# CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

## CHAPTER 24

### TRAFFIC SIGNALS, ITS AND LIGHTING

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CHAPTER 24
TRAFFIC SIGNALS, ITS AND LIGHTING

24.00 GENERAL

A. STANDARDS

Where NEMA Specifications are established, all electrical equipment shall conform to the standards of National Electrical Manufacturers Association (NEMA). In addition to the requirements of these Standard Specifications and the plans, all material and Work shall conform to the Standard Specifications of the following organizations: National Electric Safety Code (NESC); American Society for Testing and Materials (ASTM); American Standards Association (ASA); International Municipal Signal Association, Inc. (IMSA); Insulated Cable Engineers Association (ICEA); American Institute of Steel Construction (AISC); American Association of State Highway and Transportation Officials (AASHTO); Manual on Uniform Traffic Control Devices (MUTCD); and the ordinances of the City of Lincoln (City), insofar as they apply. Wherever reference is made in the Standard Specifications to the standard mentioned above, the reference shall be construed to mean the code or standard that is in effect on the date of advertising of the contract document.

Traffic Signal Poles shall reflect the 1994 AASHTO guidelines for pole design.

B. QUALIFIED PERSONNEL

A certified and qualified journeyman lineman shall be on the job site to supervise pulling of fiber, splicing of wire where permitted, and to perform the task of final connections in all signal indications, push buttons, detectors, cameras, dynamic message signs, and cabinets. The Contractor shall be IMSA Traffic Signal Construction Technician Level II certified. All workers on the job site shall have Work Zone Temporary Traffic Control certification. Proof of certification or license of individuals on job site shall be required at the pre-construction meeting.

C. MATERIAL TESTS

When any reference is made in the Standard Specifications to a standard, such as ASTM, ICEA, IMSA, etc., or a related Specification referred to by reference therein, which states that a certain test is to be made only at the request of the purchaser, it shall be considered that the City does request that such test be made. The tests shall be made at the Contractor’s expense and a certified copy of each test shall be submitted to the City’s Project Manager prior to the installation of such material.

Traffic Signal and/or Street Lighting poles require shop drawings and Manufacturer’s certification of compliance. In the case of wood poles, the type, size, treatment, or certain unspecified situations shall require that in addition to the above, the Contractor furnish mill test data or design calculations.

The Contractor shall submit to the City’s Project Manager 1 hard copy and 1 electronic (pdf) copy of a complete list of all equipment and materials they intend to install. Catalog cuts and/or Manufacturers model number shall be required for the materials furnished by the Contractor and incorporated into the project. There shall be no substitutes for any of the items on the list without prior written approval of the City’s Project Manager.
D. ELECTRICAL SERVICE APPLICATIONS

The Contractor shall make arrangements with Lincoln Electric System (LES) for power service. Any delay resulting from a Contractor’s untimely request to the local utility for power service shall not be justification for the suspension or extension of the working days or calendar days on a project. Electrical services at the locations shown on the plans have been previously agreed to by the City and the Utility. The locations of all such services are subject to minor revisions in the field in order to adapt field requirements as may be determined by the Utility and the City’s Project Manager.

E. CITY FURNISHED MATERIALS

The Work covered in this chapter shall include the furnishing of certain materials and equipment and the installation of all necessary materials and equipment to provide a traffic signal and/or a street light installation complete, in place and ready for operation; and/or the modification, removal or salvage of existing traffic signal and/or street light components or systems; in conformance with the plans and these Standard Specifications. When the item is furnished by the City the item of payment is prefaced by the word, “Install”.

Furnished Traffic Signal Materials shall be picked up at Traffic Operations storage locations between 8:00 a.m. to 3:00 p.m. weekdays with 24-hour notice, with the exception of city holidays. Furnished Street Lighting materials shall be picked up at LES Storeroom at the Walter Canney Service Center at 27th and Fairfield Streets, between 7:30 a.m. to 4:00 p.m. weekdays, with the exception of holidays. Further direction may be required either by Special Provision or by the City’s Project Manager. Refer to Section IV; “Control of Materials”, Subsection E. “Materials Supplied By The City” of the General Provisions and Requirements for procedures to be followed in handling City-furnished materials and/or equipment.

