capacitors mounted on a removable door, a slipfitter for 2" (50.8 mm) mounting brackets, and a socket adjustable in both vertical and horizontal directions capable of producing light in conformance with the specified IES distribution classification. Use a heat resistant glass prismatic heat refractor.

Use luminaires that have an internal high power factor ballast of the regulated type, capable of operating from a multi-wire circuit and energize a high intensity discharge lamp. Have these lamps operate satisfactorily with a line voltage variation of ±10%. Provide a ballast pre-wired to the lamp socket and terminal board, requiring only the connection of the power supply leads to the terminal board.

Use luminaires with a wattage rating, voltage rating, lamp type, and light distribution as indicated on the plans.

**1406-3 CONSTRUCTION METHODS.**

Date lamps with a code on the base and install just prior to the system being ready for testing.

Level luminaires using leveling pads on the luminaire enclosure. Adjust any luminaires, as directed, to give optimum illumination distribution.

**1406-4 MEASUREMENT AND PAYMENT.**

The quantity of luminaires to be paid for will be the actual number of luminaires of each size and style which have been installed and accepted.

The quantity of luminaires, measured as provided above, will be paid for at the contract unit price each for "Light Standard Luminaires \_\_\_\_\_" of the appropriate size and style.

Payment will be made under:

Light Standard Luminaires \_\_\_\_\_ .....Each

**SECTION 1407  
ELECTRIC SERVICE POLE AND LATERAL**

**1407-1 DESCRIPTION.**

Furnish and install wood service poles, wire, conduit, bushings, fittings, connectors, meter base, and weatherhead from the service point to a control system.

**1407-2 MATERIALS.**

Provide service poles which are Southern Yellow Pine, Class 4, 30 feet (9.1 m) in length, and conform to ANSI Standard 05.1. Provide poles with pentachlorophenol or chromated copper arsenate (CCA) preservative. Perform the treatment using the pressure process in accordance with AWWA C4 "Poles-Preservative Treatment by Pressure Processes". Make sure that the retention of preservative is not be less than 0.6 lb. (9.1 kg) of dry chemical by assay per cubic foot (cubic meter) of wood for CCA and not less than 0.45 lb (6.7 kg) per cubic foot (cubic meter) for pentachlorophenol.

Use stranded copper Type USE conductors installed in rigid galvanized steel conduit sized as shown on the plans for the service lateral.

**1407-3 CONSTRUCTION METHODS.**

Dig holes large enough to permit the proper use of tampers to the full depth of the hole. Place backfill in the hole in 6 inch (152.4 mm) maximum layers and thoroughly tamp. Place surplus earth around the pole in a conical shape and pack tightly to drain water away.

Set the pole to a depth of 5'-6" (1.7 m) minimum unless shown otherwise on the plans.

Make connections at the service head at the bottom of the drip loop to prevent siphoning of water through the cable.

Provide for a meter in accordance with the requirements of the utility company's condition of service.

A meter base for a self-contained meter may be mounted on the service pole or back of the control enclosure as indicated on the plans. A current transformer (CT) cabinet and meter base may be mounted in either location if requested by the utility company.

If the utility company provides a pad mount transformer or allows attachment of the riser and weatherhead to their pole, then any proposed service pole will be deleted from the contract.

**1407-4 MEASUREMENT AND PAYMENT.**

The quantity of service poles to be paid for will be the actual number of service poles which have been installed and accepted.

The quantity of service poles, measured as provided above, will be paid for at the contract unit price each for "Electric Service Pole \_\_\_\_" of the appropriate length and class.

The quantity of service lateral from service pole to control panel to be paid for will be the actual number of linear feet (linear meters) of service lateral which has been installed and accepted. Measurement will be along the longest conductor from electrical terminal to electrical terminal.

The quantity of service lateral from service pole to control panel, measured as provided above, will be paid for at the contract unit price per linear foot (linear meter) for "Electric Service Lateral \_\_\_\_" of the appropriate size and type.

