667.01 M  Local Road Gravel Surface Course, Type A  Cubic Meter
667.02 M  Local Road Gravel Base Course, Type B  Cubic Meter
667.03 M  Local Road Gravel Subbase Course, Type C  Cubic Meter

SECTION 668 AND 669 (VACANT)

SECTION 670 - HIGHWAY LIGHTING SYSTEM

670-1 DESCRIPTION. This work shall consist of furnishing and installing an operating highway lighting system in accordance with the plans, standard sheets, and specifications or as directed by the Engineer.

Where not specifically covered on the plans, specifications, or special provisions, all equipment shall be installed according to the manufacturer’s published recommendations.

Included in this work is the furnishing and installing of metal light standards, breakaway transformer bases, arms, luminaires, lamps, electrical conductors, fittings, minor miscellaneous components (pole line hardware, insulators, etc.), concrete foundations, pull boxes and all other materials necessary for operating and controlling the highway lighting system. Also included is the removal, relocation, storage, and/or disposal of the above materials.

670-2 MATERIALS. All electrical equipment shall conform to the EEI, NEMA, ANSI and ASTM Standards. All material shall conform to the latest requirements of the “National Electrical Code”, herein referred to as the “Code”; the rules of the New York State Public Service Commission; local power company requirements and any local ordinances which may apply. Differences in standards or code requirements shall be resolved as determined by the Engineer.

The materials used in the construction of lighting systems shall meet the requirements of the following subsections of Section 700-Materials:

- Aluminum Light Standards and Arms 723-01
- High Mast Pole, Head Frame Assembly with Luminaire Ring and Lowering Device 723-02
- Portable Power Drive for High Mast Luminaire Lowering System 723-03
- Anchor Base (Aluminum) 723-10
- Breakaway Transformer Base (Aluminum) 723-15
- Rigid Plastic Conduit 723-19
- Metal Steel Conduit, Zinc Coated 723-20
- P.V.C. Coated Galvanized Steel Conduit 723-23
- Flexible Liquid-Tight Steel Conduit 723-24
- High Pressure Sodium Vapor Luminaires (Standard Mount) 723-27
- Low Pressure Sodium Vapor Luminaires (Underbridge Mount) 723-28
- High Pressure Sodium Vapor Luminaires (Underbridge Mount) 723-29
- Mercury Vapor Luminaires (Standard Mount) 723-30
- Mercury Vapor Luminaires (Underbridge Mount) 723-31
- Cast Iron Junction Box 723-40
- Precast Reinforced Concrete Foundations and Pullboxes 723-45
- Photoelectric Control 723-50
- Anchor Bolts 723-60
- Single Conductor Cable 723-70
- Single Conductor Direct Burial Cable 723-71
- Ground Wire 723-75
§670-2

Rubber Impregnated Woven Cotton-Polyester Fabric  728-01
Rubber Impregnated Random Fiber Pad  728-02

All cast-in-place concrete base, foundations and pullboxes shall conform to the requirements of Section 501, Portland Cement Concrete - General, except that the requirements for inspection facilities, automated batching control and recordation do not apply. The concrete shall be Class A concrete for structures unless otherwise specified. The batching, mixing and curing methods, and the inspection facilities shall meet the approval of the Department or its representative. The Contractor may submit for approval by Director, Materials Bureau, a mix at least equivalent to the specified Class A Concrete.

All precast concrete bases and foundations shall meet the requirements of §723-45 Precast Reinforced Concrete Foundations and Pullboxes. Anchor bolts encased in concrete foundations shall meet the requirements of §723-60, and shall be set by template.

All concrete bases, foundations and pullboxes shall conform to the dimensions and details shown on the plans, standard sheets and specifications.

Materials will be subject to inspection at any time during the contract. Failure of the Engineer to note faulty material or faulty installation during construction will not relieve the Contractor of responsibility for removing or replacing such materials or redoing work which may fail to pass any of the Engineer's inspections of this work.

670-2.01 Conduit. Couplings, condulets, adaptors and bends shall be made from the same material as the conduit, unless otherwise indicated on the plans or directed by the Engineer.

670-2.02 Pullboxes. Pullboxes shall be cast-in-place or precast concrete units. Precast concrete units shown on the contract drawings for rectangular or circular pullboxes will be acceptable if they are of sufficient interior volume required under the pay item. If no drawings are given, the details shown on the Standard Sheet “Pullbox, Conduit and Ground Rod Installation Details” shall apply.

670-2.03 Luminaires. Luminaires shall be suitable for severe vibrations up to 3 G's, and lamp supports shall be provided if the lamp is horizontally mounted.