The Contractor shall be responsible for all material or equipment furnished by the City from the time that it is picked up to the completion of work. The costs of damaged materials shall be deducted from the final payment.

The contractor shall take all precautions to protect the cabinet from damage including any concrete splatters, dents, scratches or any other damage as noted by the City’s Project Manager. In the event of damage to the cabinet, the contractor shall remove the damaged cabinet and re-wire a new cabinet supplied by the City. The cost of the damaged cabinet shall be deducted from the final payment.

City traffic signal personnel shall be responsible for bench testing traffic signal cabinets to be installed by the Contractor, and shall field test each installed traffic signal cabinet prior to turn on. All other activities associated with the installation, including but not limited to, labor, materials, tools, and transportation are the responsibility of the Contractor.

The Contractor shall furnish all other materials, including, but not limited to concrete, epoxy coated reinforcing steel, conduit, pull boxes, cable, splice kits, messenger cable and hardware, pole clamps and hardware, risers, down guys, ground rods and clamps, traffic signal poles, street light poles, luminaires, and all other miscellaneous materials and/or hardware necessary to complete the Work in conformance with the Plans, Standard Specifications, or the Special Provisions.
F. EXCAVATION AND BACKFILL

Excavation for trenches, pull boxes or foundation removal shall be backfilled and compacted daily unless properly protected. All trenches for burial of electrical cable and conduit shall not exceed 6" in width.

All excavations shall be backfilled within 48 hours of excavation.

The first 4" of backfill for trenches shall consist of finely pulverized earth and shall contain no broken glass, rocks, or other sharp material that might damage the cable.

The remainder of the backfill material will normally be earth excavated from the trench unless such earth is water saturated or frozen. Backfill material shall be substantially dry, loose, clean earth free from rocks and debris. Excessively dry or excessively sandy material is not permitted.

Before backfilling, all standing water shall be removed from the trench. Tamping shall be done at no more than 12" backfill level intervals to ensure proper compaction throughout the depth of the void. The foot of the compressed air or hydraulic tamper to be used to compact the backfill shall be sized in conformance with the width of the trench. Hand tamping is not permitted. All excess backfill material shall be removed from the site within 48 hours.

G. CONTRACTOR RESPONSIBILITY

The Contractor is responsible to inform the City’s Project Manager of any defect found in the existing electrical or communications systems. Such defects may include, but not be limited to existing improper splices or existing damaged cable or existing damaged conduit. The City’s Project Manager and Contractor shall determine a plan and cost to correct said defect.

The Contractor is responsible to locate the signal system within the project area, until the final inspection is complete.

H. GRADES

All work shall conform to line, elevation and grade as shown on the plans. If no grades are shown on the plans, the longitudinal grade for the improvement shall be the same as the grade of the top of the existing curb. If there is no curb, the longitudinal grade shall be considered as a straight line between points where elevations are shown on the plans.

The elevation of top of pull box and top of pole foundation shall be established according to conditions below. The elevation of the top of Cabinet Base shall be 3" above the grade listed unless the Cabinet Base is in the sidewalk, in which case it shall be at grade.

1. Existing curb with no sidewalk: The grade shall slope upward from the top of the back edge of the curb at the rate of 2%.

2. Existing curb with sidewalk: The grade shall be a straight line from the top of the back edge of the curb to the top of the curbside of the sidewalk.

3. Existing curb with adjoining sidewalk: The grade shall be the same as the grade of the top of the sidewalk.

4. If the lateral grade of the existing street exceeds 2.5%, the grade will be set by the City’s Project Manager.

2020 City of Lincoln Standard Specifications
CHAPTER 24 – TRAFFIC SIGNALS, ITS AND LIGHTING
I. FOUNDATIONS AND BASES

Foundations and bases shall be constructed and/or installed in conformance with Lincoln Standard Plans (LSPs) LSP 82 and 92, to the elevation as shown on the plans or directed by the City’s Project Manager.