Payment will be made under:

Electric Service Pole \_\_\_\_ .....Each  
 Electric Service Lateral \_\_\_\_ .....Linear Foot (Linear Meter)

## SECTION 1408 LIGHT CONTROL SYSTEM

### 1408-1 DESCRIPTION.

Furnish and install an entire control system, including enclosure, control panel, photocell, switches, contactors, breakers, terminal blocks, wiring, concrete foundation, and lightning arrester. The control system will be standard electrical components in a stainless steel enclosure mounted on a metal pole with a concrete foundation as shown on the plans and as specified in these specifications.

### 1408-2 MATERIALS.

Provide concrete foundations and wire in accordance with the applicable Sections of this Division.

Use a piece of rigid galvanized steel conduit, embedded in concrete as shown on the plans for mounting the control system

Provide a NEMA type #3R stainless steel enclosure with external stainless mounting flanges, back panel and continuous hinge door that has a print pocket and a door closing mechanism. Provide a door closing mechanism interlocked with a flange mounted operator handle to prevent the opening of the door with the service circuit breaker in the ON position, except by use of safety override devices.

Provide an enclosure approximately 36" (914.4 mm) high by 30" (762 mm) wide by 10" (254 mm) deep unless noted otherwise on the plans.

Provide only openings necessary for the entrance of conduits as shown on the plans. Do not use knockouts. Have the enclosure conform with NEC Article 373 and mount the devices so the NEC clearances will be provided, except use 1 1/2" (38.1 mm) where "not specified" is noted in the tables for min. wire bending space.

Use galvanized slotted steel framing channel with straps and bolts, sized as shown on the plans for the mounting brackets and hardware for attaching the enclosure to the pole. Use galvanized finish on the brackets and hardware and coat all field cuts or scratches with organic zinc repair paint.

Provide a neutral bar, bondable to the panel and with sufficient box lug type terminals to accept the required number of wires.

Use a service circuit breaker providing an interrupting rating of 22,000 amperes minimum. Provide breakers which are thermal magnetic molded case permanent trip type. Provide solderless box lugs of the appropriate size. Use insulating material approved for NEMA 3R applications. Provide a breaker with a voltage and amperage rating as indicated on the plans.

Provide a control circuit breaker which is rated 240 VAC phase to ground, has a current interrupting capacity of 5000 amps minimum, and is a single pole, open type with a high magnetic trip setting of 20 amps.

Provide three (3) 60 ampere, 4 pole mechanically held contactors that have coil clearing contacts and coil voltage rating as indicated on the plans. Contactor latching with hooks or semi-permanent magnets is unacceptable

Use a control relay rated 600 VAC with one normally open contact and one normally closed contact and has a "continuous load" rating and "inductive make" rating greater than that required by the mechanically held contactor. Use a coil rated for 240 VAC 60 Hz.

Use a selector switch which is a heavy duty 3 position maintained contact unit in a surface mount (NEMA 1) enclosure with a legend consisting of "On-Off-Auto" and having continuous current rating of 10 amperes at 240 VAC for the contacts.

Use feeder circuit breakers which are rated 14,000 amps minimum interrupting capacity and have an open type molded case with a non-adjustable thermal magnetic trip setting of 50 amps maximum, and as noted in the plans.

**Section 1408**

Use a photo-control which is the encapsulated cadmium-sulfide type, suitable for use on an operating voltage range of 105-285 volts and nominal control voltages of 120, 208, 240, and 277 volts. Have the control rated for 1000 watts resistive load or 1800 volt-amperes of inductive load. Set the light-level within a range of 1.0 to 3.0 footcandles at 120 volts. Have internal protection for surges in excess of 2000 volts peak for the control. Mount a receptacle directly to the top of the enclosure with a weather-proof fitting. Use controls and receptacles which conform to NEMA Standard C136.10, "Locking-type photocontrol devices and mating receptacles-physical and electrical interchangeability and testing" for roadway lighting equipment.

Use a lightning arrester of the thyrite type, designed to contain and snuff out an arc of 10,000 amps.

Use terminals and lugs rated for the connection of the appropriate size copper conductors and conductors made of copper and neatly wrapped in bundles or run in plastic raceways.

Perform all galvanizing in accordance with Section 1076.

Provide a drawing to scale showing the location, brand and catalog number of each component of the control system for approval.

