

600 INCIDENTALS

ITEM 625 - FREEWAY LIGHTING

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625.01 Description. This work shall consist of furnishing and installing electrical materials and equipment complete and ready for service, in reasonably close conformity with locations, dimensions, and grades shown on the plans or ordered by the Engineer. This work shall also include necessary excavation and backfill, and disposal of discarded materials and restoration of disturbed facilities and surfaces in accordance with 603.09 and electrical testing as specified.

625.02 Materials. New first quality materials shall be furnished. They shall comply with the Underwriters Laboratories requirements. The materials shall also comply with the National Electrical Code and local codes for the area of installation. No materials furnished under this specification shall contain polychlorinated biphenyls. All electrical parts, wire, switches and other elements of the installations shall be of ample capacity to carry the required current without excessive heating or causing an excessive drop of potential.

Except as otherwise provided herein, each individual item of equipment shall bear a nameplate, or other type of indelible marking or brand that shall identify it as to type, catalog number and manufacturer.

Specific materials and items shall be as follows:

Anchor bolts and nuts.....	713.01, 713.21
Cable.....	713.02
Cable connectors and connector kits	713.15
Cable splicing kits	713.15
Concrete.....	499, 511
Conduit.....	713.04, 713.07
Power service components.....	713.19
Ground rods	713.16
Junction boxes	713.10
Lamps	713.14
Light poles, bracket arms	713.01
Light towers.....	713.21
Luminaires	713.11, 713.13, 713.21
Portable power units	713.21
Pull Boxes.....	713.08, 713.081, 713.09
Reinforcing steel.....	509.02
Sand.....	703.06
Structure ground cable	713.17
Unit type duct-cable systems	713.03
Wood service poles	713.19

625.03 General. In general, definitions of electrical terms used shall be in accordance with Appendix F of the American National Standard Practice for Roadway Lighting ANSI D12.1. Exceptions are as follows:

- (a) A luminaire shall include direct appurtenances such as a reflector, refractor, housing and supports that are integral with the housing and high intensity discharge (HID) or fluorescent ballasts when applicable. The luminaire shall include the lamp.
- (b) A light pole shall be considered to include anchor or transformer base, shaft, bracket arm if required, and integral hardware to support luminaires at heights of less than 70 feet (21.3 m) above the foundations.
- (c) A light tower shall be considered to include a shaft with base plate, pole head, luminaire ring and integral lowering mechanism, complete lightning protection system, internal power cable, and connecting and associated hardware, to

support luminaires at heights of 70 feet (21.3 m), and greater, above the foundation.

Items of electrical equipment shall consist of products of the same manufacturer, as far as practicable.

Each system shall conform as to voltage, amperage, frequency and type specified. The Contractor shall furnish and install all incidentals necessary to provide a complete and practical working unit or system.

All installations shall be in accordance with the National Electrical Code and National Electrical Safety Code, and shall also conform to local laws and codes governing such work.

The Contractor shall obtain and pay for all permits required.

In order to provide all necessary requirements for the proposed lighting system, the Contractor shall cooperate with the agency which will furnish electrical service, also hereinafter referred to as the supplying agency.

625.04 Working Drawings. The Contractor shall submit 8 sets of shop drawings, catalog cuts, specifications, photometric data, brochures, data sheets and wiring diagrams for review and approval, as required by the Director, of apparatus and equipment to be furnished. The submitted documents shall show clearly the design, quality, dimensions, and other such information as may be necessary for a proper evaluation of the items submitted. All submitted documents shall identify the specific project number and year with the bid item reference number to which the apparatus or equipment applies. If more than one catalog number or type is listed on a sheet, the item intended to be furnished shall be identified by an appropriate mark. The working drawing submission shall indicate specific compliance with applicable specifications.

The Contractor shall not install any of the items until written approval is received from the City. After approval, working drawings shall be considered as supplemental to, but not a substitute for, the original plans. Approval of working drawings shall not relieve the Contractor of responsibility for omissions, erroneous or inconsistent dimensions and notations, other errors or the proper functioning of the completed installation.

625.05 Light Poles and Towers. Light poles and towers conforming to approved shop drawings shall be erected upon the completed concrete foundations or other specified type of mounting. Light poles shall be plumbed or aligned by using metal shims. Towers shall be plumbed or aligned with leveling nuts. After erection, each light pole shall be adequately grounded as provided for in 625.10 or 625.20, and shall have hand hole covers or transformer base doors fastened in place.