All foundations shall be poured within 48 hours of excavation.

Positioning of anchor bolts shall ensure that all access and relative position of the structure and its components are in the position shown on the project plans. Anchor bolts shall be set so that 2 bolts are placed in tension and 2 in compression.

Foundations and Bases will not be measured for payment separately, but are considered subsidiary to the installation or relocation of poles or traffic signal cabinets.

1. Reinforced Concrete

Forms shall be firmly braced and secured in place. Forms shall not be removed until the concrete has set, and at no time shall they be removed within 12 hours after the concrete has been placed.

Prior to pole and cabinet installation, anchor bolts and foundation holes shall be barricaded or suitably enclosed to protect the public from possible injury.

All reinforcement bars for concrete reinforcement shall be epoxy coated, Grade 40 or Grade 60 steel and shall conform to the requirements of “Standard Specifications for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement”, ASTM Designation A615, or “Standard Specifications for Raw Steel and Axle-Steels Deformed Bars for Concrete Reinforcement”, ASTM Designation A 996. Bars shall be free from excess rust, scale or other substances which prevent the bonding of concrete to the reinforcement.

There shall, in all cases, be at least 3" of concrete between anchor bolts and epoxy coated steel reinforcing members at any edge of foundation or base.

No foundation or base shall be poured until they are free of water or debris including trash. The bottom of the foundations and bases shall rest securely on firm undisturbed ground. Both forms and excavations shall be thoroughly wet before placing concrete. An Observer shall be present for the pouring of all traffic signal foundations and bases. The Project Manager shall be contacted 24 hours in advance of the pour. Any foundations poured without the Observer present shall be subject to removal and replacement at the Contractor’s expense.

The foundations and bases shall be L3500 concrete, poured monolithically and consolidated with a mechanical vibrator as it is placed, from the bottom to the top, in the form. No floating of steel allowed. The top and any exposed portion of the foundation or base shall be troweled smooth, true and level.

Anchor bolts shall protrude within the range shown on LSP 82 with the nuts and threads covered to protect them during pouring.

Grinding concrete to form a chamfer shall not be permitted.
24.00 GENERAL (Continued)

I. FOUNDATIONS AND BASES (Continued)

1. Reinforced Concrete (Continued)

After the foundation or base has been poured, no modification shall be made. If the anchor bolts, conduit, or any part of the foundation or base are installed in an incorrect manner, as determined by the City’s Project Manager, the entire foundation or base shall be removed and a new foundation or base installed. The Contractor shall bear all costs of replacing work, including cost of anchor bolts, deemed unsatisfactory by the City’s Project Manager.

Pole shafts shall not be set on the foundations until the concrete has achieved a compressive strength of 2500 psi or an age of 72 hours. Mast arms shall not be installed until the concrete has achieved a compressive strength of 3000 psi or an age of 7 days.

2. Power Installed Foundation

The Power Installed Foundation shall be of the size required by the luminaire mounting height as shown on LSP 92.

The Power Installed Foundation is not to be used in fill areas or where the soil bearing strength is less than 1,500 pounds per square foot or on slopes in excess of 5%.

Power Installed Foundations shall be installed in conformance with the manufacturer’s instructions. The foundation shall be installed with its axis plumb. Cable entrance shall be parallel to the street unless indicated otherwise in the plans or directed by the City’s Project Manager. Trenches for conduit or cable shall be as narrow as practical, but in no case shall the trench width exceed the diameter of the foundation shaft.

J. DOWNTIME FOR TRAFFIC SIGNALS OR STREET LIGHTING

When the described Work includes any task that renders the existing traffic signal system inoperable, the downtime necessary shall be coordinated with and approved by the City of Lincoln Traffic Engineering Division and the City Project Manager.

There shall be No night time disruption to existing street lighting at any time during the project. Any street light disruption shall be restored to full operation prior to other project work commencing.
K. ENERGIZING OR DE-ENERGIZING TRAFFIC SIGNALS

It is the intent of this Standard Specification to minimize interruption to both vehicular and pedestrian traffic and activities in the area adjacent to the described Work.

