

DIVISION 14 LIGHTING

SECTION 1400 ROADWAY LIGHTING

1400-1 DESCRIPTION

Furnish, install, connect and place into satisfactory operating condition lighting at locations shown in the plans. Perform all work in accordance with the contract 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 shall be an expert in the trade, capable of understanding the intent of the contract 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 contract shall 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 possess a set of project plans and Specifications on the job site and maintain a set of accurate as built plans. This Contractor shall be qualified to responsibly instruct and direct all employees regarding the electrical work.

1400-2 MATERIALS

Refer to Division 10.

Item	Section
Conduit	1091-3
Ground Rod	1091-6
Wire	1091-2

(A) General

All materials used in the work are to be new materials unless noted elsewhere in the contract. 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 that is either metallic (Rigid Metallic Conduit) or non-metallic (PVC or HDPE), as noted in the plans.

(C) Wire

Use stranded copper conductors unless specifically noted otherwise on the contract. Use wire and cable which conforms to Insulated Cable Engineers Association (ICEA)

Section 1400

1 specifications and has marks for identification (manufacturer's name, type insulation and
2 gauge of conductor) and the UL label.

3 Use wire insulation rated at 600 VAC or greater.

4 Use the following types of wiring unless noted otherwise in the plans:

Service Lateral	UL Type USE
Control System	UL Type THW or RHW or THHN
Feeder Circuits in Conduit	UL Type USE
Branch Circuits in Light Standards	UL Type SOOW Cable
Equipment Grounding Conductor	Solid MHD, Bare or Insulated
Grounding Electrode Conductor	ASTM B2

5 Use #6 AWG for the grounding electrode conductor unless noted larger in the plans.

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

7 All grounding and bonding equipment shall conform to UL Standard 467. Use ground
8 rods which are 5/8 inch diameter x 10 feet copper clad steel. Permanently bond
9 grounding conductor to ground rod using an irreversible compression ground connector.
10 Unless the irreversible compression connectors are designed for use with more than one
11 conductor, only one conductor shall be placed under each irreversible compression
12 ground connector. Ensure all connections are made using a hydraulic, power or
13 ratcheting type crimper with appropriate dies. Use of handheld pliers for crimping is
14 prohibited.

15 For ease of inspection, the top of ground rods shall be no more than 6 inches below
16 finished grade and shall remain exposed until electrical inspection is complete.

17 **(E) Fuseholders**

18 Provide fused overcurrent protection in the base of each light standard and other locations
19 as noted. Use a fuseholder rated at least 600 VAC and 30 A approved for wet locations,
20 constructed so the fuse will be disconnected from the line side power every time the
21 fuseholder is opened. The fuseholder may be made of molded plastic or rubber and have
22 insulating boots. Use terminals which are specifically rated for the size and number of
23 conductors required.

24 Use fuses which have 5,000 A minimum interrupting capacity at the supply voltage, are
25 rated 10 A or as noted in the plans and are not glass type unless specified different in the
26 contract. Use the same type fuse in all fuseholders on a project unless specified
27 differently at specified locations.

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

32 **(F) Hardware**

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

37 **(G) Duct and Conduit Sealer**

38 Use duct and conduit sealer or mastic which is a putty-like compound and complies with
39 the following:

40 (1) Is permanently non-hardening, non-oxidizing and non-corrosive to metals, rubber,
41 plastic, lacquer and paints;

- 1 (2) Is readily workable for thumbing into openings and forming into seals around wires
2 inside conduits and openings around conduits;
- 3 (3) Has a service temperature range of minus 30°F to 200°F;
- 4 (4) Is clean, non-poisonous and non-injurious to human skin; and
- 5 (5) Seals against water, dust and air and shall adhere to wood, glass, plastics, metal,
6 rubber and painted surfaces.

7 **(H) Pull Lines**

8 Place pull lines specifically designed for pulling a rope in all empty conduits and
9 electrical duct so that electrical circuits can be installed in the future. Use pull lines
10 which are 2 ply with a tensile strength of at least 240 lb. and resistant to tangling, rot and
11 mildew.

12 **1400-3 SUBMITTALS**

13 **(A) Catalog Cuts, Working Drawings, and As-Built Plans**

14 Electronically submit catalog cuts and/or shop drawings for materials proposed for use on
15 the project per Sections 105 and 106. Do not deliver materials which have not been
16 approved to the project. Each material catalog cut and/or drawing shall show the
17 description, brand name, stock-number, size, rating, manufacturing specification and the
18 intended use.

19 The approved submittals will be returned to the Contractor through the Resident
20 Engineer's office. Present a catalog cut or drawing for all components of each contract
21 item. Electronic submittals shall be legible with the intended item clearly marked, and
22 arranged in the same order as the contract bid items.