670-3 CONSTRUCTION DETAILS

670-3.01 Plans. The Contractor shall study the plans and details and use them as a guide in determining the location of the highway lighting equipment. Any discrepancies in the contract documents shall be resolved with the Engineer before any materials are ordered. Additionally, the manufacturer or supplier of the lighting equipment shall also use the plans to clearly label what each component part is or where it is to be installed.

All installation shall conform to the latest EEI, NEMA, ANSI and ASTM standards. In addition, workmanship shall conform to the latest requirements of the Code; the rules of the New York State Public Service Commission; local power company requirements and any local ordinances which may apply. Any work performed within the boundaries of New York City shall also be in accordance with the “General Specifications for Street Lighting Facilities” contained in the latest publication of “City of New York SPECIFICATIONS For Use With State of New York Department of Transportation Construction Contracts.” Differences in standards or code requirements shall be resolved as determined by the Engineer.

670-3.02 Shop Drawings. The Contractor shall submit six copies of the Manufacturer’s Shop Drawings to the Engineer for approval. These drawings shall cover the following items and be submitted at least ten working days prior to the date the Contractor orders the light standards, breakaway transformer base, arms, precast concrete foundations and high mast poles, head assemblies and lowering devices. These items shall not be shipped to the job site until the shop drawings are approved. The shop drawings shall be neatly drawn and clearly legible.

For luminaires and photoelectric controls catalog cuts may be submitted instead of shop drawings.
§670-3

670-3.03 Excavation and Miscellaneous Work. All excavation shall conform to Section 206, Trench, Culvert and Structure Excavation. Included shall be the protection of workers and the public. Details of this protection shall conform to the requirements of 29CFR1926 Safety and Health Regulations for Construction (OSHA) and §107-05 Safety and Health Requirements Paragraph F. Cuts in roadways, sidewalk surfaces and driveways shall be done in a neat manner, so as to cause the least possible damage. Sawcutting will be required unless otherwise shown on the plans or directed by the Engineer.

Excavation shall not be performed until immediately before installation of the conduit, direct burial cable or any other appurtenances.

The excavated material will be placed in a location or locations approved by the Engineer. These locations shall be selected by the Contractor so as to cause the least inconvenience to vehicular and pedestrian traffic and to cause the minimum interference with the surface drainage.

All surplus excavated material shall be removed and disposed of by the Contractor as specified in §203-3.08, Disposal of Surplus Excavated Materials. Excavations shall be backfilled as specified in §203-3.15, Fill and Backfill at Structures, Culverts, Pipes, Conduits and Direct Burial Cables. After backfilling, the location shall be maintained to the satisfaction of the Engineer until permanent repairs are made.

Pavement or structure courses shall be replaced as specified in §206-3.02, Replacement of Pavement Structure Courses, except that in concrete sidewalks, the complete sidewalk panel shall be removed and replaced.

670-3.04 Foundations. Locations of concrete foundations for light standards shown on the plans are approximate only and the exact location will be determined in the field. The Contractor has the option to use precast foundations in place of cast-in-place foundations for light standards. However, precast foundations shall not be allowed for high mast systems.

All excavation necessary for constructing or installing a lamppost foundation shall be performed in conformance to §670-3.03.

When cast-in-place concrete foundations can be constructed in undisturbed soil, as determined by the Engineer, the concrete shall be poured in direct contact with the earth. Forms shall not be used unless the excavation is oversize or where neat limits must be maintained. The top 0.3 to 0.5 meters shall be formed as specified on the plans or as directed by the Engineer. Care shall be taken to construct the tops of all foundations so they are level and true to line and grade. Anchor bolts shall be set by template, as ordered by the Engineer.

When cast-in-place concrete foundations are to be constructed in soil that will not support a vertical cut, the foundations shall be formed. When forms are used, the foundations shall be backfilled and compacted allowing sufficient room for the compaction equipment selected.

Where unstable soil is encountered, permanent support shall be used. This can include driving sheeting, augering in a pipe section, or any other method acceptable to the engineer.

When precast foundations are used, the size of the precast foundation shall not be less than that shown on the plans or standard sheet for cast-in-place foundations. They are only to be used in conjunction with one of the following special excavation and backfill methods to ensure foundation stability:

**Method A.** The excavation shall allow a minimum clearance of 0.15 meters around the precast foundation to be backfilled with concrete meeting the requirements of §501-2.02, Class A. For backfill purposes, small construction mixers will be permitted.

**Method B.** The excavation shall allow a minimum clearance around the precast unit compatible with the compaction equipment used. The clear area shall be backfilled with Select Granular Fill in accordance with §203-2.02 of the Standard Specifications, and compacted in accordance with §203-3.15.
§670-3

Method A or Method B can be used in undisturbed areas. Only Method B is to be used in disturbed areas.