A Traffic Signal or Pedestrian Signal shall only be turned off by City personnel.

The Contractor is responsible for contacting LES, to have LES energize or de-energize any Street Light Cable or energize Service Cable for Traffic Signal Equipment. Under no circumstance shall the contractor open any LES locked facilities, such as a Transformer or Pedestal.

Prior to a new or rebuilt signal being turned on, in flashing or permanent operation, the Contractor shall have completed all non-LES splices; including signal display, detection, power, pre-emption, and flash testing of the completed installation.

The Work shall be planned such that the City Traffic Engineering personnel are notified 48 hours prior to placing the signal in flash. In cases where multiple signals are involved, 48 hours for the first signal and 24 hours per additional signal shall be provided. Signal turn-ons shall occur between 9:00 a.m. and 2:00 p.m., Monday through Thursday.

New signalized locations shall be placed in pre-determined flashing operation for a minimum of 7 days, with the exception of new streets.

L. ANTI-SEIZE COMPOUND

The Contractor shall use an approved anti-seize compound everywhere metal screws into, onto or against metal.

M. SUBSTANTIAL COMPLETION

The traffic signal and/or street lighting portion of projects shall not be considered substantially complete until all items shown on the design plans or called for in any contract document are completed to the satisfaction of Traffic Engineering, excluding seed/sod if outside planting season. This substantial completion shall include all street lighting and communications systems components and the submittal of completed AS BUILT plans. The Contractor is responsible for identifying any changes in the construction from the original plans so that updated information can be documented in AS BUILT plans. The system shall be fully operational in conformance with the project plans, City of Lincoln Standard Specifications, and any special provisions.

Liquidated damages shall continue to accrue until such time as the Work is deemed to be substantially completed by Traffic Engineering.
24.00 GENERAL (Continued)

N. INSPECTION COMPLETION

Prior to the start of inspection, 1 hard copy and 1 electronic copy of as-built plans shall be provided to the City. These as-built drawings shall be labeled “AS BUILT”, with the Contractors initials and date.

Upon completion of a fully operational traffic signal, ITS, lighting, and communications system, and submittal of AS BUILT plans, an inspection shall be completed by the City. The Contractor shall correct any items as listed on the inspection forms, return inspection forms back to City, and correct any subsequent deficiencies identified by inspections until City accepts all work. The number of allowable calendar days, including the inspection process, and any associated liquidated damages shall be defined in the project contract documents.

O. SIGNAL SUPPORT SPAN

Span wire shall be 3/8", galvanized, 7 strand, high-strength grade steel wire strand. Signal support span wire shall, in all cases, have a minimum strength capable of supporting the maximum load to which they may be subjected. Tie wire shall be 1/4" diameter high-strength grade steel wire strand. Tie wire installed for any one span wire mounted location shall be the same diameter for all tie wire spans. Span wire and tie wire shall conform to the requirements of “Standard Specifications for Zinc-Coated Steel Wire Strand”, ASTM Designation A-475.

All ferrous metal line hardware items shall be galvanized and shall conform to the requirements of “Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware”, ASTM Designation A153. All hardware items shall have a minimum strength capable of supporting the maximum load to which they may be subjected.

Pole clamps used for signal support spans and messenger cable shall be installed in such a manner to prevent any rubbing or strain of the cable clamp against the pole clamp or its connecting bolt. 4 piece (90° separation) clamps shall be used.

Span wire shall be installed with 5% sag, +/− 1%, with traffic signals installed, and shall be adjusted on the poles so as to provide the proper mounting height indicated on the plans.

Tie wires shall be pulled snug to stabilize the traffic signal heads, but shall not support any of their weight. A tie wire safety link as described on the plans furnished by the City and installed by the Contractor shall be placed between the pole band and tie wire. Under no circumstances shall the tie wire be utilized to plumb poles.
24.01 REMOVE OR RELOCATE OR ADJUST

A. GENERAL

Existing traffic signal and/or street light components or systems shall be removed, relocated or adjusted in conformance with the plans and these Standard Specifications. All bases and foundations shall be removed completely. All poles or components indicated to be removed shall become the property of the Contractor except as noted on the plans or by the Special Provisions. Equipment designated for return shall be returned to the location shown on the plans. Retained equipment and material shall be protected to prevent damage. The cost of damaged equipment or materials shall be deducted from the final payment. The excavation remaining after the removal of an item from below grade shall be backfilled in conformance with Chapter 20 of these Standard Specifications.