23 **(B) Certifications**

24 Furnish a Type 3 material certification in accordance with Article 106-3 for light
25 standards, high mounts and lowering devices and a Type 6 material certification for
26 conductors. Submit certifications when the above materials are delivered to the project.

27 Type 3 or Type 6 material certifications in accordance with Article 106-3 may be
28 requested for any or all of the other material which does not have a name plate showing
29 sufficient information to verify that the material was manufactured to the requirements of
30 this section.

31 **(C) Samples**

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

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

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

Section 1400

1 (D) As-Built Plans

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

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

9 Submit one set of as-built plans to the Department.

10 Show the light standard foundations that are relocated on the as-built plans in their final
11 locations.

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

14 (E) Warranties

15 Turn over warranties from each manufacturer of electrical materials and equipment
16 pertinent to the complete and satisfactory operation of the system before the acceptance
17 of the project. Indicate the expiration date on each warranty furnished. The warranty
18 shall not be less than those provided as a customary trade practice.

19 1400-4 CONSTRUCTION METHODS

20 (A) Location Surveys

21 All light standards, high mount foundations and electrical duct will be located unless
22 indicated differently elsewhere in the contract. Mark the proposed location of circuits,
23 circuit markers, control systems, service poles, junction boxes, luminaires and all other
24 components for approval before installation.

25 The plan locations of the light standards and high mounts may be adjusted to be behind
26 guardrail, to avoid obstructions or to avoid undesirable foundation conditions. Ensure
27 location changes are approved before construction. Light standards can be moved no
28 more than 10 feet longitudinally and 2 feet laterally unless approved by the Department.
29 High mast light standards can be moved no more than 25 feet radially unless approved by
30 the Department. Verify project dimensions on the site, actual measurement always taking
31 precedence over scaled plan dimensions, with every part of the work fitted to actual
32 conditions at the site.

33 (B) Damage to Facilities

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

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

43 Installation of conductors may require trenching through existing guardrail locations.
44 Trenching may be done beneath the guardrail in a manner that will not disturb the
45 guardrail installation or the Contractor may remove short sections of guardrail to
46 facilitate mechanical trenching. Reinstall all removed guardrail by the end of the day's

1 work. Permission is required before removal of any guardrail. Repair any damage to the
2 guardrail installation or to the galvanizing of the material as directed.

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

6 **(C) Existing Utilities**

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

9 Locate these lines before operations are begun. Field changes approved by the Engineer
10 may be made to provide clearance required by the NESC.

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

14 When the work involves replacing or renovating existing lighting, make all reasonable
15 efforts to prevent dark spots in the lighting system. Phase lighting construction to allow
16 existing lighting to remain in operation as long as possible.

17 **(D) Operation of Equipment**

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

21 Install all bore pits outside the clear zone.

22 **(E) Conduit Installation**

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

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

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

33 Install the conduit in such a manner that temperature changes will not cause elongation or
34 contraction that might damage the system. Provide expansion fittings where conduit
35 crosses structure expansion joints and at other locations shown in the plans.

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

38 Install caps or plugs on stub-outs for future use. Caps and plugs shall be made of the
39 same material as the conduit. Where non-metallic conduit is joined to metallic conduit,
40 use a transition adapter. Install bushings on all conduit ends projecting into panels, boxes,
41 or other enclosures. Provide pull lines in all conduits for future installation of circuitry.
42 Coat field cut threads and other uncoated metal or damaged galvanizing with organic zinc
43 repair paint. Securely fasten conduit. For the spacing of fasteners, do not exceed 4 feet
44 for 1 1/2 inches conduit and larger or 6 feet for 1 1/4 inches conduit and smaller. Use
45 fasteners that are hot dipped galvanized or stainless steel. Provide backs with all conduit
46 straps installed on flat surfaces. Rotary-impact drills may be used for installing expansion
47 anchors in concrete. Do not use powder explosion type units.

Section 1400

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

4 (F) Wiring Methods

5 Do not pull wire through a conduit system until the system is complete and has been
6 cleaned. Use approved wire pulling lubricants. Pull conductors by hand, or use
7 motorized cable-pulling equipment designed for pulling multiple cables into conduit.
8 Use sheaves or rollers, as required to prevent damage to conductor insulation. Use a
9 dynamometer (clutch device) so as not to exceed maximum allowable pulling tension if
10 conductor is pulled by mechanical means. Do not use a motorized vehicle or heavy
11 equipment to generate pulling forces. Color code all conductors per the NEC (grounded
12 neutral is white, grounding is bare or green) and use phase conductors which are black
13 and red. Approved marking tape, paint, or sleeves may be used instead of continuous
14 colored conductors for No. 8 AWG and larger. White, red or black conductor may be
15 stripped at all accessible points and used as a bare equipment grounding conductor.