670-3.05 Grounding. A 3 meter by 16 millimeter diameter, copperclad ground rod shall be driven near each foundation, maintaining at least 600 mm of cover, or through selected pullboxes where metal conduit is used. The ground rod shall be electrically connected to the base of the pole with a No. 6 soft drawn bare stranded copper ground wire. A copperclad groundwire clamp shall be used to attach the ground wire to the ground rod.

Where a 3 meter ground rod cannot be driven, or is insufficient to provide adequate grounding (see §670-3.16), alternate methods shall be used as shown on the plans or ordered by the Engineer. Such alternate methods can include changing the ground rod length or location, or connecting the ground wire to some other grounded object.

670-3.06 Light Standards, Breakaway Transformer Bases and Arms. Each metal light standard shall be set vertically (within 1° of plumb) on a foundation or anchorage, employing approved shims when necessary, either with or without a transformer base as shown on the plans or in the proposal. The transformer base, or the anchor base when a transformer base is not used, shall be securely bolted to the anchorage by the anchor bolts previously set.

The individual light standards shall be identified as required by the responsible maintenance agency and as shown on the plans.

Each arm shall be mounted on the shaft so the luminaire will be at the proper mounting height as shown on the plans. The mounting height shall be measured from the center of the light source to the pavement. The arms shall be in a plane perpendicular to the roadway. The Contractor, in conjunction with the Engineer, shall determine the necessary elevation data for fabricating the light standard with the correct mounting height.

A Number 8 Gauge galvanized steel or 6 millimeter nylon rope drag line shall be furnished and installed running from the terminal strip area in the luminaire to the anchor base or box where the power distribution cable is or will be installed. This drag line shall be securely anchored at each end, and removed only after the cables are installed.

The protective wrapping shall not be removed from any of the shafts or arms until the Engineer instructs the Contractor to do so.

670-3.07 Conduit. Underground conduit shall be either zinc coated metal steel conduit, PVC coated galvanized steel, rigid plastic, or flexible liquid-tight steel conduit, as indicated on the plans, and shall be carefully laid in trenches prepared to receive them. Unless indicated otherwise, conduits in exposed areas, when attached to the outside of structures, such as underdeck installations, shall be PVC coated galvanized steel conduit installed as shown on the plans or in a manner approved by the Engineer. Hot dipped, galvanized or non-rusting alloy steel clamps shall be provided to support the conduit at intervals not exceeding 1 m or as directed by the Engineer.

Underground conduit installations shall have a minimum cover of 0.45 meters except under roadways, where the minimum cover shall be 0.6 meters. The conduit shall be laid on a uniform grade to allow any condensation to drain to pull boxes or "T" drains, as detailed on the Standard Sheet "Pullbox, Conduit and Ground Rod Installation Details". Where uniform grades cannot be maintained, "T" drains shall be installed where directed by the Engineer. Conduit shall be backfilled in accordance with §203-3.15 Fill and Backfill at Structures, Culverts, Pipes, Conduits, and Direct Burial Cables. However, in rock excavations, a bedding of selected backfill must be placed and tamped before laying the conduit.

All bends in the conduit shall be made without kinking, flattening or appreciably reducing the internal diameter of the conduit. A hydraulic or power pipe bender shall be employed, unless a template is used, for all bends in steel conduit. No bends will be accepted for exposed conduit which shows any evidence of destruction of the protective coating.

Where conduits terminate at pullboxes, the Contractor shall break into the pullbox and seal, usually
with mortar, the remainder of the hole(s) in a manner acceptable to the Engineer. Sealed bonding bushings shall be provided at each conduit outlet in boxes. Bushing caps, to prevent entry of dirt and refuse prior to pulling cables, shall be placed on all conduit ends. Outlet boxes with conduits properly connected shall be accurately located according to the plans and securely fastened.

All conduits installed shall be tested for clear bore and correct installation by the Contractor using a ball mandrel, brush and snake before the installation will be accepted. Two short wire brushes shall be included in the mandrel assembly. Snaking of conduits shall be done by the Contractor in the presence of the Engineer. Any conduit which rejects the mandrel shall be cleared and the Contractor shall bear all costs to replace defective conduit and restore surface to original condition.

Numbers or letters shall be assigned to the various conduit runs, and as they test clear, they shall be identified by a brass tag, no less than 31 mm in diameter, attached by means of No. 20 AWG brass wire. All conduit terminations in pole bases or pull boxes shall be tagged.

As the conduit runs test clear, a record shall be kept under the heading of "Empty Conduits Tested, Left Clear, Tagged and Capped," showing conduit designation, diameter, location, date tested and by whom. When completed, this record shall be signed by the Electrical Inspector and submitted in triplicate for approval. This record shall be entered on the Record Drawings.

