SECTION 1900 STREET LIGHTING

1901 GENERAL.

A. Scope. The work of this Section shall consist of all labor, materials, equipment, testing, and services necessary to install complete and operational street lighting as shown on the Plans and herein specified.

B. Codes and Standards. All work and material shall be in accordance with the latest requirements of the National Electrical Code (NEC), National Electrical Safety Code (NESC), Standards of the American Society of Testing Materials (ASTM), American Standards Associations (ASA), National Electrical Manufacturers Association (NEMA), and all applicable local ordinances. The standard referred to shall be the latest revision of said standard as amended at the time of the Advertisement, except as noted on the Plans or in the Project Special Provisions.

C. Modification of Specifications. These Specifications may be modified or deleted by appropriate items in the Project Special Provisions or by written authorization by the City Engineer.

D. Incidental Work and Parts. Work incidental to street lighting installation that is not covered in these Specifications shall be performed in accordance with the City of Liberty specifications and standards. All incidental parts, which are not shown on the Plans or specified in the Specifications and which are necessary to complete the street lighting system, shall be supplied and installed by the Contractor to the satisfaction of the City Engineer. No additional payments will be made for incidental work or parts.

E. Existing Lighting. Existing lighting shall be maintained in effective operation by the Contractor except for shutdowns with approval from the City Engineer for alterations or final removal. The Contractor shall take all precautions necessary to minimize the downtime of the existing street lighting systems to be modified.

F. Removal of Existing Equipment. All existing lighting equipment that is removed from service shall become the property of the Contractor, unless otherwise indicated in the Plans or Project Special Provisions. It is the Contractor's responsibility to remove the equipment from the site and dispose of it. Foundations and conduits shall be removed to a minimum depth of 24 inches below finished grade. Foundations and conduits below 24 inches may be abandoned in place. Underground cables shall be removed if they are not in service.

G. Permits and Inspections. The Contractor shall contact the Public Works Department before any project work begins to notify the City Engineer of the construction schedule and to request project inspections. The Contractor is responsible for obtaining all necessary permits from the City, and is responsible for all associated costs, before any work can begin.

The Contractor is responsible for obtaining the owner's building permit from the City's Planning Department before electrical service can be delivered to a service enclosure. The Contractor shall contact the City's Building Division for an electrical inspection when each service enclosure is ready for operation. The Contractor will obtain an address for each service enclosure from the City's GIS Department, which the Contractor will need when coordinating with the electrical utility company.

H. Electrical Service. The Contractor is responsible for contacting the electrical utility company in advance to schedule delivery of service to each service enclosure. The Contractor shall pay the electrical utility company's fees to deliver electrical service. The Contractor shall also be billed for all electrical utility service charges until the entire project is substantially complete and the burn test is successfully completed. After those milestones, the electrical service can be transferred to the City.

I. Maintenance Work. The Contractor is responsible for making all repairs and replacements to the street light system, including but not limited to, downed poles, damaged or cut cables, non-operational luminaires, regardless of the cause or responsible party, until the work is determined by the City to be substantially complete.

1902 MATERIALS AND EQUIPMENT.

This section governs the furnishing of all luminaires, poles, conduits, cables, and other material and equipment supplied by the Contractor, as required, to complete the street lighting system as shown on the Plans, the Standard Drawings, and as specified in the Project Special Provisions. All lighting equipment shall be of new stock unless the contract provides for relocation of existing units or use of units furnished by others. New equipment and material shall be of the best grade, and shall meet the approval of the City Engineer. Insofar as practical, major items supplied under a single contract or tied contracts shall be of the same type and consist of products of the same manufacturer to secure uniformity.

A. Street Light Poles. The type of pole shall be as specified on the Plans. This specification is in addition to the City of Liberty's "Pole and Luminaire Details" Standard Drawing, which describes the Specifications and pertinent design details. It is the responsibility of the fabricator to verify and attest that the material sizes proposed are structurally adequate and in full compliance with this specification and Standard Drawings.

The aluminum street light pole shaft assembly shall be spun from one piece of seamless tubing, and after fabrication it shall have mechanical strength of not less than T6 temper. The cross section of the pole shall be round, and the shaft shall be fabricated in a continuous true taper from at least 6" above the hand hole to the top of the shaft. The shaft shall have no longitudinal or circumferential welds, except at the lower end, joining the shaft to the shoe base. Pole shaft shall have a satin ground finish. The shaft shall have a factory applied protective paper wrapper conforming to the manufacturer's standard practice to protect the shaft during shipping. Poles are to be kept dry and out of the weather until time for erection.

The top of the shaft shall be equipped with a cast aluminum removable pole cap held securely in place by means of set screws. Lighting standard shafts shall have a minimum 4" x 6" hand hole with frame and cover and a grounding lug opposite the hand hole. Shafts shall have internally-mounted vibration dampers.

Pole dimensions shall be as specified on the Standard Drawings. It is the responsibility of the fabricator to verify and attest that the material sizes proposed are structurally adequate and in full compliance with this specification and the pole detail drawing.