**1408-3 CONSTRUCTION METHODS.**

Construct the foundation for the control system as shown on the plans with the top of the foundation 3 inches (76.2 mm) above finished grade.

Fasten the enclosure to the pole by means of a galvanized bracket assembly as shown on the plans. Make all cuts square and remove all rough edges. Have mounting holes match existing mounting holes of the enclosure.

Arrange all conduits entering the enclosure in a neat symmetrical manner and extend directly downward into the foundation. Install all conduits shown on the plans. Stub and cap spare conduits for future circuits underground.

Apply two (2) coats of organic zinc repair paint to all field cut metal and conduit threads.

**1408-4 MEASUREMENT AND PAYMENT.**

The quantity of light control systems to be paid for will be the actual number of light control systems which have been completed and accepted.

The quantity of light control systems, measured as provided above, will be paid for at the contract unit price each for "Light Control Equipment \_\_\_\_\_" of the appropriate type.

Payment will be made under:

Light Control Equipment, (Type) \_\_\_\_\_ .....Each

**SECTION 1409  
ELECTRICAL DUCT**

**1409-1 DESCRIPTION.**

Furnish and install electrical duct including materials, equipment, and labor for trenching, backfilling, and jacking or boring so that electrical circuits may be easily installed at locations shown on the plans.

**1409-2 MATERIALS.**

Use electrical duct that is non-metallic rigid PVC (Polyvinyl Chloride) heavy wall conduit or rigid galvanized steel conduit unless indicated otherwise on the plans.

Use non-metallic rigid PVC (Polyvinyl Chloride) heavy wall conduit which is approved for above ground and underground use without concrete encasement in conformance with UL 651 "Rigid Non-Metallic Conduit".

Provide rigid galvanized steel conduit in conformance with UL 6 "Rigid Metallic Conduit".

**1409-3 CONSTRUCTION METHODS.**

Duct is a passageway for electrical circuits. Install ducts in accordance with NEC requirements for an approved raceway. Locate the duct as shown on the plans, and at a minimum depth of 30" (762 mm) unless indicated otherwise on the plans.

The lengths noted on the plans are only typical. Make actual field measurements to place the ends of the duct at the required locations. Make up lengths of duct with the minimum number of pieces joined together with couplings and solvent as recommended by the manufacturer.

Clean and plug the duct in accordance with Article 1400-4(E).

Plug the duct with oakum or duct seal after feeder circuits in the conduit are extended through duct..

Place buried duct in a trench with essentially vertical walls and only wide enough for easy installation of the duct. Tunneling by hand or other approved methods may be required to install duct beneath existing walks or paved ditches. Perform backfilling in accordance with Article 300-7.

Jacked duct may be installed by either of the following methods at the Contractor's option when placement of electrical duct beneath pavement by jacking is noted on the plans.

- (a) The duct may be pushed beneath the pavement through earth without prior construction of an opening.
- (b) A bored opening not more than 1" (25.4 mm) larger than the outside diameter of the duct may be made by augering and the duct inserted.
- (c) A drilled opening not more than 1" (25.4 mm) larger than the outside diameter of the duct may be made with a pneumatic vibrating machine and the duct inserted.

Do not install non-metallic conduit by jacking method (a) as listed above.

If installation of a duct is begun and not completed, plug any opening as directed. Installation of duct by "water jetting" will not be acceptable.

At locations where it is indicated on the plans that the duct is to be connected to boxes, foundations, or other raceways, make the installation as required by the Section titled "Conduit Installation" to provide an "approved raceway" as specified by the NEC.

**1409-4 MEASUREMENT AND PAYMENT.**

The quantity of electrical duct to be paid for will be the actual number of linear feet (linear meters) of duct, measured in place to the nearest whole foot (meter), which has been installed and accepted.

The quantity of duct, measured as provided above, will be paid for at the contract unit price per linear foot (linear meter) for "Electrical Duct, \_\_\_\_\_" of the appropriate size and type.

Payment will be made under:

Electrical Duct, (Size & Type) \_\_\_\_\_ ..... Linear Foot (Linear Meter)

**SECTION 1410  
FEEDER CIRCUITS**

**1410-1 DESCRIPTION.**

Furnish and install all conductors and conduit, including tools, equipment, trenching, and backfilling to provide electrical circuits at locations shown on the plans.