All empty conduit and duct openings after test, shall be capped or plugged by the Contractor as directed. After a conduit is properly installed and cleaned, the Contractor shall furnish and install in each conduit run a No. 10 AWG galvanized steel drag line or nylon or polypropylene rope, with a tensile strength of at least 2222 newtons, leaving at least 1 meter of extra line in each pull box, transformer base, or other terminus. If cable is not pulled through the conduit within thirty days, the steel drag shall be grounded to a suitable grounding device at each end of the circuit.

All metallic connections shall be tight to assure continuity of ground bondings.

Conduit shall be placed under existing pavement by approved jacking or boring methods and as directed by the Engineer. The jacking or boring pit shall be located beyond the outside shoulder keeping at least 0.6 meters clear of the edge of shoulder. Jacking pits will not be permitted in the median, but receiving pits may be dug in grass medians after the jacking is completed if permitted on the plans or by the Engineer.

670-3.08 Pullboxes. Cast-in-place or precast concrete pullboxes shall be constructed at the locations and to the dimensions shown in the plans, standard sheets, specifications, or proposal. Excavations for pullboxes shall be performed in accordance with the requirements of §206-3, Construction Details for Trench, Culvert and Structure Excavation, and included in this item.

Frames and covers shall be furnished and placed on each pullbox. They shall be placed true to line and grade and make full and even bearing on the pullbox.

The frames and covers shall be of the design and detail shown in the plans, standard sheets, specifications or proposal. Frames and covers which do not fit together properly, are warped or rock, will be rejected by the Engineer. Any material rejected by the Engineer, will be removed from the site by the Contractor.

No pullbox shall be backfilled until all cement concrete has sufficiently hardened and forms, if any, have been removed.

The requirements of §203-3.15, Fill and Backfill at Structures, Culverts, Pipes, Conduits and Direct Burial Cables, shall apply.

670-3.09 Junction Boxes. Cast iron junction boxes shall be installed at the locations shown on the plans. For surface mounting, the boxes shall be securely bolted to brackets as detailed on the plans. For installation where boxes are embedded in cement concrete, the boxes shall be set with the covers flush with the surface.

All hardware used in conjunction with mounting of these boxes shall be rust and corrosion resistant.
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670-3.10 Luminaires. Luminaires of the type and wattage specified, complete with all components shall be installed where shown on the plans standard sheets, or proposal or where directed by the Engineer. All necessary field adjustments required to achieve the specified light distribution shall be performed as directed by the Engineer.

A. Standard Mounting. Luminaires shall be installed on light standard mast arms with the vertical axis perpendicular to the roadway and the longitudinal axis parallel to the roadway centerline. The luminaires shall be installed, though not necessarily powered, immediately after the mast arms are connected to the shaft. Otherwise, vibration dampeners shall be used until the luminaires are installed.

B. Underbridge Mounting. Luminaires of the type and wattage specified shall be installed on wall mounts or outlet box studs.

Self-contained underbridge luminaires complete with all specified ballasts, and any other appurtenances necessary shall be installed according to manufacturers written instructions, as shown on the plans, as specified in the proposal or as directed by the Engineer.

670-3.11 Photovoltaic Control. Photoelectric controls shall be installed at the locations shown on the plans, preferably facing north, and properly adjusted to energize the luminaires at the specified illumination levels.

670-3.12 Single Conductor Cable and Single Conductor Direct Burial Cable. Wire installation shall not start until raceways and boxes have been cleared of all foreign matter and all other operations of the work which are likely to damage the conductors have been completed. The National Electric Code Rules shall be observed regarding installation of wire and cable.

Unless otherwise specified, splices will be permitted only in pullboxes, junction boxes, utility manholes, luminaires, transformer bases, and lamppost hand holes. All conductor runs between units of equipment shall be without splices. Conductors in control cabinets shall not be spliced.

All splices shall be capable of satisfactory operation under continuous submersion in water. Multiple conductors shall be spliced and insulated to provide a watertight joint and to prevent absorption of moisture by the conductors.

Moisture shall be excluded from the joint during the splicing operation and the work shall be done in dry weather or under shelter. Perspiration from the splicer’s hand should be wiped off with dry material. All materials and tools involved in the splicing process shall be kept dry.

One of the following methods shall be used for making a watertight and electrically insulated splice:

Method No. 1. The outer covering and insulation shall be removed from each conductor for a minimum length necessary for the use of a pressure release crimping tool. The conductor ends shall be bared and joined with a seamless, solderless type sleeve connector of the same AWG size as the conductor being spliced, using a pressure release crimping tool designed for the size connector being used. After crimping the sleeve connector shall maintain proper contact with both conductors around the circumferences of the splice and along the length of the sleeve.