The aluminum shoe base shall be a permanent mold casting. The base shall be free of cracks, pits, and blow holes and of sufficient size and strength to withstand full design loads. The base shall telescope the shaft; and one weld shall be on the inside of the base at the end of the shaft while the other weld shall be on the outside at the top of the base. The shoe base and the two (2) welds

shall develop the full strength of the pole assembly. The base shall be cast with four (4) slotted holes to receive the anchor/connecting bolts and tapped holes for attaching the four (4) cast aluminum alloy removable bolt covers provided for each pole. The bolt covers shall attach to the upright portion of the body of the base. The bolt circle diameter is provided in the Standard Drawings.

If poles are to be installed on existing foundations or structures with anchor bolts in place, the Contractor shall furnish poles with a shoe base to fit the anchor bolt spacing.

All poles shall be attached to a cast aluminum break-away base sized according to the Standard Drawings. The break-away base shall conform to the break-away criteria of AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, current edition.

B. Bracket Arms. The type and size of bracket arms shall be as specified on the plans.

The single member arm shall be tapered by cold working from round tubing. After tapering, the member shall be flattened to produce an elliptical cross-section with the major diameter in the vertical plane, perpendicular to the wind. The outboard end of the arm shall remain round with a two-inch slipfitter for mounting the luminaire. The single member arm shall be designed to meet given design factors and mounting dimensions.

The truss type member arm assembly shall be a one piece welded assembly consisting of an upper arm and lower arm (brace) securely joined by a vertical strut and a connector or weld at the outboard end of the arm assembly. The upper arm shall be tapered by cold working from round tubing. After tapering, the upper arm shall then be flattened to produce an elliptical cross-section with the major diameter in the horizontal plane, parallel to the wind. The outboard end of the upper arm shall remain round with a two-inch slipfitter for mounting the luminaire. The outboard end of the lower arm (brace) shall be covered by an end cap.

C. Screw-In Anchor Foundations. Screw-in anchor foundations shall be the size and type shall be as shown in the Plans and Standard Drawings, based on the pole mounting height and number of bracket arms. The conduit access slot shall be smooth and clean to prevent damage to the conduit.

D. Concrete. All concrete for foundations, whether reinforced or non-reinforced, shall be KCMMB 4,000 psi mix. Concrete construction shall be in accordance with ACI 301 Standard Specifications for Structural Concrete.

E. Reinforcing Steel for Concrete Foundations. All reinforcing steel shall meet the requirements of steel bars for concrete reinforcement. AASHTO specifications, when referenced, will control the physical properties, chemical properties and handling and storage of the material, except as otherwise specified herein or shown on the Plans. Unless otherwise specified, reinforcement shall be Grade 40 or 60 deformed bars in accordance with ASTM A 615. Splicing of bars is not allowed.

Upon request, Contractor shall provide documentation of reinforcing steel that shall include the steel manufacturer's certified mill test report showing complete chemical and physical test results for each heat.

F. Anchor Bolts. Anchor bolts shall be steel with 50,000 PSI minimum yield. Anchor bolts shall be threaded for the length of the bolt that is to be exposed. The anchor bolts shall be hot dipped galvanized on the top ten inches of the threaded end, after threading. Each anchor bolt shall include one nut and two washers, galvanized to ASTM A153 standards. Threads shall be Coarse Thread Series as specified in ANSI B1.1 and may be formed by cutting or rolling. Nut dimensions shall conform to the requirements of ANSI B18.2 for heavy semi-finished hex nuts. Washer dimensions shall conform to ASTM F 436.

G. LED Luminaires. All luminaires shall be LED as listed on the City's Approved Products List, and as shown on the Plans.

The luminaire shall be equipped with an integral slipfitter for 2-inch bracket arm mounting. The mounting device shall allow the luminaire to be mounted absolutely level and shall have no more than four (4) fasteners serving both the leveling and clamping functions. It shall allow one person to install the luminaire by simultaneously holding it in position and tightening the fasteners, such that the luminaire will be properly level at the first attempt. Mounting provisions shall meet 3G vibration rating per ANSI C136. Wildlife guard shall be provided to conform to the bracket arm with no gaps.

Luminaires shall have a precision-cast aluminum housing with integral light source, driver, and thermal management system. Housing shall have a gray polyester powder-coated finish to provide durability and corrosion resistance.

The electrical compartment shall be accessed through a hinged, removable power door with tool-less entry from the bottom of the fixture. Luminaires shall be pre-wired with quick disconnects, requiring only connection of pole and bracket cables to a terminal block. The manufacturer shall place a permanent tag in the luminaire housing imprinted with: the manufacturer name, luminaire voltage, wattage, and provide a blank area for the Contractor to inscribe the installation date.

Luminaires shall be provided with the following components:

1. 7-Pin photocell receptacle meeting ANSI C136.41 standards and a shorting cap.
2. Internal surge protection device (SPD) rated 10kV/5kA, meeting the requirements of ANSI C136.2. The SPD shall have a fuse that protects the fixture by disconnecting the luminaire from the power at the end of life. It shall have an indicator light that is lit when the SPD is fully functional and dark when it needs to be replaced.
3. Module for field adjusting light output and fixture wattage by up to 50% of full output.