After erection, galvanized poles shall be inspected for defects in the galvanized surfaces. Minor scratches shall be given two coats of zinc-rich primer. The second coat shall not be applied until after the first coat has adequately dried. Poles having major scratches or defects in the galvanized surfaces will not be accepted.

625.06 Foundations. Excavation for foundations shall be completed, as nearly as practicable, to the dimensions shown for the foundations. Concrete shall be cast-in-place, Class C, and construction shall be in accordance with 511, except that forms will not be required for portions of foundations extending more than 6 inches (152 mm) below the ground line, unless the soil does not have sufficient stability to stay in place during the placing of the concrete. When rock is encountered in excavation, the total depth of the foundation may be decreased, when so directed by the Engineer, by an amount not exceeding one-half of the depth of the rock excavation required to obtain the foundation depth shown on the plans. Where, in the opinion of the Engineer, an excavation for a foundation has revealed an unstable condition at the bottom of the excavation, the foundation shall be deepened or enlarged in size as directed by the Engineer. Payment for additional quantities of excavation and foundation concrete required by the Engineer for this purpose shall be made by supplemental agreement. If a caving should occur during excavation, the Contractor may continue excavating using casing, sleeving or other methods, with the approval of the Engineer.

Reinforcing steel as specified shall be placed in accordance with 509.

Anchor bolts for light poles and towers shall be installed in the foundations in accordance with approved shop drawings and anchor bolt setting templates. The tops of foundations shall be finished smooth and level.

Anchor bolt settings for light poles shall provide that light poles predominantly illuminating a mainline roadway shall be positioned with the arm of the pole perpendicular to the roadway.

After forms have been removed, excavated spaces around the foundations shall be backfilled with suitable material placed and tamped in thin layers as directed by the Engineer.

625.07 Luminaires. Light pole luminaires shall be adjusted vertically and horizontally to provide the required mounting height and the specified alignment with the roadway. At pole locations where the profile grade exceeds 4 percent, the luminaires shall be oriented so that the vertical axis of the luminaire shall be perpendicular to the longitudinal centerline of the roadway at that location. Tower luminaires shall be leveled by means of the adjustment device provided.

After all other work has been completed and just prior to leaving the job, refractors shall be cleaned with a detergent and reflectors cleaned with an approved cleaner to provide the maximum lumen output possible.

Lamps shall be compatible with ballasting characteristics of the specified luminaires.

625.09 Glare Shields. Glare shields shall be furnished and installed where designated. The shields shall be obtained from the manufacturer of the luminaires with which they are to be used.

625.10 Ground Rods. A ground rod unit shall consist of furnishing one ground rod of the specified type and size installed as shown on the plans. Each ground rod shall be tested as specified in 625.22. If the earth resistance measurement exceeds 10 ohms for traffic signal controller and tower lighting ground rods and 25 ohms for all other ground rods, a second ground rod shall be installed as shown on the plans. The two rods shall be temporarily connected together with ground cable and the earth resistance measured. If the earth resistance still exceeds the above values, a 10 foot (3.0 m) rod shall be exothermically welded to the top of the second rod to constitute a continuous 20 foot (6.1 m) long rod. After this is driven into the earth, it shall be temporarily connected to the first rod and the earth resistance measured. If the earth resistance still exceeds the required value, this procedure of lengthening and driving the second rod shall continue until either an acceptable value of earth resistance is obtained or the extended rod cannot be driven further. The rods shall be permanently interconnected with a ground cable conforming to the requirements of 713.17.

If the measured earth resistance still exceeds the required value after the last rod is driven and interconnected, the Engineer shall direct the Contractor to install a grounding grid utilizing direct buried messenger cable or rods exothermically welded end to end. The grid shall be used to bond light poles and structures in continuous series to some point on a type of terrain that will permit obtaining an acceptable earth ground. Where rock is encountered and acceptable earth grounds cannot be accomplished, a grid system, as described above, shall be installed. Payment for these changes shall be made by supplemental agreement.

Connections between rods and cable shall be made by exothermic welds with two coats of insulating varnish applied over the welds and exposed cable.