The portion of each conductor where insulation has been removed, and the sleeve connector, shall be reinsulated using a coat of fast drying sealing agent of electrical grade, wrapped tightly with overlapping layers of rubber tape, a second coat of the sealing agent applied, and then wrapped tightly with overlapping layers of polyvinylchloride tape.

The sealing agent and tape shall extend at least 25 mm onto the undisturbed insulation of each conductor. Sufficient layers of tape shall be applied to equal 1.5 times the thickness of the original insulation.

Rejacketing the cable shall be accomplished in a similar manner as described above except that the sealing agent and tape shall extend at least 0.1 meters onto the undisturbed outer covering of each cable.

Individual splices in each conductor shall be staggered to minimize the outside diameter of the
splice.

**Method No. 2.** All of the requirements for splicing, specified in Method No. 1, shall apply, except that the completed splice including sleeve connector and the portion of each conductor where the insulation has been removed, shall be reinsulated and the conductor rejetted by using an acceptable mold poured full with a two component dielectric epoxy resin. The resin shall not require external heating to produce satisfactory pouring consistency.

670-3.13 Ground Cable. Ground cable shall be installed where and as detailed on the plans or as directed by the Engineer.

670-3.14 Regulations. All work shall be done in accordance with latest edition of the national electrical safety codes, rules and regulations of the State authorities having jurisdiction over such work, and regulations of the utility companies where the work is being installed. Where differences or discrepancies occur, the most stringent requirements shall apply.

670-3.15 Prosecution of Work. All work shall be done by qualified and experienced mechanics of each labor class, as determined by the Engineer. All work shall be inspected and approved by the Engineer before concealment.

670-3.16 Tests. The Contractor shall conduct all tests, in the presence of the Engineer. The equipment required for each test shall be supplied by the Contractor, along with the equipment manufacturer’s written instructions describing how to perform the test. The following tests shall be performed by the Contractor, at the time directed by the Engineer, prior to acceptance of the work:

**A. Insulation Test.** Each circuit with associated ballasts and protective devices shall be insulation tested using an insulation tester connected according to manufacturers instructions. A polarization index shall be computed by dividing a ten minute reading by a one minute reading. The polarization index shall be greater than four (4) for acceptance of new circuits, and greater than two (2) for acceptance of existing circuits. The lighting system shall be properly grounded and disconnected while this test is taking place.

**B. Ground Test.** A ground test shall be performed by the Contractor using an earth tester with resolution to at least a tenth of an ohm. The test shall be performed, and the results interpreted, according to manufacturer’s instructions. Readings of five ohms or less will be required for acceptance. Additional grounding methods satisfactory to the Engineer may be necessary until the installation can pass the ground test.

**C. Functional Test.** After satisfactory completion of all other tests, a functional test shall be performed consisting of not less than ten consecutive days of satisfactory operation. If unsatisfactory performance of any component of the lighting system is discovered during this time, the condition shall be corrected and the Engineer may require the test repeated until ten days of continuous satisfactory operation is obtained.

Temporary shut downs caused by power interruption or vehicle impact shall not constitute discontinuity of the functional test.

670-3.17 Coordination with Utility Company. The Contractor shall be responsible for all coordination with and between the utility company.

The Contractor shall make all necessary arrangements with the utility company for the required electrical services necessary for the energizing of a temporary lighting installation and barricade lighting.

The Contractor shall comply with the utility company regulations. The utility company will connect and disconnect the power as required. When an entry into a service manhole or attachment to any utility company pole is required, the Contractor shall notify the utility company sufficiently in advance, and under no condition shall the Contractor enter any utility company owned manhole or place an attachment.
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to a utility company owned pole without an agreement with the utility company.

The service points shown on the plans are approximate only and the Contractor shall determine the
exact location from the serving utility company.

When called for in the contract documents the Contractor shall make arrangements with the local
utility company to complete the service connections.

670-3.18 Removal and Disposal, or Storage, of Lighting Equipment. Existing lighting
equipment designated for storage shall be carefully removed from their present locations by
disconnecting the conductors, unbolting the mast arm(s) and luminaire(s) and detaching the shaft (and
transformer base) from the anchor bolts. The work shall be performed in a manner acceptable to the
Engineer. Component parts designated for storage shall be neatly stored and protected during storage
at locations and in a manner as approved by the Engineer. Standards designated for removal and disposal
shall be disposed of by the contractor in a manner approved by the Engineer within the directed time
period after removal from their original location. The concrete lamppost foundations shall be cut free
of the attached trenched conduits and shall be removed by the Contractor from the job site. The hole
resulting from removing the foundation shall be filled with an approved material and compacted as
directed by the Engineer.