Luminaires shall meet the following requirements:

1. Housing shall be IP66 rated.
2. UL 1598 listed for use in wet locations.
3. Accept an input voltage of 120/208/240/277 volts.
4. Rated for operation in ambient temperatures ranging from -40° C to 40° C.
5. Electromagnetic compatibility meets or exceeds FCC CFR Part 15.
6. Driver shall be rated for 100,000 hours based on IES TM-21 testing procedures, and have a power factor greater than or equal to 90 percent at full load with a total harmonic distortion less than or equal to 20 percent at full load.
7. Maintain 95% of initial intensity at 10,000 hours with an ambient temperature of 25° C based on IES LM-80 testing procedures.
8. Light source shall emit no direct uplight (BUG rating, U = 0).
9. IES Type 2 light distribution with photometric curves developed by a Nationally Recognized Testing Laboratory (NRTL) in accordance with IES LM-79 procedures.

10. Color Correlated Temperature (CCT) of 4,000 K (+/- 250 K).
11. Minimum Color Rendering Index (CRI) of 70.

The manufacturer shall submit a five-year non-prorated full warranty on all components of the luminaire to the City. The warranty shall being on the project acceptance date and include all components of the luminaire.

H. Conduit. The location and type of conduit shall be as shown on the Plans or Standard Drawings. The Contractor may furnish and install polyvinyl chloride (PVC), or high-density polyethylene (HDPE) conduit for the distribution system. Rigid Metallic Conduit (RMC) shall be used where conduit is to be installed externally on a structure per the specifications of the Missouri Department of Transportation. For projects where the ground surface is largely unpaved, it is the Contractor's option to furnish and install cable-in-duct, instead of separate conduit and cables for the distribution system.

1. Polyvinyl Chloride (PVC) shall be Schedule 40 or Schedule 80, and shall conform to NEMA Standard TC-2 and NEMA TC-3. The conduit shall bear an Underwriters' Laboratories (U.L.) label and shall conform to Federal Specification WC-1094A (latest version). The conduit shall be clearly and durably marked at least every 10 feet with the material designation, nominal duct size, and the name and/or trademark of the manufacturer.

   Fittings for PVC conduit shall be in accordance with U.L. 514. Cement used for the fittings shall be in accordance with the conduit manufacturer's recommendations. Conduit, fittings, and cement shall be supplied by the same manufacturer.

2. High Density Polyethylene (HDPE) shall be smooth walled inside and out, and shall be gray in color. The conduit shall be manufactured and coiled or reeled in continuous transportable lengths and uncoiled for further processing and/or installation without adversely affecting its properties or performance. The conduit shall be manufactured to NEMA Standard TC-7 and ASTM D 3035 SDR11 specifications. The conduit shall be clearly and durably marked at least every 10 feet with the material designation, nominal duct size, and the name and/or trademark of the manufacturer.

   An approved factory coupling shall be used for connection of the HDPE conduit to a 90° factory PVC elbow or between two lengths of HDPE conduit. The coupling shall be of high density polyethylene material. The coupling shall provide an airtight and watertight lock connection.

3. Cable-In-Duct shall consist of three low voltage, insulated power cables, factory installed in conduit intended for direct burial. The duct shall meet all the specifications for high density polyethylene, as described previously in this Specification. The duct shall be clearly and durably marked at least every 10 feet with the material designation, nominal duct size, and the name and/or trademark of the manufacturer. The cables shall meet all the specifications for distribution cable, as described in the following sections of in this Specification.

I. Pull and Junction Boxes**.** Pull and junction boxes shall be as shown on the Plans and shall be fiberglass reinforced polymer concrete of a size and shape as indicated on the Standard Drawings. Junction boxes may be either Type 1 or 2, and pull boxes shall be Class 1. Pull and junction box material is to be an aggregate consisting of sand and gravel bound together with a polymer and

reinforced with continuous woven glass strands. Pull boxes shall withstand a wheel load of 20,000 pounds and junction boxes shall withstand a wheel load of 15,000 pounds. All pull and junction boxes are to have an open bottom.

Each pull or junction box shall be equipped with a bolt down cover. The threaded hole that receives the cover lock-down bolt shall be open at the bottom to allow the cleanout of sand, dirt and other debris. Lock-down bolts shall be stainless steel with a hex-head. Pull and junction box covers shall be polymer concrete and shall have a minimum wheel load rating of 20,000 pounds and 15,000 pounds respectively. A lift opening or pull slot shall be provided on all covers. Covers shall be embossed with "STREET LIGHTING".

J. Cable. The types and lengths of cables shall be supplied as shown on the Plans, Standard Drawings, or as specified in the Project Special Provisions. All cable shall be stranded annealed soft drawn copper wire, and shall be the AWG size as listed on the Plans. Cable shall be 600-Volt and be thermoplastic or thermosetting polyethylene insulated. All cable shall be plainly marked on the outside with the manufacturer's name and identification in accordance with industry practice.