625.11 Pull Boxes. The types and sizes of pull boxes and covers furnished shall be as specified, and they shall be located where designated on the plans. Excavation shall be performed as nearly as practicable to the outside dimensions of the pull box. A 6 inch (152 mm) gravel base shall be provided below the pull box. After boxes are set to proper grades, excavated spaces around the boxes shall be backfilled with suitable material placed and thoroughly tamped in thin layers.

When pull boxes are installed in paved areas, an adequate area shall be removed by saw cutting on the sides, or by removal back to an expansion joint. The cover surface shall be adjusted to be slightly above the surrounding pavement. Pavement matching the surrounding

area shall be placed from the pull box rim to the existing pavement, permitting no gaps larger than 1/4 inch (6 mm).

625.12 Trench. Trenches located adjacent to and parallel with curbs or pavements shall not deviate more than 6 inches (152 mm) from the lines designated. Trench backfill shall be placed in layers not to exceed 4 inches (102 mm) in thickness and compacted with mechanical tampers or other approved compaction equipment as directed. Backfill material shall consist of suitable soil or granular material, except the material around and in the first 4 inches (102 mm) above the top of unit type duct-cable not encased in concrete shall not contain pieces larger than 1/2 inch (13 mm). Material for trenches in areas of pavement and stabilized aggregate shoulders shall be granular material.

Trenches shall have a minimum depth of 2 feet (0.6 m) and shall not exceed 12 inches (0.3 m) in width.

However, for trenches in paved areas, the existing pavement shall be removed for at least 6 inches (152 mm) beyond the edge of the underlying trench. Saw cut lines shall follow existing joints or grooves where possible and shall be premarked and be approved by the Engineer before sawing. Replacement for flexible pavement shall be Class C concrete placed to within 2 inches (51 mm) of the surface, with a 404 surface course. Replacement for rigid pavement shall be Class C concrete placed, finished and textured to the satisfaction of the Engineer.

In paved areas the Contractor may utilize a narrow slit type trench with a minimum depth of 2 feet (0.6 m) and a minimum width of 4 inches (102 mm). Backfill shall be Class C concrete to full depth, except the bottom 4 inches (102 mm) around the conduit may be tamped soil or granular material.

625.13 Conduit. Conduit of the type and size shown on the plans shall be installed at locations designated by the plans, or as directed. Where the size is not specified, the Contractor shall submit to the Director for approval, plans showing the size and location of each conduit and the number and size of wires contained in each. Such conduit shall comply with the National Electrical Code in so far as conduit fill is concerned.

Where underground conduits are to be encased in concrete, the concrete encasement shall be Class C and shall have a minimum thickness of 3 inches (76 mm). Spacers shall be used as shown on the plans.

Bends in conduit shall be used only when absolutely necessary. The total bending between adjacent junction boxes and/or pull boxes shall not exceed 180 degrees and the total bending between adjacent light poles shall not exceed 270 degrees. The radius of any field bend shall be not less than 12 times the internal diameter of the conduit. Bends in conduit shall

be so made that the protective covering will not be injured and the internal diameter at the bend will not be reduced.

All rigid ferrous metal conduit, and fittings and appurtenances thereto, shall be galvanized. They shall be of such size that the wires can be easily drawn into the conduit without excessive pull. All cut ends of metallic conduit shall be reamed to remove rough edges. All conduit threads shall be painted with an electrical conductive paint in such a manner that there will be no unprotected surfaces and the joint will be watertight and will electrically bond the jointed sections of conduit. A conduit on a structure shall be securely fastened or build into the structure and properly drained using a T coupling at the low point of each concrete encased run, unless the conduit is sloped to drain into junction boxes. In the latter case, junction boxes shall be provided with drains. Expansion fittings shall be provided at all expansion joints on structures, and they shall be provided with suitable copper jumpers to assure electrical continuity of the grounding system.

All metallic conduit shall have electrical continuity and be adequately grounded. The ends shall be fitted with approved bushings and all boxes, fittings, expansion joints and other appurtenances to the conduit shall be so designed and connected that adequate electrical continuity from one conduit to another will be secured. Where boxes or fittings are not used, suitable means shall be provided to accomplish adequate electrical continuity between the several parts.

The Contractor shall check each conduit run by rodding or by pushing a mandrel through the conduit run. Any obstructions which may develop in the conduit shall be removed.