**1410-2 MATERIALS.**

Use load current carrying conductors which are UL Type USE, except that UL Type UF may be used for sizes 8 AWG and smaller. The equipment grounding conductor may be bare or insulated. Use conductors which are copper and in accordance with Article 1400-2(C). For feeder circuits size 10 AWG, a cable assembly UL Type UF with the proper number of conductors may be used in lieu of individual conductors. Give careful attention to the required color code. Do not mark a white conductor in a cable assembly any other color; however, it may be stripped at all accessible points and used as a bare equipment grounding conductor.

Provide metallic (rigid galvanized steel) and non-metallic (polyvinyl chloride) conduit in accordance with the Article 1400-2(B) "Conduit" with the appropriate type being used at locations as shown on the plans.

**1410-3 CONSTRUCTION METHODS.**

Install feeder circuits in continuous runs, without splices, except at junction boxes or within light standard bases.

Install conductors in accordance with the Article 1400-4(F) and conduit in accordance with the Article 1400-4(E).

Excavate trenches to depths and widths as shown on the plans with essentially vertical walls and as straight as possible, when underground feeder circuits are required. Locate underground feeder circuits a minimum of 6 feet (1.8 m) back of the face of curb or outside the limits of the paved shoulder and stone base, as directed. Use care to prevent conflict with existing or future guardrails, sign posts, delineators, and similar devices.

Surround the underground feeder circuit in conduit with clean soil and use backfill free of rocks and other objectionable materials which might damage the conduit. This will require partial backfilling by hand in areas where it is likely that objectionable materials will be included if mechanical methods of backfilling are used.

Perform all necessary search methods, including but not limited to use of underground metal detection equipment and excavation equipment, to locate existing electrical duct. Locate the duct and perform all necessary work including cleaning of the duct before installation of proposed circuits.

When a feeder circuit in conduit passes through electrical duct, make the conduit continuous through the duct unless specifically noted otherwise on the plans. After feeder circuits in conduit are extended through duct, plug the conduit with oakum or duct seal.

When only feeder circuits are required, install the load current carrying conductors and grounding conductors in either existing conduit or conduit installed under other contract items.

When more than one circuit is installed in a single raceway, a single equipment grounding conductor sized as required for the largest circuit may be used without change in the contract unit bid prices.

Multiple circuits may be placed in the same trench if they are grouped and separated a minimum distance of three inches (3") (76.2 mm). When more than one circuit is installed in the same trench there will not be any adjustment of the contract unit bid prices.

**1410-4 MEASUREMENT AND PAYMENT.**

The quantity of feeder circuits to be paid for will be the actual number of linear feet (linear meters) of each size and type feeder circuit which have been completed and accepted. Measurement will be to the nearest whole foot (tenth of a meter) from electrical terminal to electrical terminal of the longest load current carrying conductor.

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The quantity of feeder circuits, measured as provided above, will be paid for at the contract unit price per linear foot (linear meter) for " \_\_\_\_\_ Feeder Circuit" or " \_\_\_\_\_ Feeder Circuit in \_\_\_\_\_ Conduit" of the appropriate size and type.

Payment will be made under the following pay items:

_____ Feeder Circuit.....	Linear Foot (Linear Meter)
_____ Feeder Circuit in _____ Conduit.....	Linear Foot (Linear Meter)

**SECTION 1411  
ELECTRICAL JUNCTION BOXES**

**1411-1 DESCRIPTION.**

Provide junction boxes made from fiberglass reinforced polymer concrete and cast-metal boxes encased in concrete of the appropriate type at locations noted on the plans, complete with all necessary covers, conduits, duct, and hardware, in accordance with the requirements shown on the plans and the specifications.

**1411-2 MATERIALS.**

Use polymer concrete (PC) boxes which are stackable, and have bolted covers and are sized as shown in the plans.

Use polymer concrete material made of an aggregate consisting of sand and gravel bound together with a polymer and reinforced with continuous woven glass strands. Use material with the following minimum mechanical strength properties: 11,000 psi (75.8 MPa) compressive, 1700 psi (11.7 MPa) tensile, 7500 psi (51.7 MPa) flexural.