1. Distribution cable shall be no larger than No. 4 AWG and no smaller than No. 8 AWG. The insulation shall be type RHH, RHW-2 or USE-2, meeting the requirements of ICEA S-95-658. The average thickness of insulation shall be no less than 60 mils.
2. Pole and bracket cables inside the pole to luminaire(s) shall be three-conductor (3c) No. 12 AWG cables, meeting the specifications of IMSA 19-1. For poles with dual luminaires separate pole and bracket cables will be required to each luminaire.

K. Connectors. All cable splices shall be made in boxes or pole bases using connector assemblies as shown in the standard drawings. Connectors shall have set screw type terminals to accommodate the wire sizes indicated in the Plans. All connectors shall be UL listed and rated for 600 volts.

1. Multiple tap connectors shall be insulated pre-molded electrical power connectors, with one terminal per wire. All terminals shall be set screw type.
2. Break-away connectors shall be in-line waterproof pre-molded fused slip disconnect assemblies with slipover plastic boots. Fused disconnects shall be used for each phase conductor, and non-fused disconnects shall be used for the ground. Fuses shall be high interrupting 8-Amp fuses. Poles with dual luminaires will require two-wire terminals and plastic boots for the load side of the fused disconnects. All terminals shall be set screw type.

L. Service Enclosure. Service enclosures shall consist of all equipment and material necessary for the distribution of secondary electrical power as shown on the Plans. Service enclosures shall be an underground service type, rated for 200 amps, 240 volts, unless otherwise noted. Each service enclosure shall have a ringless meter socket with horn bypass meeting the requirements of the electrical utility company.

The cabinet shall be fabricated from minimum 1/8 inch thick non-anodized aluminum alloy with NEMA 3R construction. It shall have an individual meter, panel, contactor, and rear service pull "compartments". The meter and panel/contactor compartments shall have piano hinged doors. All hinges, catches and other hardware shall be non-ferrous metal or stainless steel. The meter compartment shall include padlocking provisions, and the panel/contactor outer door shall have a factory installed Corbin lock assembly designed for a standard number 2 key. The panel/contactor compartment shall have an inside panel door. The outer front and inside panel

doors shall be equipped with an approved doorstop. Panelboard shall have silver plated copper buss and shall accept the required number of 1 inch plug in breakers. Panelboard compartment shall contain a photocell and test switch. All factory installed wire shall be 600 volt rated copper. The cabinet shall have a natural aluminum finish.

M. Photoelectric Cells. Photoelectric cells shall operate a lighting system through mercury load relays. Photoelectric cells shall be of the solid-state type operating on 120 volts. The photoelectric cell circuitry shall be designed to be normally closed at night. The photoelectric cell shall be configured such that in the event of failure, the lights shall be on. The photoelectric cell shall be mounted inside the service enclosure such that all luminaires within the system operate simultaneously and shall illuminate only during hours of darkness or low visibility. Turn-on shall occur at 2.6 foot candles ± 0.5 foot candles. The photoelectric cell shall have an inverse off/on ratio for energy savings. Photoelectric cells shall sense light levels with a non-drifting phototransistor. The photoelectric cell shall have a time delay to avoid turn off due to lightning and transient light.

1903 INSTALLATION.

This section governs the construction of all foundations and the installation of all luminaires, poles, conduits, cables and other material and equipment as required to complete the street lighting system as shown on the Plans, the Standard Drawings, and as specified in the Project Special Provisions.

A. Conduit Installation. Conduit shall be installed as shown in the Plans and the Standard Drawings. The size of the conduit used shall be as shown on the Plans. It shall be the privilege of the Contractor, at his own expense, to use larger size conduit if desired, as approved by the City Engineer. Where larger size conduit is used, it shall be for the entire length of the run from outlet to outlet. No reducing couplings will be permitted. No additional payment will be made for larger conduit.

Wherever a conduit passes beneath a curbed street, aluminum conduit markers shall be installed in the curb immediately over the conduit location. Conduit markers shall be furnished by the Contractor as detailed in the Standard Drawings and shall be installed in the top of the curb by drilling the curb and epoxying the conduit marker in place. Conduit markers are subsidiary to the installation of conduit.

The ends of all conduits shall be well-reamed to remove burrs and rough edges. All conduits shall be cleaned and swabbed prior to installation of cable. Field cuts shall be made square and true so that the ends will butt or come together for the full diameter thereof. The end of each conduit run shall be covered to prevent water or debris from entering the conduit while the system is being constructed.

Existing underground conduit to be incorporated into a new system and GRS conduits shall be cleaned with a mandrel and blown out with compressed air.

An approved factory coupling shall be used for connection of the HDPE conduit to PVC conduit. The interior of all conduit joints shall be sufficiently smooth to prevent cable damage during pulling.

Conduit bends, except factory bends, shall have a radius of not less than six times the inside diameter of the conduit. Where factory bends are not used, conduit bends shall be made without

crimping or flattening, using the longest radius practicable and utilizing an appropriate conduit bending tool.