After installation, all conduit which will not have circuit wire or cable pulled into it during construction shall have a No. 10 AWG copper-clad, aluminum-clad or galvanized pull wire installed in it and the end shall be closed with capped bushings or otherwise sealed in an approved manner to completely keep all moisture and foreign matter out of the conduit. Terminal points of all conduits containing wire or cable, shall be completely sealed by the application of heat shrinkable tubing, or pre-molded boots. Equivalent temporary sealing approved by the Engineer shall be provided immediately after placement of conduit where conductors or cable are not installed promptly in the conduit.

Where conduit enters a junction box through a slip hole, locknuts shall be provided to fasten the conduit to the junction box.

625.131 Conduit Jacked or Drilled under Pavement. Conduit placed under existing pavement or paved shoulder shall comply with 713.04 and will be installed by jacking or drilling, subject to the approval of the Engineer. If placed by drilling, the bore shall not exceed the conduit diameter by more than 5 percent. The conduit shall be placed with a minimum amount of disturbance to the roadway.

625.14 Cable. Copper wire cables of the types and sizes required shall be installed as designated or as ordered. Cable installed in light poles shall be supported by cable grips attached to J hooks at the tops of the poles. The cable shall not drag against the openings to the bracket arm.

All cables, except structure grounding system cables and pole and bracket cable, entering an assessable enclosure such as a pull box, handhole, transformer base, device housing, etc., for the purpose of being terminated or connected to another cable, shall be identified in such enclosure with tags or bands as described in 713.18. No splices will be permitted between terminations. Exothermically welded joints in structure grounding systems and taps required for circuit branches are not considered as splices.

625.15 Unit Type Duct-Cable Systems. Duct-cable shall not be installed when the temperature of the duct is below 32°F (0°C), except with the permission of the City.

Prior to installation, the duct-cable shall be "paid-out" from its reel as the reel is moved alongside and parallel to the trench. Duct-cable shall not be pulled off a reel located in a stationary position. It shall be provided in sufficient length to be installed without splices between terminations in pull boxes, handholes, junction boxes, etc. Allowances shall also be made for extensions into pull boxes for splicing, and for extension of the conductors through the handholes in light poles.

Duct-cable shall be installed as straight as possible to facilitate cable replacement.

Terminal points and splice locations of duct-cable shall be completely sealed by the application of heat shrinkable tubing or premolded boots. Sealing shall be performed promptly upon completion of installation. All conductors or cables shall be identified as specified in 713.18.

625.17 Connections. Cable connections in the handholes or transformer bases of all light poles, or in junction boxes within concrete barrier medians and above pavement elevations, shall be accomplished by the use of approved factory preassembled cable connector kits and, in addition, the kit used in the hot leg shall be of a fused type. Where used in handholes or transformer bases, the kits shall be of a quick disconnect type. When Type II or III cable connection kits are specified for use with 600 volt cable, Type IX kits may be substituted.

Cable connections below ground line, whether directly buried or in accessible enclosure shall be accomplished by the use of a permanent water resistant cable splicing kit. Each kit shall provide a splice in compliance with ANSI C 119.1 when applied in accordance with the manufacturer's instructions.

Connector kits used in cable connections installed at the last light pole or pull box on a circuit shall have the vacant wire opening plugged in accordance with the manufacturer's recommendations.

Until cable connections have been completed, all cable connector kits and exposed cable ends shall be adequately protected by enclosing in plastic bags, taping or other approved means.

625.18 Power Service. The Contractor shall furnish and install all equipment necessary to provide complete electrical service to the roadway facilities. The Contractor shall also make all necessary arrangements with the supplying agency for connections to establish electrical service. Equipment shall include, but is not necessarily limited to, the following items: wood poles, hardware for dead-ending an overhead line, lightning arrestor, weatherhead, conduit riser, meter base, fused main disconnect switch, magnetically held lighting contactor, HOA switch for control of contactor, photoelectric cell, over-current protection devices for each individual branch circuit fed by the control center, enclosures, conduits, fittings, cables and connectors.

Unless otherwise directed by the Engineer, the components of the lighting control center shall be installed in the enclosure with the fused disconnect switch which is part of the power service. Where multiple enclosures are used, each enclosure shall bear the appropriate designation of the principal component contained therein, such as "SERVICE SWITCH," "SIGNAL POWER," "MAIN LIGHTING SWITCH," "TRANSFORMER," "LIGHTING CONTACTOR," stenciled on the outside of the enclosure door or cover in black, weather-resistant paint.