670-3.19 Relocation of Lighting Equipment. Lighting equipment designated for relocation shall
be detached and stored as per §670-3.18, reinstalled and successfully retested at the new location. The
complete relocation shall take place in one work shift unless otherwise shown on the plans or ordered
by the Engineer.

Where bracket arms and luminaires are to be relocated onto other utility poles, the down leads shall
also be relocated, or replaced in kind if necessary, AOBE. (Down leads include small sections of conduit
or wood molding, wires and fuses connecting the secondary power supply line to the luminaire.) The
bracket arm shall be attached to the pole with hardware similar to existing. The Contractor shall also
relocate the epoxied strap used where the bracket arm is located above telephone lines.

Any part of the bracket arm, luminaire, or down lead damaged during removal or reinstallation shall
be replaced or repaired to the satisfaction of the Engineer.

670-3.20 High Mast Pole, Head Frame Assembly and Lowering System. The high mast steel
pole, head frame assembly and lowering system shall be installed in accordance with the manufacturer's
recommendations, or as directed by the Engineer. With each installation a Manufacturer's instructional
manual shall be furnished in each pole base. This manual shall include, but not be limited to the
following details:

1. Raise and lower assembly instructions
2. Operating instructions
3. Maintenance instructions
4. Attachments

Additionally, the luminaire ring with all luminaires installed shall be lowered and raised five (5)
times, at least twice in the coldest part of the winter and twice in the hottest part of the summer, if
possible, to test functionality. These test dates shall be determined by the Engineer. Failure to lower
or rise properly will be means for rejection of the assembly.

670-3.21 Portable Power Drive for High Mast Luminaire Lowering System. The portable
power drive shall be used to raise and lower the luminaire ring as described above, and be delivered in
good condition to the location shown on the plans upon acceptance of the high mast system.
670-4 METHOD OF MEASUREMENT

670-4.01 Foundations. Lighting standard foundations will be measured as the number of complete units installed in accordance with the plans, specifications or as directed by the Engineer.

670-4.02 Light Standards. Light standards will be measured as each standard of the type specified, complete, in place, in accordance with plans, specifications or as directed by the Engineer.

670-4.03 Arms. Arms of the type and length specified will be measured by the number of units furnished and installed on the respective light standards (or wood poles) according to the plans, specifications or as directed by the Engineer.

670-4.04 Breakaway Transformer Base. Breakaway transformer bases will be measured as the number furnished and installed in accordance with the plans, specifications or as directed by the Engineer.

670-4.05 Conduit. Conduit will be measured by the linear meters along the axis of the conduit, of the type and size specified, installed according to the plans, proposal, or as directed by the Engineer. Measurement shall include all couplings, conduits, adaptors and bends.

670-4.06 Pullboxes. Pullboxes, including frames and covers, will be measured as the number furnished and installed in accordance with the plans, specifications or as directed by the Engineer.

670-4.07 Junction Box. Cast iron junction boxes will be measured as the number of each size furnished and installed in accordance with the plans, specifications or as directed by the Engineer.

670-4.08 Luminaires. Luminaires of the type and wattage specified will be measured by the number of units furnished and installed according to the plans, specifications or as directed by the Engineer.

670-4.09 Photoelectric Controls. Photoelectric controls will be measured as each control furnished and installed in accordance with the plans, specifications or as directed by the Engineer.

670-4.10 Single Conductor Cable and Direct Burial Cable. Single Conductor Cable wire will be measured for payment by the number of linear meters of single conductor of each size actually installed in accordance with the plans and specifications or as directed by the Engineer.

670-4.11 Ground Wire. Ground wire will be measured for payment by the number of linear meters of ground wire installed in accordance with the plans and specifications or as directed by the Engineer.

670-4.12 Removal of Lighting Equipment. The removal of lighting equipment will be measured by the number of light standards (including bracket arms and luminaires), or foundations, removed from the site and stored or disposed of as ordered by the Engineer.

670-4.13 Relocation of Lighting Equipment. The relocation of lighting equipment will be measured by the number of specified units removed and reinstalled at the new location.

670-4.14 High Mast Pole, Head Frame and Lowering Assembly. High mast steel pole, head frame assembly and lowering system will be measured by the number of complete units furnished and installed in accordance with the contact documents.