The conduit shall be installed continuous from outlet to outlet or as otherwise shown on the Plans. With respect to HDPE conduit, no couplings or joints will be allowed at intermediate points unless approved by the City Engineer. The conduit may be directional bored to minimize disruption to the existing improvements or may be plowed or trenched. Conduit shall be installed under pavement sections at a depth not less than 36 inches below top of pavement. In all other areas, conduit shall be installed to a depth of 24 to 36 inches below finish grade.

At all outlets, conduit shall enter from the direction of the run. PVC conduit bends shall enter all junction or pull boxes from below the box and shall extend into the box a minimum of 2 inches. RMC conduits may enter a pull or junction box from the side. The side of the box shall be drilled per the manufacturer's recommendations. The hole shall be no more than one-half inch larger than the conduit. The gap between the box and conduit shall be filled with sealing compound.

1. Trenching. Trenches shall be excavated to a maximum width of 6 inches and deep enough to provide the minimum cover for conduits as shown in the Standard Drawings. Trenches leading to screw-in anchor foundations shall not be wider than the shaft of the anchor. If two or more conduits are placed in a common trench, the conduits shall not cross each other. If the bottom of the trench is in rock or rocky soil, the conduit shall be placed on a 6 inch protective layer of clean, tamped backfill material. Trenches shall be backfilled as soon as practical after the installation of conduit, but after inspection of the trench by the City Engineer. Backfill material installed within 6 inches of the conduit shall be free of rock or other solid material that might cause mechanical damage to conduit. The backfill material shall be placed in layers not to exceed 6 inches deep, and each layer shall be thoroughly compacted to the approximate density of the adjacent material before the next layer is placed. The 4 to 6 inches of backfill material directly below finished grade shall be topsoil. All disturbed areas shall be restored to the satisfaction of the City Engineer.

2. Plowing. Conduit may be installed by plowing in unpaved areas. The equipment used for plowing conduit is designed specifically for that purpose with the power and versatility to easily and accurately bury the various sizes of conduit under all normal soil conditions. This equipment places the conduit without twisting, kinking, or damaging the material in any way. The vibrating unit shall be attached to a tractor unit in such a manner that the tractor does not dampen the vibration. The cable way and guides shall be smooth, free of obstructions and sharp edges and shall not cause bending of the conduit at shorter than the minimum bending radius recommended by the manufacturer, nor cause excessive strain to the conduit. Conduit reels may be mounted on the tractor or conduit unreeled along the proposed route before plowing in such a manner to allow as direct a line as possible to the trench to avoid unnecessary bending of the conduit or rubbing of the conduit against the reel. The plow shall not be backed onto the conduit. If an underground obstruction is encountered, the plow shall be lifted out of the ground and the obstruction removed. After installation of conduit by plowing, the disturbed earth shall be leveled and, if necessary, compacted by a device approved by the City Engineer. Ends of conduit shall be capped immediately after cutting to prevent moisture and debris from entering the conduit. All disturbed areas shall be restored to the satisfaction of the City Engineer.

3. Boring. Pavement shall not be disturbed without the written permission of the City Engineer and then only in the event insurmountable obstructions are encountered. Conduit shall be placed under existing pavement by boring. The Contractor shall complete the boring as to maintain minimum permissible clear distances, both horizontally and vertically, from all underground utilities. Boring pits shall be kept 2 feet clear of the edge of any type of pavement wherever possible. Boring alignment shall be perpendicular to the curb line in order to achieve the shortest possible crossing distance. Excessive use of water such that pavement might be undermined or subgrade softened, will not be permitted. The Contractor shall at all times and for the entire length of the boring alignment be able to demonstrate the horizontal and vertical position of the alignment. All disturbed areas shall be restored to the satisfaction of the City Engineer. Boring may be used instead of trenching or plowing at all other locations.

B. Cable-In-Duct Installation. All applicable portions of the conduit installation and circuit wiring sections of these Specifications apply to cable-induct installation. Cable-in-duct may be installed by boring, trenching, or plowing operations. Cable-in-duct runs shall be continuous without splice between the service enclosure, pole bases, and junction or pull boxes. Cable-in-duct shall extend far enough to provide the required amount of cable slack at all terminations or connections. For concrete foundations, rigid conduit of sufficient size to facilitate the pulling of cable-in-duct shall be cast in the foundation as shown on the Plans. The cable-in-duct shall be installed through the rigid conduit in the foundation. The plastic duct of the cable-in-duct is to be terminated 3 inches above the bottom of junction or pull boxes and foundations, leaving the cables exposed for connection. All terminations of this plastic duct are beveled free from any sharp edges or burrs. The insulation of the electrical conductor may not be damaged when cutting the duct.

C. Pull and Junction Box Installation. Pull and junction boxes shall be installed as shown on the Plans, Standard Drawings, or as directed by the City Engineer.

The top surface of all pull or junction boxes shall be flush with surfaced areas and approximately one inch above earth or sodded areas. All boxes shall have 1/2 inch clean crushed aggregate or other porous material for a minimum depth of 12 inches below the box for drainage. The excavated opening outside the junction box shall be wide enough to allow compaction of the backfill material. Cinders, broken concrete, broken rock or other hard or undesirable material shall not be used for backfilling. The backfill material shall be placed in layers not to exceed 6 inches deep, and each layer shall be thoroughly compacted before the next layer is placed. All disturbed areas shall be restored to the satisfaction of the City Engineer.