Branch circuit neutrals shall not be fused. When grounded, service is provided or when ungrounded, service is provided and an isolation transformer is used, branch circuit neutrals shall be solidly connected and grounded. When ungrounded, service is provided and no isolation transformer is used, branch circuit neutrals shall be ungrounded and switched simultaneously with their associated line conductors.

At the time of installation, the photoelectric cell shall face due north unless other orientation is required. In no case shall the sensor element be rotated more than 45 degrees east or west of due north, tilted off of horizontal or shielded with auxiliary devices without prior approval of the Engineer.

All equipment housings and conduits shall be connected to a ground rod installed in accordance with 625.10. Lightning arrestors on incoming service shall be connected to equipment ground wire only when grounded neutral service is used and transformation is not required. Otherwise, these lightning arrestors shall be separately grounded to a butt ground or to an additional ground rod installed in accordance with 625.10 and located a minimum of 1

foot (0.3 m) from the base of the pole and all other ground rods. Grounding cables installed on a pole shall be protected by wood or plastic ground wire moldings.

Fusing of service neutrals shall not be permitted. Grounded service neutrals shall not be switched, but shall be connected to a neutral bar in the disconnect enclosure with a screw type pressure connector. All ungrounded neutrals shall be switched simultaneously with the associated line conductors.

625.20 Structure Grounds. A complete grounding system shall be provided for each bridge, wall, or other structure having electrical elements contained therein or attached thereto.

The furnishing of all materials necessary to provide the entire structure grounding system, including ground rods, complete in place, shall be included in this item.

In order to provide continuity in the grounding of conduit at light poles on bridge structures, ground cable shall be installed between grounding lugs of each grounding bushing and the ground lug or bolt in the pole base. Where the plans require the use of a raceway employing a junction box, the cable shall be connected between three grounding bushings through 1 1/2 inches (38 mm) conduit to the pole ground connection.

In order to minimize potential differences between units of a bridge structure, each unit shall be electrically tied to each adjacent unit both longitudinally and transversely with grounding cable connecting the outside girders or beams together as shown on the plans. Transverse electrical ties need not be made when the lateral separation between sections of parallel bridges is 6 feet (1.8 m) or greater.

Two coats of insulating varnish shall be applied over all exothermic welds and exposed cable.

625.21 Junction Boxes. Junction boxes of the size and types specified shall be furnished and installed as required. All junction boxes embedded in concrete shall be provided with drains.

625.22 Electrical Tests. The Contractor shall be responsible for furnishing all personnel and equipment required to successfully perform the following tests and shall furnish six certified copies of complete test records to the Engineer on test reporting forms supplied to the Contractor by the Engineer or alternate certification approved by the Engineer.

Except for the high voltage test, all costs of labor, materials, equipment, electrical energy and incidentals required for performing the following electrical tests shall be included in the contract unit prices for the respective items tested.

The Contractor shall submit to the Engineer the types, styles, or catalog numbers of all testing equipment to be used for such tests. At the same time, the Contractor shall include a written certification that the testing equipment was last calibrated by a testing agency, whose qualifications as such are acceptable to the Director, not more than 6 months prior to the date when such tests are performed.

- (a) **Ground Test.** Each ground rod, structure ground and ground grid shall be measured for earth resistance immediately after being installed and before the ground wire is attached. If the earth resistance measurement exceeds 10 ohms for traffic signal controller and tower lighting ground rods or 25 ohms for all other ground rods, the Contractor shall proceed as specified in 625.10. Units of measurement for reporting shall be expressed in ohms.
- (b) **Cable Continuity Test.** Prior to the performance of any cable insulation tests, high voltage tests or performance tests on primary feeder cable, secondary feeder cable, distribution cable or other special circuits, a continuity test shall be performed with a volt-ohmmeter or other approved instrument. Continuity tests shall be conducted with electrical loads, power sources and grounds, including earth grounds, disconnected.

Each conductor shall also be measured against every other conductor and ground, including earth ground, to assure that no short circuits, cross circuits or other improper connections exist. No voltage shall exist between any conductor and another conductor, including ground. One at a time, each circuit branch shall then be temporarily shorted at its termination and measured for continuity to assure that no open circuits exist, that the circuit branch is according to plan, that no high resistance connections exist and that each circuit is properly identified.