16 Joints, taps and splices will only be permitted at locations indicated in the plans and by
17 the following method.

18 Install UL Listed manufactured set screw type connectors, suitable for connecting
19 multiple wires for all phase conductor splices. These precise fit connectors are insulated
20 with high-strength dielectric material and have removable access plugs over the set
21 screws. Direct buried and/or submersible versions of these connectors (UL486D),
22 equipped with factory made waterproof insulating boots, are required for splicing inside
23 junction boxes. Non-direct buried and/or non-submersible connectors (UL486A and
24 UL486B) may be used for phase conductor splicing in normally dry areas such as inside
25 poles and transformer bases. After tightening set screw, tape down the access plugs to
26 keep them securely in place. Split-bolt connectors may be used for ground wire splicing.
27 Wire nut and compression type connectors will not be allowed.

28 Cut conductor so that 3 feet of spare conductor is available for splicing from the end of
29 each respective conduit. Neatly coil extra conductor in junction box.

30 All splices inside light standards shall be easily accessible through handholes unless
31 standard is mounted on breakaway transformer base.

32 (G) Grounding Electrodes

33 Install grounding electrodes at each light standard, high mast light standard and control
34 system as shown in the plans. The rod shall be driven vertically until the top is 6 inches
35 below the ground surface. The grounding conductor must be connected to the grounding
36 electrode by an irreversible compression ground connector.

37 (H) Equipment Mounting

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

42 (I) Base Protection

43 For median mounted light standards, use a protective metal shroud installed underneath
44 the light standard base plate to protect the exposed anchor bolts and lighting circuitry
45 segments between the base plate and the top of the concrete median barrier. The metal
46 shroud shall be fabricated of either galvanized steel, minimum gauge 22, or aluminum,
47 minimum gauge 18, to match the material type of the light standard. The metal shroud
48 shall be composed of two overlapping pieces, and attached with two self-tapping stainless
49 steel or galvanized machine screws at each overlap point.

1 For high mount standard, use galvanized steel welded wire reinforcement between the top
2 of foundation and bottom of mounting base. Attach welded wire reinforcement to anchor
3 bolts with size AWG 14 copper wire or small gauge galvanized wire.

4 **(J) Galvanizing Repair**

5 Repair any damaged galvanized components in accordance with Article 1076-7.

6 **(K) Foundations**

7 Form foundations with prefabricated cardboard forms down to 12 inches minimum below
8 top of ground.

9 To avoid vehicle undercarriage snagging of any substantial remains of a breakaway
10 support (when it is broken away), the edge of the foundation or top of anchor bolt should
11 not extend more than 4 inches above a 60 inch chord aligned radially to the centerline of
12 the highway, and connecting any point within the length of the chord on the ground
13 surface on one side of the foundation to a point on the ground surface on the other side.

14 **1400-5 ELECTRICAL INSPECTIONS AND TESTING**

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

17 Provide a calibrated MegOhmMeter, with certification that calibration was done within one
18 year of use. Provide a meter manufactured by Fluke, Amprobe, Biddle or Engineer approved
19 equal. Present the meter for inspection, at the Pre-Lighting-Work meeting described in
20 Section 1400-11.

21 During project construction perform an insulation resistance test on each feeder circuit
22 conductor. The insulation resistance for each conductor shall exceed 5 megaohms after
23 charging for 30 seconds at 500 VAC or 1000 VDC. The Contractor Meg Circuit Data Form is
24 available on the Department website. Submit the data form to the Engineer for review before
25 final inspection.

26 If the insulation resistance test of any conductor indicates a value of less than 5 megaohms,
27 locate the fault. If the fault is in a conductor between terminal connections, replace the
28 conductor. If the fault is at a terminal connection, repair or replace the terminal device.

29 Removing water from the conduit of a faulty circuit is not considered a repair. Water in the
30 conduit allows electric current to flow between skinned places in the conductor's insulation.
31 If a circuit fails the insulation resistance test and removing water allows the circuit to pass,
32 replace the conductors and re-test the new circuit.

33 After all control system cabinet wiring has been installed and connected in the proposed
34 permanent manner the Contractor will contact the Office of State Fire Marshall of the
35 Department of Insurance, or local authority having jurisdiction, to perform an electrical
36 inspection of the lighting system. Upon satisfactory testing, the Contractor will be issued
37 a Certificate of Inspection for the lighting system. The Contractor may then arrange with the
38 power company to provide the necessary power service. The Certificate of Inspection will be
39 turned over to the Engineer before project acceptance. Inspection by local authorities will
40 neither eliminate nor supersede the final inspection by the Engineer to ensure compliance with
41 the contract.