B. BASIS OF PAYMENT

1. Remove

REMOVE (Rem) _____, completely removed and accepted by Traffic Engineering, shall be measured for payment as single units, except cable as linear feet and shall be paid for at the contract unit price bid per each for the item. This price and payment shall be full compensation for removing and disposal of all materials; removal of existing foundation, existing luminaire, ground rod or existing base, for all excavation and backfill; for the return of equipment designated for return and for all labor, equipment, tools, materials, and incidentals necessary to complete the Work in conformance with the plans and these Standard Specifications.

2. Relocate

RELOCATE (Rel) _____, complete, in place and accepted by Traffic Engineering, shall be measured for payment as single units, except cable as linear feet and shall be paid for at the contract unit price bid per each for the item. Relocate Poles and Cabinets includes removal of existing foundation or base, existing luminaire, excavation and backfill; new foundation or base and contractor supplied concrete, conduit stub-out, epoxy coated reinforcing steel, power installed foundations, pole setting foam, ground rods and anchor bolts. This price and payment shall be full compensation for all removal from original position and installation to proposed position, and for all labor, equipment, tools, materials, storage, and incidentals necessary to complete the Work in conformance with the plans and these Standard Specifications. Clamp Kit shall be provided by City if needed.

3. Adjust

ADJUST (Adj) _____, complete, in place and accepted by Traffic Engineering, shall be measured for payment as single units and shall be paid for at the contract unit price bid per each for the item. This price and payment shall be full compensation for all adjustments from the original position, orientation and installation to the proposed position, excavation and backfill; and for all labor, equipment, tools, materials, storage, and incidentals necessary to complete the Work in conformance with the plans and these Standard Specifications. Clamp Kit shall be provided by City if needed.
24.02 TEMPORARY TRAFFIC SIGNAL

A. GENERAL

Temporary traffic signal systems shall be installed as called for in the project contract documents. The City shall furnish the Contractor with traffic signal and pedestrian signal heads, traffic signal cabinet, luminaires, overhead signs, detectors and assemblies, complete with the correct hardware for the application, such as, hanger assembly and tether for span wire installation. All other materials shall be furnished and installed by the Contractor, unless otherwise noted.

The Contractor shall make arrangements with LES for power service for the temporary signals. Any delay resulting from a Contractor's untimely request to the Utility for temporary power service shall not be justification for the suspension or adjustment of the calendar days on a project. The Contractor shall be responsible for the utility costs to install or relocate the power service.

When the Temporary Traffic Signal is approved for removal by the City of Lincoln, the Contractor shall remove the traffic signal and return furnished materials to the City. The cost of the damaged material shall be deducted from the final payment.

B. BASIS OF PAYMENT

INSTALL AND REMOVE TEMPORARY _____, complete, in place, removed and accepted by Traffic Engineering, shall be measured as a single unit and shall be paid for at the contract unit price per each system. This price and payment shall be full compensation for furnishing all materials not furnished by the City, installing all materials, connecting, maintaining, and removing the temporary signal system, salvaging requested items from the temporary signal, and for all labor, equipment, tools, materials, excavation, and incidentals required to complete the Work.
24.03 CONDUIT

A. GENERAL

Conduit used for cable runs shall be rigid polyvinyl chloride (PVC) conforming to Underwriters Laboratories (UL) “Standard for Safety” UL-651, or in the case of HDPE, ribbed or smooth wall. Conduits for Fiber Optic Cable installation shall be orange and conduits for Electrical shall be black/gray.