- (c) **Cable Insulation Test.** The insulation resistance shall be measured for each insulated cable, except pole and bracket cable, located in each primary feeder, secondary feeder, and distribution circuit, including duct-cable used in distribution circuits. The test shall be performed on each cable of each circuit with all ballasts disconnected and all connections to earth grounds, including ground rods and grounding connections to light poles, disconnected. Units of measurements for reporting shall be expressed in megohms. The cable insulation resistance shall exceed 10 megohms. The above testing requirements are waived for those circuits on which a high voltage direct current test is to be performed.
- (d) **High Voltage Test.** Where required by the plans and before the 10 day performance test begins, a high voltage test shall be performed in accordance with ODOTCMS Supplement 1003 on all insulated cables and connections

installed by the Contractor. The test shall not be performed until after all new construction, such as guardrail, fence, delineator posts, and sign supports, in the immediate vicinity of the location of the cable run being tested, has been completed.

The Contractor shall furnish for operation of the test equipment a source of electrical energy which preferably shall be a suitable transformer in the power line which will ultimately supply the electrical system. The supply voltage shall be well regulated (plus or minus 5 percent) and free of transient variations. If the voltage is not steady, or if it is necessary to use portable generating equipment, a voltage regulator with adequate power capacity shall be inserted in the supply line. The test equipment shall have adequate milliampere capacity capable of supplying a variable, metered direct current voltage from 0 to 6000 volts to the circuit, and a meter to read the system leakage current.

- (e) **Performance Test.** Prior to acceptance, the Contractor shall operate the lighting system, including automatic control equipment and other specified apparatus, from sunset to sunrise for ten consecutive days without interruption or failure. If a lamp or ballast should fail, it shall be immediately replaced. This shall not require a restart of the test. The Contractor shall record each fault, the method and date of correction of each, and the beginning and end of the 10 day test. The Engineer shall be notified at least 3 days prior to the commencement of this performance test.

If the performance test is conducted prior to all other tests, the Contractor shall energize and manually operate the entire roadway lighting system, including control equipment for a minimum period of 1 hour to insure that all connections disturbed by later tests are completely restored.

The Contractor shall arrange with the supplying agency to purchase electrical power necessary to conduct the performance test. Portable generating plants will not be considered a suitable source of power for the performance test.

- (f) **Luminaire Lowering Device Test.** Prior to acceptance, the Contractor shall demonstrate to the Engineer the workability of the luminaire lowering devices by lowering and raising the luminaire assembly on each tower on two separate occasions during the 10 day performance test. The Contractor shall record the cause of, and the method and date of correction for each malfunction.

625.23 Light Pole Identification. Each light pole and light tower shall be identified by a number which will indicate both the circuit number and the pole number. Identifying numbers shall be as indicated on the circuit drawings in the plans, or as specified by the maintaining agency. Identification shall be located approximately 7 feet (2.1 m) above the

ground line, on the quadrant of the surface of the pole that faces oncoming traffic and shall be applied when the ambient temperature is above 40°F (4°C). Payment for furnishing and placing light pole identification shall be included in the unit price bid for light poles and light towers.

625.24 Method of Measurement. When the contract stipulates that payment will be made for various elements of an electrical installation on a linear foot (meter), lump sum or each basis, measurement will be made as follows:

- (a) **Trench.** The number of linear feet of (meters) trench completed will be measured from center to center of foundations, pull boxes, etc., and shall include all excavation, sawing and removal of pavement, granular and other backfill material, compaction, disposal of surplus materials and restoration of disturbed facilities and surfaces.
- (b) **Conduit.** The number of linear feet (meters) of conduit furnished and installed will be measured from center to center of pull boxes, foundations, etc., and shall include all fittings and appurtenances, joints, bends, grounds, and concrete encasement where specified.
- (c) **Primary Feeder Cable.** The number of linear feet (meters) of primary feeder cable furnished and installed will be measured as the sum of the distances from the top of the primary cable pot head to the primary terminals on the pad-mounted transformer, plus 10 feet (3.0 m) per pull box, manhole, etc., to allow for slack and splicing leads, multiplied by one of the following, as applicable:
 - (1) By one for single conductor cable with a concentric neutral.
 - (2) By two for a feeder composed of one primary cable and one neutral cable.
- (d) **Secondary Feeder Cable.** The number of linear feet (meters) of 3 wire secondary feeder cable furnished and installed will be measured as 3 times the distance between the service pole and the load center being supplied, plus 30 feet (9.0 m) to allow for slack and leads.
- (e) **Distribution Cable.** The number of linear feet (meters) of distribution cable furnished and installed will be measured as the sum of the distances from center to center of foundations, pull boxes, etc., plus 10 feet (3.0 m) per each spacing to allow for slack and splicing leads multiplied by one of the following, as applicable:
 - A. By two for two-wire distribution circuits.
 - B. By three for three-wire distribution circuits.