A pull or junction box placed in an unpaved area shall have a concrete pad around the perimeter as shown on the Plans. Concrete for the pad shall be per Section 1902. The concrete pad shall be reinforced with welded wire fabric. Concrete pads will not be required for boxes installed in concrete. Pull or junction boxes shall not be installed in sidewalk ramps.

Each Class 1 Pull Box shall be equipped with cable hooks as shown on the Plans. Cable hooks shall be galvanized steel or brass with a minimum diameter of 3/8 inch and a minimum length of 5 inches.

Additional pull or junction boxes may be installed when approved by the City Engineer. If it becomes necessary to increase the excavation depth and extend the box, no direct payment will be made.

D. Screw-in Anchor Foundation Installation. The Contractor is responsible for verifying the correct line and grade of all screw-in anchor foundations prior to installation. The Contractor shall stake the location of all street lighting poles to be installed. The City Engineer shall inspect the staking prior to any excavation and/or construction. Minor relocation of equipment to avoid conflicts may be allowed with the approval of the City Engineer.

Screw-in anchors shall be of the size and type required for the type of pole. Pre-drilling holes for screw-in anchors is not allowed, except for a depression to improve location accuracy. If a screw-in anchor foundations is not able to be used for any reason, a concrete foundation shall be installed at the contractor's expense.

The screw-in anchor foundations shall be screwed straight into the ground and the steel base plate shall be at the proper elevation and properly oriented to receive the shoe base. During installation the anchor shall be plumbed with a level. The base plate shall be flush with the finished grade. Minor leveling adjustments may be made with the use of leveling shims or washers. Shims and washers shall be galvanized or cadmium-plated steel no more than one-quarter inch thick. Only one shim or washer will be allowed at any one anchor bolt with a maximum of two on any pole. The installing torque for screw-in anchor foundations shall be between the maximum and minimum torque ratings shown on the Standard Drawings or per the manufacturer's recommendations.

Conduit bends shall be installed into all screw-in anchors through the slots in the base of the anchors. After conduit bends are installed and capped, the internal cavity of the screw in anchor shall be backfilled with sand or other fine aggregate material, as approved by the City Engineer.

An aluminum cover skirt must be installed around all sides of the base plate of screw-in anchor bases if a gap of more than two inches is visible between the bottom face of the base plate and the finished grade. The cover skirt is to be made of a solid sheet of aluminum, alloy designation 3003-H14, which is field cut and shaped to fit flush against the base plate and extend down to the finished grade. The cover skirt should form a lap joint, where it is to be fastened together with stainless steel self-taping screws.

E. Concrete Foundation Installation. The Contractor is responsible for verifying the correct line and grade of all concrete foundations prior to installation. The Contractor shall stake the location of all street lighting poles and service enclosures to be installed. The City Engineer shall inspect the staking prior to any excavation and/or construction. Minor relocation of equipment to avoid conflicts may be allowed with the approval of the City Engineer.

All concrete foundations shall be of the size and type show in the Plans, including all reinforcing steel. Reinforcing steel for concrete foundations shall be accurately cut and bent to the dimensions and shapes shown on the Plans. Cutting and bending tolerances for reinforcing steel shall be in accordance with the Concrete Reinforcing Steel Institute's Manual of Standard Practice. When placed in the work and before concrete is placed, reinforcing steel shall be free from dirt, oil, paint, grease, loose mill scale, thick rust, any dried mortar and other foreign substances. Reinforcing bars shall be positively secured against displacement. The bars shall be firmly tied at alternate crossings or closer. The steel shall be spot welded or tied in the correct position with proper clearance maintained between bare earth or the forms and the reinforcement. Measurements to reinforcing steel will be made to the centerline of bar, except where the clear distance from face of concrete is shown on the Plans. Splicing of bars shall not be allowed.

PVC conduits and conduit bends should be set in the forms for concrete foundations. Pole and service enclosure foundations shall have separate conduits for exiting/entering cables and a separate one inch conduit for the ground wire. The direction of the exiting conduits and the orientation of the service enclosure shall be as shown in the Plans. Conduit set in concrete foundations shall extend approximately three inches above the foundation vertically and a minimum of three inches outside the foundation horizontally underground.

The bottom of all concrete foundations shall rest on firm ground. Forms shall be true to line and grade. The top of the foundation for street light poles, except raised foundations, shall be finished to curb or sidewalk grade, or as directed by the City Engineer. Forms shall be rigid and securely braced in place. Conduits and anchor bolts shall be placed in proper position, to proper heights, and held in place by means of a template until the concrete sets. Conduits shall be covered before concrete is poured to prevent concrete from entering the conduits. All portions of the anchor bolts extending above the foundation shall be threaded. Anchor bolts shall be provided with a hex head nut, flat washer, and a lock washer. Both forms and ground which will contact the concrete shall be thoroughly moistened before placing concrete. Concrete shall not be poured until forms and reinforcing steel have been checked and approved by the City Engineer.