Have the material meet minimum acceptance criteria for: chemical resistance, accelerated service exposure, simulated sunlight exposure, water absorption, flexural properties, and flammability in accordance with ASTM D-543, D-756, D-1501, D-560, D-790, and D-635 respectively.

Provide light vehicular traffic design and base it on a 5000 pound (73 kN) load over a 10" x 10" (254 mm x 254 mm) area.

Provide a bottom box which is open "footed" unless specifically noted as "closed" bottom on the plans.

Provide a standard "Electric" logo on the cover unless specifically noted otherwise on the plans. Provide a minimum of 2 size 3/8" (9.5 mm) hex head stainless steel cover bolts and inserts.

Backfill beneath and around the boxes using ABC in conformance with Section 1005.

Use ground rods which are 5/8" (15.9 mm) in diameter, 8' (2.4 m) long solid steel core with copper jacket, have a ground rod clamp made of one piece bronze with a hex head screw, and both the rod and clamp conform to UL Standard 467 "Electrical Grounding and Bonding Equipment".

Provide cast-metal (BR) box, replaceable frame, and cover that are hot dipped galvanized with factory or field drilled conduit entrances. Cover with checkered imprint, pry bar slots, and reinforcing ribs for heavy loading, neoprene gasket, and brass or stainless steel bolts. Blind tapped (1/4" [6.4 mm] NC thread minimum) boss on interior of box for grounding.

**1411-3 CONSTRUCTION METHODS.**

Install conduits and duct before the polymer concrete (PC) boxes are set in place. Do not rest the bottom of the box directly on conduits, ducts or cables.

Set the boxes plumb and secure with the top above grade so that water will not drain into the boxes. Perform backfilling with sufficient care that no part of the junction box, conduit or duct is displaced or moved out of alignment. Place backfill material in 6 inch (152.4 mm) layers and compact to a density comparable to the adjacent undisturbed material.

**Section 1411**

Locate junction boxes for best routing of conduit and duct, and to minimize drainage problems. Do not locate boxes in useable shoulders or pavements or other areas where they may be subjected to traffic loadings.

Place the top of the box on the same grade as the surrounding area except raise it three inches (3") (76.2 mm) minimum to allow the backfill material to be sloped to prevent surface drainage from entering the box.

Install a ground rod as indicated on the plans with bonding jumpers, etc. as required. Stub the ends of conduit and duct up vertical as near the top of the box as practical and seal. Arrange wiring so that it will not lay in the bottom of the box.

Place sealant between the cover and box to prevent surface drainage from entering the top of the box.

Install cast-metal (BR) boxes and arrange conduits and ducts to best fit field conditions. Place boxes, conduit, and ducts as the work is built up, thoroughly bonded and accurately spaced and aligned. Place boxes with covers flush with surface of concrete (generally traffic side of median barrier).

Place mastic between the cast metal box frame and the cast concrete barrier, as shown on plans to allow easy replacement of the frame.

**1411-4 MEASUREMENT AND PAYMENT.**

The quantity of electrical junction boxes to be paid for will be the actual number of junction boxes that have been installed and accepted. The quantity of electrical junction boxes, measured as provided above, will be paid for at the contract unit price each for "Electrical Junction Boxes \_\_\_\_\_" of the appropriate type and size. Payment for the conduit, duct and wiring will be paid for under other contract items. Ground rods, clamps and bonding jumpers are incidental to the junction boxes.

Payment will be made under:

Electrical Junction Boxes \_\_\_\_\_.....Each

**SECTION 1412  
UNDERPASS LIGHTING**

**1412-1 DESCRIPTION**

Furnish and install wall mounted and/or pendant mounted luminaires with electrical circuitry, for underpass lighting at locations shown on the plans. Work includes but is not limited to furnishing and installing underpass luminaires with lamp, ballast, and mounting hardware as well as furnishing and installing circuit breakers and enclosure, pull boxes, conduit, conductors, expansion fittings, anchors, straps, and ground rod.