1. Rigid Polyvinyl Chloride (PVC) Conduit, Schedule 40

Standard plastic couplings must be used to join conduit ends. The conduit may be formed or bent by warming until it is flexible and pliable enough to work easily. Wrinkles or buckling will not be permitted. Conduit must not be heated to the point of deterioration or damaging the material.

2. High Density Polyethylene (HDPE) Conduit, Schedule 40

All HDPE conduit shall have a tensile strength of 4000 psi. Either smooth wall or ribbed types are acceptable for traffic signal applications. All street light applications shall use smooth wall.

3. Main Line Conduit Group (MLCG), ASTM D 1248 Type III Class C, Grade P33, Category 5, SDR 11 unless otherwise specified in the Plans.

All Main Line Conduit Group shall consist of (6) 1-1/4" High-density polyethylene (HDPE) conduits in conformance with the requirements of NEMA TC7. Conduit shall be smooth wall coilable duct meeting the requirements of ASTM D 1248 Type III Class C, Grade P33, Category 5, SDR 11 (direct bury), SDR 13.5 (installed within other conduits), SDR 15 (if allowed on specific project plans), unless otherwise specified in the Plans.

B. INSTALLATION

Electric (Street Light Only) Conduit shall be placed at a depth of 2'-6". Traffic Signal Conduit shall be placed at a depth of 3'-6". Fiber Optic Conduit shall be placed at a depth of 4'-6".

The routing of conduit as shown in the plans indicates, the location and direction of the conduit runs. If, due to obstructions or certain other field conditions encountered during construction, it is necessary to depart from the routing shown, Traffic Engineering will determine the new location in the field.

Conduits shall be secured in their permanent positions during the pouring and curing of the foundation or base or placement of rock in pull boxes. The installation of transformer base-type poles requires that the conduits shall be placed as near the door opening as possible.

Conduits terminating in pull boxes shall be routed under the pull box and cut parallel to the pull box lid.

The individual conduits in the MLCG shall be bound together as one with a hose clamp at the bottom of the pull box line.

A continuous length of polypropylene, 200-pound pull string shall be placed in City designated fiber conduit with 10' extra neatly secured at each end.

A continuous Fiber Locate Cable shall be placed in City designated fiber conduit.
24.03 CONDUIT (Continued)

B. INSTALLATION (Continued)

The Contractor shall use 90° factory sweeps, with a 48" radius, in controller bases, the home run pull box (first electrical pull box to the cabinet) and in fiber pull boxes; in all other cases, the Contractor shall use 90° factory bends with a 16" minimum radius.

All joints and terminations shall be made in conformance with the manufacturer’s instructions and good practice. Joints shall be watertight and mechanically sound. The conduit shall not contain debris or other foreign matter and shall have a constant circular cross-sectional area.

For communication system conduits, any fiber conduit entering the bottom of fiber pull boxes shall be located in the near right side corner of the box, as you approach, at least 4" from the side and end walls. The conduit shall be sloped towards the top far edge of the box to facilitate pulling of the cables. In applications where MLCG is utilized, the conduits shall be hose clamped together, 6" from the end of the conduits. The hose clamps shall be installed prior to rock backfill in the pull box. When long radius sweeps are needed to bring the MLCG into a pull box, a compression coupling capable of providing a watertight connection in buried or restrained applications shall be used. In the unusual event that the MLCG is shallow MLCG penetrations into the side wall of pull boxes shall be made using single conduit knockouts or cored entrances.

In special cases, only approved by Traffic Engineering, conduits entering through the side wall of pull box shall be located a minimum of 4" above and maximum 8" above the floor, 4" away from the pull box corner and shall extend 4" inside the box wall. The void between the knockout and the conduit shall be filled with mastic to form a watertight seal.

Excavation for trenches shall be backfilled and compacted daily unless properly protected. All excavations shall be backfilled within 48 hours of excavation. Any excavation required to be open longer than 48 hours will need approval by Traffic Engineering. The first 4" of backfill for trenches shall consist of finely pulverized earth and shall contain no broken glass, rocks, or other sharp material that might damage the conduit. The remainder of the backfill material will normally be earth excavated from the trench unless such earth is water saturated or frozen. Backfill material shall be substantially dry, loose, clean earth free from rocks and debris. Excessively dry or excessively sandy material is not permitted. Before backfilling, all standing water shall be removed from the trench. Tamping shall be done at no more than 12" backfill level intervals to ensure proper compaction throughout the depth of the void. Hand tamping is not permitted. All excess backfill material shall be removed promptly from the site.