Placement of concrete shall be witnessed by the City Engineer. Concrete foundations shall be poured monolithic, except for the pole cap. The pole cap of foundations for street light poles shall be formed and poured after the poles are plumbed with bracket arms installed. Foundations shall be consolidated by an internal type vibrator. The vibrator shall operate at frequencies of vibration not less than 4,500 cycles per minute under load. The amplitude of vibration shall be adequate to consolidate concrete properly. The concrete shall be cured with an approved moisture barrier such as wet burlap, polyethylene, etc., for a period of seventy-two hours. Cold weather curing shall be such that the concrete temperature shall be maintained above freezing for the entire curing period. Forms shall not be removed until the concrete is thoroughly set.

The exposed portions of the foundation shall be finished to present a neat appearance. Finishing should be done with the positioning jig in place. If the jig must be removed for finishing, it shall be re-installed immediately after finishing and left in place throughout the cure period. Prior to installing the pole or service enclosure, the positioning jig shall be removed and loose concrete cleaned from around the anchor bolts and conduits.

Cinders, broken concrete, broken rock or other hard or undesirable material shall not be used for backfilling around the finished foundation. The backfill material shall be placed in layers not to exceed six inches deep, and each layer shall be thoroughly compacted to the approximate density of the adjacent material before the next layer is placed.

Expansion joints shall be provided where a concrete foundation is adjacent to a concrete surface. After concrete has cured a minimum of seven days, the joint shall be cleaned, filled, and sealed per Section 1500.

F. Street Light Pole Installation. Street light poles shall not be installed on concrete foundations sooner than five day after pouring the concrete foundation, or as directed by the City Engineer. Poles and luminaires shall be cleaned of dirt, grease, etc. Scratches, abrasions or other surface damage shall be repaired to like new condition. Street light poles shall be fastened to screw-in anchor foundations or concrete with a break-away base using galvanized hardware. The pole shall be checked for plumb, minor corrections made using galvanized or cadmium plated steel shim stock, the nuts tightened, and the removable bolt covers installed. Hand holes in the pole and break-away base shall be oriented so that they are 180° measured radially from the direction of

oncoming traffic. In a median, the hand holes should be oriented 180° radially from one direction of oncoming traffic, facing either North or East, for all poles installed in medians. The opening in the break-away base should be located on the same side of the pole as the hand hole.

G. Bracket Arm Installation. Bracket arms for luminaires shall project from the street side of the pole and be perpendicular to the roadway. Install a rubber grommet around the hole at the top of the street light pole for the cable entrance. Sufficient lengths of pole and bracket cable shall be run inside the length of the street light pole shaft, out through the grommet at the top of the pole, and through the bracket arm. The bracket arm is to be attached to the pole using stainless steel hardware. Cables shall not be pinched when bracket arms are attached to poles.

   For poles with dual luminaires, pole and bracket cable to each luminaire shall be identified by means of round brass or aluminum identification tags with a minimum thickness of 0.1 mil attached to the cables with copper wire. Identification tags shall be installed convenient to the hand hole, above the break-away connectors. Tags shall indicate the direction of the bracket arm, right or left, when looking at the hand hole.

H. Luminaire Installation and Adjustment. Luminaires shall be installed on the slipfitter at the end of the bracket arm. The luminaire shall be adjusted and leveled in accordance with the manufacturer's instructions, to place the nadir directly below the light center.

I. Service Enclosure Installation. The service enclosure shall be constructed and installed as shown on the Plans or as directed by the City Engineer. The Contractor shall coordinate his activities with the electrical utility company to insure delivery of power to the service enclosure when and where required. The cabinet shall be cleaned of wrapping, shipping material, dirt, grease, etc. Scratches, abrasions or other surface damage shall be repaired to like new condition. The service enclosure shall be installed orient the photoelectric cell to the North or to the East.

N. Circuit Wiring. Installation of wiring shall be in accordance with the Plans and appropriate articles of the NEC. Distribution cables shall be installed in conduit, wired as a two-wire 240 volt (hot to hot) system with a ground wire. Distribution cables shall be continuous between street lighting appurtenances. Cables shall be color coded (black for phase conductors and green for ground).

   Cable shall be pulled with minimal dragging on the ground or pavement. Frame mounted pulleys or other suitable devices shall be used for pulling cables out of conduits into pull boxes. Powdered soapstone, talc or other approved lubricant shall be used to facilitate pulling cable in conduits. All cable to be installed in one conduit shall be pulled by the Contractor in one operation, and all ends shall be taped to exclude moisture and shall be so kept until the splices are made or terminal appliances attached. Ends of spare conductors shall be taped. After cables are installed all conduit ends shall be sealed around the cables with a readily workable, soft, sealing compound. The compound shall be workable at 30° F and shall not melt or run at temperatures up to 175° F.

   Splices in the distribution cable will only be permitted in pole bases or in boxes where circuits branch, as indicated in the Plans. Distribution cables shall be unspliced from the service enclosure to the first light pole. Splices shall be made with multiple tap connectors or an approved equivalent.