**1412-2 MATERIALS**

Use luminaires that are listed as "Suitable for Wet Locations" according to UL Standard #1572, with sealed and filtered optical assemblies. Use high power factor ballasts that are completely pre-wired integral units, for reliable starting and operating of high pressure sodium lamps at -40°F ambient temperature. Use heavy-duty mogul base lamp sockets, with split shell tempered brass lamp grips and a free-floating, spring-loaded center contact. Use the luminaire type, wattage, voltage and IES illumination distribution pattern as shown on the plans.

Provide type WM luminaires that are wall mounted, with cast aluminum housing painted with premium quality gray or dark bronze paint. Provide a prewired ballast and terminal board assembly, and cast aluminum side-hinged door with glass refractor. Use the same color WM luminaires throughout the project. Provide factory installed mounting holes in the back, and conduit entrances in the sides and top. Provide a formed aluminum reflector and socket assembly, with a chemically bonded lightweight non-breakable glass finish, which is removable with only a screwdriver.

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Provide type PM luminaires that are a pendant mounted assembly of ballast, optical and mounting components, including a safety chain and hanging hardware. Provide a die-cast aluminum ballast housing with gray paint finish, with a prewired ballast assembly and an external quick electrical disconnect receptacle for attachment of hanging hardware. Provide a faceted aluminum reflector with an Alzak (proprietary term of Aluminum Company of America) finish, and a lightly diffused refractor made of UV stabilized, injection molded, prismatic, heat-resistant, acrylic. Provide hinges and stainless steel, over-center, vibration-resistant spring latches for easy access to the lamp, and clamping of the gasket between the refractor and ballast housing.

Use a 3/4" (19.1 mm) rigid galvanized steel conduit with a hook and power cord entrance as the pendant. Provide a 3-conductor type SO power cord and a 3/4" (19.1 mm) female threaded wiring compartment with quick electrical disconnects, to attach the ballast housing to the pendant as shown in the plans.

Use galvanized weldless forged steel eye-nuts that comply with Federal Specification WW-H-171E (Type 17), or Manufacturers Standardization Society SP-69 (Type 17). Attach eye-nuts to galvanized steel or stainless steel threaded rod that has been anchored to the bridge deck with adhesive anchors. Use galvanized steel or stainless steel safety chain, S hooks and lock nuts.

Use conduit and wire in accordance with Standard Specification Section 1400-2, and gasketed PVC junction boxes as shown in the plans.

Use a 2-pole, 480 VAC, 20 AMP circuit breaker, installed in a NEMA 3R enclosure that has been primed and painted with a premium grade exterior paint before installation, to increase corrosion resistance. Install an equipment ground bar, and provide a lock in accordance with section 1400-8 of the Standard Specifications.

**1412-3 CONSTRUCTION METHODS**

Mount luminaires as shown in the plans. Use galvanized steel or stainless steel clamps and attachment hardware.

Install circuitry in accordance with portions of Standard Specification Section 1400-4, titled "Wiring Methods" and "Conduit Installation."

**1412-4 MEASUREMENT AND PAYMENT**

The quantity of underpass luminaires to be paid for will be the actual number that have been installed and accepted.

The quantity of underpass luminaires, measured as provided above, will be paid for at the contract unit price each for "Underpass Luminaires \_\_\_\_\_" of the appropriate type.

There will not be any direct measurement for underpass circuitry; it will be paid for lump sum.

Underpass circuitry will be paid for at the contract lump sum price for "Underpass Circuitry at \_\_\_\_\_" at the appropriate location.

Payment will be made under:

Underpass Luminaires _____	.....	Each
Underpass Circuitry at _____	.....	Lump Sum

**SECTION 1413  
PORTABLE CONSTRUCTION LIGHTING**

**1413-1 DESCRIPTION.**

Furnish, operate and maintain everything necessary to provide lighting for compliance with the Standard Specification Section 105-14 Night Work requirement for artificial lighting.

**1413-2 MATERIALS.**

Furnish all lighting equipment as required and retain after the work is completed. Material and/or equipment is not required to be new but must be in good operating condition and in compliance with applicable safety and design codes.