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

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

Section 1400

1 Contact the Department to schedule a final inspection of lighting systems at least 2 weeks
2 before the requested inspection date. The Lighting and Electrical Squad will perform an
3 insulation resistance test as described above, inspect the system for adherence to contract
4 requirements and prepare a lighting inspection memo based on the Lighting System
5 Inspection Checklist. The inspection checklist is available on the Department's website.
6 Provide the personnel and equipment necessary for removing and replacing fuseholders
7 and/or operating circuit breakers to facilitate the insulation resistance test performed by the
8 Lighting and Electrical Squad.

9 **1400-6 BURN-IN TEST**

10 After all the issues mentioned in the lighting inspection punchlist are addressed to the
11 satisfaction of the Engineer, the lighting system will undergo a 2 week burn-in test. The burn-
12 in test consists of normal dusk to dawn operation of all lighting system control equipment and
13 apparatus, without interruption or failure attributable to poor workmanship or defective
14 material. At the end of the burn-in test, all lights and equipment will be inspected for normal
15 operation. The Contractor will make any necessary repairs or replacements at no cost to the
16 Department.

17 Conduct the burn-in test at the same time for all lights which are energized from the same
18 utility company service point.

19 Burn-in tests of individual circuits or groups of lights will not be acceptable.

20 The Contractor is responsible for all maintenance of the lighting system(s) installed or
21 renovated as part of the contract until project final acceptance.

22 **1400-7 IDENTIFICATION**

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

28 Identify each circuit conductor using a one piece nylon cable tie with a label at each terminal
29 and access point. Use permanent marker to label the circuit conductor with the circuit number
30 indicated in the plans.

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

35 **1400-8 LOCKS AND KEYS**

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

38 **1400-9 ELECTRICAL SERVICE**

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

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

1 **1400-10 TERMINOLOGY**

2 The terms “High Mast” and “High Mount” are used synonymously in the contract.

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

7 Abandon means that the materials will not be used in the final completed form of the work.
8 Remove all abandoned materials from the project or terminate at least 18 inches below
9 subgrade so they will not be in conflict with the finished project.

10 **1400-11 CONSTRUCTION PHASING**

11 Schedule a Pre-Lighting-Work meeting before beginning work on the lighting system.
12 Include staff members from the prime contractor, electrical sub-contractor, Resident
13 Engineer’s office and the Department Lighting Designer in Raleigh.

14 Accomplish lighting work along with other roadway construction in the appropriate phases as
15 indicated in the Transportation Management Plans and these Specifications.

16 **1400-12 COORDINATION OF EXISTING LIGHTING WORK**

17 Maintain operation of the existing lighting systems until such time that they become in
18 conflict with the actual construction work, or they become a hazard to traffic as determined by
19 the Engineer.

20 Use care in working around the lights and circuitry and phase operations so that the disruption
21 of existing lighting systems will be minimized. Make repairs or replacements in conformance
22 with the contract. Should the Contractor fail to make such repairs within the time allowed,
23 the Department will cause the necessary repairs to be made by others. The costs of such
24 repairs will be deducted from any monies due the Contractor on the next subsequent monthly
25 or final payment.

26 **1400-13 MEASUREMENT AND PAYMENT**

27 There will be no direct payment, except where specifically noted in Subarticle 1400-3(C) and
28 Article 1400-9 for the work required in the preceding sections of this division. Payment of
29 the contract unit prices for the various items in the contract will be full compensation for all
30 work required.

31 **SECTION 1401**
32 **HIGH MOUNT STANDARD**

33 **1401-1 DESCRIPTION**

34 Design, furnish and install a high mount standard 60 feet or greater in height with a top-
35 latched lowering device and portable drive unit including the drive, winch, wiring, cables,
36 brackets, hardware, transformer, power cord, storage case and operating manuals.

37 **1401-2 MATERIALS**

38 **(A) High Mount Standard**

39 Provide certified computations and fabrication drawings by a professional engineer
40 licensed in the State of North Carolina.

41 Design the support including base plate and anchorage in conformance with the *AASHTO*
42 *Standard Specifications for Structural Supports for Highway Signs, Luminaires and*
43 *Traffic Signals, Fourth Edition, 2001* and the Interim Specifications valid at the time of
44 letting. Use Fatigue Category II. Design and fabricate welds in accordance with
45 Article 1072-18. Design the support for the wind velocity shown in the plans.