- (f) **Pole and Bracket Cable.** The number of linear feet (meters) of pole and bracket cable furnished and installed will be measured as twice the light pole mounting height, plus twice the designated arm length or lengths.
- (g) **Duct-cable.** The number of linear feet (meters) of duct cable furnished and installed will be measured from center to center of pull boxes, foundations, etc., plus 10 feet (3.0 m) per each spacing to allow for slack and splicing leads.
- (h) **Ground Rods.** The number of ground rods furnished and installed will be the actual number of each 10 foot (3.0 m) section of rod, complete in place, and shall include grounding cable and all specified tubing, fittings, and connections.
- (i) The number of light poles, light towers, light tower maintenance platforms, portable power units, luminaires, glare shields, pull boxes, connector kits, cable splicing kits, light pole anchor bolts for structures and structure grounding systems furnished and installed will be the actual number of each, complete in place. Bracket arms will be included with the light poles for payment; however, when separate bracket arms are required, they will be measured as the actual number of each, complete in place.
- (j) **Power Service.** The power service will be measured as one unit for each of the installations specified and shall include all materials, equipment and incidentals, complete in place.
- (k) **Junction Boxes.** The number of junction boxes furnished and installed will be the actual number of each, complete in place, and shall include the junction box drain and the conduit section between the junction box and the adjacent light pole base.
- (l) **Foundations.** The accepted number of light pole foundations and light tower foundations furnished and installed will be the actual number of each, complete and in place, and shall include reinforcing steel, anchor bolts, and conduit ells, as specified in the plans.
- (m) **High Voltage Test.** The performance of the high voltage test will be paid for at the lump sum price bid, which price will be full compensation for furnishing all labor, equipment and incidentals necessary to complete this item.
- (n) **Conduit Jacked or Drilled under Pavement.** The length of conduit to be paid for will be the actual number of linear feet (meters) installed, measured in place, as accepted by the Engineer, and including excavation, conduit, jacking or drilling, and restoration.

When the contract stipulates that payment will be made for specific complete electrical equipment installation on a lump sum basis, the pay item stipulated will include all electrical materials, equipment and incidentals, including specified tests required at the locations and within the limits specified on the plans, complete in place.

625.25 Basis of Payment. The accepted quantities of specific items of electric work and equipment measured as provided above will be paid for under:

Item	Unit	Description
625	Each	Light Pole
625	Each	Light Pole Foundation
625	Each	Light Tower
625	Each	Light Tower Foundation
625	Each	Light Tower Maintenance Platform
625	Each	Luminaire
625	Each	Bracket Arm
625	Each	Glare Shield
625	Each	Ground Rod
625	Each	Pull Box, (Type), (Size)
625	Linear Foot (Meter)	Trench
625	Linear Foot (Meter)	Trench in Paved Areas, Type _____
625	Linear Foot (Meter)	Conduit, (Type), (Size)
625	Linear Foot (Meter)	Conduit Jacked or Drilled Under Pavement, (Size)
625	Linear Foot (Meter)	No. ____ AWG, ____ Volt Primary Feeder Cable
625	Linear Foot (Meter)	No. ____ AWG, ____ Volt Secondary Feeder Cable
625	Linear Foot (Meter)	No. ____ AWG, ____ Volt Distribution Cable
625	Linear Foot (Meter)	____ -Inch (mm) Duct-Cable With ____ No. AWG, ____ -Volt Cables
625	Each	Connector Kit, Type _____
625	Each	Cable Splicing Kit
625	Each	Power Service
625	Each	Structure Grounding System
625	Each	Light Pole Anchor Bolts On Structure
625	Each	Junction Box
625	Each	Portable Power Unit
625	Lump Sum	High Voltage Test