   All cables passing through a pull or junction box shall be coiled once around the inside of the box to allow for splicing and connecting wires in the future. Wiring within power supplies and boxes

shall be neatly arranged and laced up. All circuits shall be properly labeled in all service enclosures and boxes by means of round brass or aluminum identification tags with a minimum thickness of 0.1 mil attached to the cables with copper wire. The ends of the copper wire should be wrapped with electrical tape. Circuits shall be labeled with the power supply ID number and the circuit number.

O. Electrical Connections. All distribution cable connections inside the base of the light pole shall be made with multiple tap connectors. Break-away fused disconnects shall be installed for the phase conductors and one non-fused disconnect shall be installed for the ground. The connectors and disconnects shall be installed convenient to the hand hole in the street light pole. Surplus distribution cable shall be installed at the base of each pole such that, when extended upward, the multiple tap connectors are no less than two inches and no more than five inches above the top of the hand hole cover located at the base of the pole. Twelve inches of surplus cable shall be coiled at the line side of each disconnect. Pole and bracket cable shall include 18 inches of slack on the load side of each disconnect. The non-fused disconnect for the ground shall be installed with the male end of the connector on the line side. One pole and bracket conductor shall be installed from the load side of the non-fused disconnect to the grounding lug in the pole by a 3/8" ring terminal and 3/8" - 16 x 3/4" long hex bolt. One pole and bracket conductor shall be installed from the grounding lug to the luminaire. Poles with two luminaires will require separate pole and bracket cables.

P. Grounding. All electrical systems, equipment, and appurtenances, including poles and feed points shall be properly grounded in accordance with NEC requirements. At each concrete foundation, a ground rod shall be driven in the bottom of the conduit trench adjacent to the foundation. The driven ground rod shall be connected to the grounding lug in the street light pole by a No. 6 AWG copper ground wire attached to the rod with a galvanized grounding clamp. Ground wire is to be run through one-inch diameter PVC conduit in the foundation.

At each service enclosure foundation a ground rod shall be driven in the same trench as the conduit for the secondary service connection. Driven ground rods shall be connected to the neutral bus and the service enclosure by a No. 4 AWG copper ground wire attached to the rod with a galvanized grounding clamp. Ground wire is to be run through one-inch diameter PVC conduit in the foundations. The completed ground rod installation and connection to the ground wire shall not be backfilled until it the service enclosure passes inspection by the City's Building Division. The grounding clamp connection and the listing mark on the rod must be visible for inspection.

Ground rods shall be copper coated to meet NEC requirements, not less than 5/8 inch in diameter, and 10 feet in length. Ground rods shall be driven to a minimum depth of 12 inches below the finished surface. If subsurface conditions exist which prohibit the placement of the ground rod in a vertical position, the rod may be driven at an oblique angle, not to exceed 45-degrees from vertical, or when authorized by the City Engineer, buried in a trench at least 30 inches deep. The driven ground rod shall be connected to the grounding lug by a No. 6 AWG copper wire attached to the rod with a galvanized grounding clamp. The ground wire is to be run through a one-inch diameter PVC conduit in the foundations.

Q. System Testing. The Contractor is responsible for testing the completed street lighting system. Test shall be performed by the Contractor in the presence of and documented by the City Engineer.

1. Cable Testing. Prior to final inspection, the Contractor shall test all cables for unscheduled grounds. Each conductor shall be tested to ground with a megohmeter at 500 volts. Readings in each case shall be infinity.
2. Resistance Testing. After a service enclosure is energized, the resistance to ground shall be tested. The ground rod shall have a resistance to ground of 25 ohms or less. If the resistance is more than 25 ohms, the Contractor shall install additional ground rods at least six feet away which are bonded to the first ground rod, until the required resistance is achieved. No payments will be made for additional ground rods.
3. Operational Testing. Prior to acceptance by the City, the Contractor shall notify the City Engineer as soon as the system(s) is (are) ready for operational testing. All street lighting system elements shall function properly as a complete system for a minimum period of fifteen days before acceptance is granted. The fifteen day period shall be cyclical and initiated by the City Engineer. Any malfunction observed or recorded shall stop the test period for the entire system as of the time of the malfunction. The test period shall resume when the malfunction has been repaired to the satisfaction of the City Engineer. After the burn test is completed, the street light system(s) must remain in operation if the roadway is open to vehicle traffic.

R. As-Built Plans. Prior to acceptance of the work, the Contractor shall submit marked-up or corrected plans showing in detail all construction changes, especially the location of conduit. The Designer will produce as-built plans from the Contractor's marked-up plans.

S. Final Clean Up. Before final acceptance, the Contractor shall restore to a condition equal to or better than that existing prior to construction, for all property, both public and private, within, adjacent to and beyond the limits of construction that have been disturbed or damaged while executing the work. This includes, but not limited to, existing curb and gutter, sidewalk, pavement, drainage, structures, irrigation systems, street lighting and traffic signal equipment. All unpaved areas damaged during construction shall be restored to the original condition. Unless otherwise directed, grassy areas which were originally sodded shall be re-sodded. Restoration work shall be at the Contractor's expense. All restoration work shall be acceptable to the City Engineer.