670-4.15 Portable Power Drive for High Mast Luminaire Lowering System. The portable power drive for high mast luminaire lowering system will be measured by the number of complete units delivered.
§670-5

670-5 BASIS OF PAYMENT

670-5.01 General. The Contractor shall pay all fees and expenses for testing, service connections, licenses, electrical energy and any other cost he may incur in constructing the highway illumination system, except that the cost of electrical energy used for public benefit prior to the completion of the contract will be borne by the State, when such operation is directed by the Engineer in writing. The cost of all minor miscellaneous components shall be included in the price bid for the various lighting items.

670-5.02 Foundations. The unit price for each lighting standard foundation shall include the cost of all labor and materials necessary to complete the work, including conduit elbows, grounding system, anchor bolts, all appurtenances, excavation, special fill, and any protective system(s) required to ensure the safety of the workers and the public.

670-5.03 Light Standards. The unit bid for each light standard shall include the cost of all labor and other materials necessary to complete the work.

670-5.04 Arms. The unit price bid for each arm of the type and length specified shall include the cost of the arm, appropriate down leads and all labor and other materials necessary to install it on the designated light standard or wood pole shown on the plans.

670-5.05 Breakaway Transformer Bases. The unit price bid for each breakaway transformer base shall include the cost of the breakaway transformer base and all labor and other materials necessary to install it where shown on the plans.

670-5.06 Conduit. The unit price bid per linear meter shall include the conduit and all labor and other materials necessary to complete the work, including couplings, condulets, adaptors or bends. Excavation and backfill for conduit shall be paid for separately under the item for Conduit Excavation and Backfill or as indicated.

670-5.07 Pullbox. The unit price bid for each pullbox shall include the cost of all excavation, backfill, frames, covers, labor, equipment, and other materials necessary to complete the work.

670-5.08 Junction Box. The unit price bid per each junction box shall include the cost of furnishing and installing cast iron junction boxes, and all labor, equipment and any other material necessary to complete the work.

670-5.09 Luminaires

A. Standard Mount. The unit price bid for each standard mount luminaire shall include the cost of the luminaire of the type specified, labor and other material necessary to complete the work.

B. Underbridge Mount. The unit price bid for each underbridge luminaire shall include the cost of the underbridge luminaire of the type specified, complete with mounting hardware, and all labor and other materials necessary to complete the work.

670-5.10 Photoelectric Controls. The unit price bid for each control shall include the cost of all labor, equipment and any materials necessary to complete the work.

670-5.11 Single Conductor Cable and Direct Burial Cable. The unit price bid per linear meter shall include the cost of furnishing all labor, materials, and equipment to satisfactorily complete the work. Cable from the pole base to the luminaire, or from the overhead power source to the luminaire, will be included in the light standard item or bracket arm item.

670-5.12 Ground Wire. The unit price bid per linear meter shall include the cost of furnishing all labor, materials, and equipment to satisfactorily complete the work.
670-5.13 Remove and Store Lighting Equipment. The unit price bid for removing and storing lighting equipment shall include the cost of all labor, materials and equipment necessary to complete the work. Removing concrete foundations will be paid for under its appropriate item.

670-5.14 Remove and Dispose of Lighting Equipment. The unit price bid for removing and disposing lighting equipment shall include the cost of all labor, materials and equipment necessary to complete the work. Removing concrete foundations will be paid for under its appropriate item.

670-5.15 Relocate Lighting Equipment. The unit price bid for relocating the lighting equipment shall include the cost of all labor, materials and equipment necessary to complete the work. Installing new concrete foundations will be paid for under their appropriate items. New conductors and conduit, where necessary, will also be paid for separately.

670-5.16 High Mast Pole, Head Frame Assembly, and Lowering System. The price bid shall include the furnishing of all labor, materials, and equipment necessary to complete the work. The luminaires will be paid for separately.