Submit, for the review and approval, a lighting plan showing the type and location of lights proposed for use for night work. Present the plan on standard size roadway plan sheets (22" x 36") [558.8 mm x 914.4 mm], on a scale of either 100' or 50' to the inch (1.2 m or 0.6 m to the mm), and clearly show the location of all lights necessary for every aspect of work to be done at night. In addition to the plan sheets, submit catalog cuts giving the specific brand names, model numbers and ratings of the lighting equipment. Include in the submittals power ratings and photometric data. Allow 40 days for review of the submittals. Do not begin night work without approval of the lighting plan and the indicated lighting equipment and/or materials being in operation.

**1413-3 TOWER LIGHT.**

Use tower lights which consist of mercury vapor, metal halide, high pressure sodium or low pressure sodium fixtures mounted on a tower approximately 30' (9.1 m) in height. Use tower light fixtures which are heavy duty flood, area, or roadway style with wide beam spread, have an output of 50,000 lumens minimum, have the combined outputs of all fixtures on each tower light not exceed 460,000 lumens, and are weatherproof and supplied with attached waterproof power cord and plug. Use a sturdy tower which is free-standing without the aid of guy wires or bracing. Provide sufficient capacity in the power supply to operate the light(s) and locate it for the shortest safe routing of cables to the fixtures. A tower light consisting of the combined fixture(s), tower and power supply is preferred.

Provide tower lights of sufficient wattage and/or quantity to provide an average maintained horizontal illuminance greater than 20 footcandles over the work area.

Aim and position the lights to illuminate the area for construction work. Make sure that there is not any disabling glare to the motorist. In no case should the main beam of the light be aimed higher than 60° above straight down. The lights should be set as far from traffic as practical and aimed in the direction of, or normal to, the traffic flow.

**1413-4 MACHINE LIGHTS.**

Use machine lights which have mercury vapor, metal halide, high pressure sodium or low pressure sodium conventional roadway enclosed fixtures mounted on supports attached to the construction machine at a height of approximately thirteen feet (13') (4m). Use fixtures for machine lights which have light output between 22,000 and 50,000 lumens. Use a power supply with sufficient capacity to operate the light(s) and securely mount on the machine. Perform electrical grounding of generators to frames of machines on which they are mounted in conformance with the National Electrical Code (NEC).

Use machine light fixtures with sufficient wattage and/or quantity to provide an average maintained horizontal illuminance greater than 10 footcandles on the machine and the surrounding work area. Machine lights are in addition to conventional automotive type head lights which are necessary for maneuverability.

**1413-5 CONSTRUCTION METHODS.**

Use tower lights when the night work is confined to a fairly small area and is essentially a stationary operation.

Use machine lights when the night work is not confined to a small area and is essentially a continuous moving construction operation.

Tower lights may be provided in lieu of machine lights upon approval by the Engineer. Use of tower lights in lieu of machine lights will be considered when the number of machines, type of work, or need for inspection justify their use as decided by the Engineer.

Illuminate the work area where traffic control devices are being set up or repositioned at night.

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The work areas to be illuminated are the areas where construction equipment and labor are in operation and may be different from the work areas shown in the plans.

Illuminate a large enough work area so that the movements of all personnel and equipment engaged in the work will be contained in the area.

Provide sufficient fuel, spare lamps, generators, and personnel qualified to operate the lights to assure that they will be maintained in operation during night work.

Existing street lights do not eliminate the requirement for the Contractor to provide lighting. Consideration may be given to the amount of illumination provided by existing lights in determining the wattage and/or quantity of lights to be provided, if noted in the Contractor's submitted lighting plan.

**1413-6 BASIS OF PAYMENT.**

Payment for lighting provided by Tower and Machine Lights will be made only when a significant amount of night-time work is explicitly required and a pay item for portable lighting has been included in the contract. Otherwise, portable construction lighting will be considered incidental to other contract items and no direct payment will be made.

Payment for the lighting provided by tower and machine lights will be made at the contract lump sum price for "Portable Lighting".

The aggregate amount to be paid on each partial payment estimate will be equal to the percentage that the item of "Portable Lighting" is complete as estimated by the Engineer.

Payment will be made under:

Portable Lighting.....Lump Sum

## NOTES