670-5.17 Portable Power Drive for High Mast Luminaire Lowering System. The price bid shall include the entire power drive assembly, and winch if necessary, delivered to the location indicated on the plans or directed by the Engineer.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
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<tbody>
<tr>
<td>670.01XX M</td>
<td>Foundation for Light Standards</td>
<td>Each 20</td>
</tr>
<tr>
<td></td>
<td>XX = Foundation Length in meters and tenths (1.2, 1.8, etc.)</td>
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<tr>
<td>670.11XX M</td>
<td>Aluminum Light Standards for Single Member or Truss Arm(s)</td>
<td>Each</td>
</tr>
<tr>
<td></td>
<td>XX = Mounting Height in whole meters (08, 09, 11, 13, 14, 16)</td>
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<tr>
<td>670.12XX M</td>
<td>Aluminum Single Member Bracket Arm</td>
<td>Each</td>
</tr>
<tr>
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<td>XX = Arm Length in meters and tenths (1.2, 1.8, 2.4, 3.0)</td>
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<tr>
<td>670.13XX M</td>
<td>Aluminum Trussed Arm</td>
<td>Each 25</td>
</tr>
<tr>
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<td>XX = Arm Length in meters and tenths (3.6, 4.5, 5.4, 6.0)</td>
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<tr>
<td>670.14XX M</td>
<td>Aluminum Bracket Arm, Wood Pole Mounted</td>
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<td>XX = Arm Length in meters and tenths (1.8, 3.6, 4.5, 5.4)</td>
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<td>670.15XX M</td>
<td>Aluminum Light Standard for Single Davit Arm</td>
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<td>XX = Mounting height in whole meters (09, 11, 13, 14, 16)</td>
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<td>670.16XX M</td>
<td>Aluminum Light Standard for Double Davit Arms</td>
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<tr>
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<td>XX = Mounting height in whole meters (09, 11, 13, 14, 16)</td>
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<td>670.17XX M</td>
<td>Aluminum Davit Arm</td>
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<td>XX = Arm Length in meters and tenths (1.8, 3.6, 4.5, 5.4, 6.0)</td>
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<tr>
<td>670.18XXZZ M</td>
<td>High Mast Pole, Head Frame Assembly with Luminaire Ring</td>
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<td>XX = Height of pole in whole meters (30, 36, 45)</td>
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</tr>
<tr>
<td></td>
<td>ZZ = Number of luminaire tenons (04, 06, 08, 10, 12)</td>
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<tr>
<td>670.1801 M</td>
<td>Portable Power Drive for High Mast Luminaire</td>
<td>Each 40</td>
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<td>Lowering System</td>
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</tr>
<tr>
<td>670.19 M</td>
<td>Breakaway Transformer Base (Aluminum)</td>
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<tr>
<td>670.20XX M</td>
<td>Galvanized Steel Conduit</td>
<td>Meter</td>
</tr>
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<td></td>
<td>XX= 01 02 03 04 05 06</td>
<td></td>
</tr>
<tr>
<td></td>
<td>NPS= ¾ 1 2 3 4 5</td>
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<tr>
<td>670.23XX M</td>
<td>Galvanized Steel Plastic Coated Conduit</td>
<td>Meter 45</td>
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§670-5

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<td>3</td>
<td>3(\frac{1}{2})</td>
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<td>5</td>
<td>6</td>
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**670.25XX M** Flexible Conduit

<table>
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<td>5</td>
<td>6</td>
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</table>

**670.3001 M** Pullboxes less than 0.14 m\(^3\), inside volume (Lighting)

**670.3006 M** Pullboxes 0.14 m\(^3\) to 0.21 m\(^3\), inside volume (Lighting)

**670.3010 M** Pullboxes 0.22 m\(^3\) to 0.28 m\(^3\), inside volume (Lighting)

**670.3020 M** Pullboxes 0.29 m\(^3\), to 0.42 m\(^3\), inside volume (Lighting)

**670.3030 M** Pullboxes over 0.42 m\(^3\), inside volume (Lighting)

**670.40 M** Cast Iron Junction Boxes

**670.50TCWW M** Luminaire

- **T=** Type of Lamp and Mounting: 1=High Pressure Sodium Vapor, Std. Mount; 2=High Pressure Sodium Vapor, Underbridge Mt.; 3=Low Pressure Sodium Vapor, Underbridge Mt.; 4=Mercury Vapor, Std Mount; 5=Mercury Vapor, Underbridge Mount
- **C=** Cutoff Characteristics
  - 1=Short,Cutoff; 2=Medium,Semi-cutoff; 3=Long,Non-cutoff; 4=Medium,Cutoff; 5=Long,Semi-cutoff; 6=Medium, Non-cutoff; 7=Short, Non-cutoff
- **WW=** Wattages
  - 03=35 watts; 05=50 watts; 07=70 watts; 15=150 watts; 20=200 watts; 25=250 watts; 40=400 watts; 01=1000 watts; 55=55 watts; 09=90 watts; 13=135 watts; 17=175 watts; 70=700 watts

**670.60 M** Photoelectric Controls

**670.70XX M** Single Conductor Cable

<table>
<thead>
<tr>
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**670.71XX M** Single Conductor Direct Burial Cable

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<td>10</td>
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</table>

**670.7501 M** Ground Wire No. 6 AWG.

**670.80 M** Remove and Store Lamppost Assembly

**670.81 M** Remove and Dispose of Lamppost Assembly

**670.82 M** Remove Lamppost Foundation

**670.90 M** Relocate Lamppost Assembly

**670.91 M** Relocate Bracket Arm With Luminaire

**SECTIONS 671 THRU 679 (VACANT)**

**SECTION 680 - TRAFFIC SIGNALS**

**680-1 DESCRIPTION**