C. CONDUIT BORED

When shown on the plans the jacking or directional boring of conduit is to be done with equipment designed and designated for that purpose or other approved methods where a constant pressure can be applied and controlled, and in conformance with approved procedures.

Pavement shall not be disturbed without the approval of the City’s Project Manager. Jacking or directional boring shall be kept 24" from the edge of any type of pavement wherever possible. Excessive use of water which might undermine pavement or soften sub grade will not be permitted.

Determine all utility locations near the path of the proposed pushed (bore) conduit, including depth. Use this information to avoid damage to utilities and/or facilities within the work area. Provide this information, including the sources, to the City’s Project Manager a minimum of five working days prior to boring. Do not bore until the City’s Project Manager approves that submittal.
24.03 CONDUIT (Continued)

C. CONDUIT BORED (Continued)

Prior to boring, expose all utilities for which it is customary and safe to do so.

The diameter of the drilled hole shall conform to the outside diameter of the conduit as closely as practical. Pressure grout as directed by Traffic Engineering, to fill any voids, which develop during the installation operation. Remove and replace any conduit damaged in directional drilling operations at no expense to the project.

Conduit logs detailing bore depth shall be presented to the City after all boring operations. Conduit logs shall include as built drawings of conduit and GPS location measurements of all pull box lids accurate to 10 digits. All conduit logs shall be electronic and of a format approved by the City of Lincoln.

Repairs to conduit shall use a coupling capable of providing a watertight/airtight connection in buried or restrained applications.

The use of water and other fluids in connection with the drilling operation will be permitted only to the extent necessary to lubricate cuttings. Jetting will not be permitted, and the use of water alone as a drilling fluid will not be permitted. Use a drilling fluid/slurry consisting of at least 10% high grade, processed Bentonite to consolidate excavated material, seal the walls of the hole, and furnish lubrication for subsequent removal of material and immediate installation of the pipe.

Provide a means of collecting and containing drilling fluid/slurry that returns to the surface, such as slurry pit, or a method approved by Traffic Engineering. Provide measures to prevent drilling fluids from entering storm sewer systems. Prevent drilling fluid/slurry from accumulating on or flowing onto sidewalks, other pedestrian walkways, driveways, or streets. Immediately remove any slurry that is inadvertently deposited on pedestrian walkways. Transport waste drilling slurry from the site and dispose of it. Do not allow slurry to enter wetlands. Protect wetlands using appropriate soil erosion control measures approved by Traffic Engineering.

Boring fluid shall be appropriate for soil conditions. Waste oil and/or environmentally non-compatible polymers shall not be part of the drill fluid composition. Used boring fluid shall be properly, and legally, disposed of.

The contractor shall continuously monitor boring operations for possible frac-out of drill fluid. Any frac-out or surface uplifting shall be contained, cleaned up, and repaired.

Use a digital walkover locating system to track the drill head during the bore. At minimum, the locating system shall be capable of determining the pitch, roll, heading, depth, and horizontal position of the drill head at any point along the bore. During each drilling operation, locate the drill head every 10’ along the bore and prior to crossing any underground utility or structure. Upon completion of the drilling operation and conduit installation, furnish the City’s Project Manager with an as-built profile drawing and plan drawing for the drilled conduit showing the horizontal and vertical locations of the installed conduit.

D. CONDUIT IN TRENCH

Conduit in trench shall mean conduit which is directly buried in earth and shall be installed in suitable trenches in conformance with 24.00.F.
24.03 CONDUIT (Continued)

E. BASIS OF PAYMENT

CONDUIT, ____", BORED; CONDUIT, MAIN LINE GROUP BORED; CONDUIT, ____", TRENCHED; and CONDUIT, MAIN LINE GROUP TRENCHED, complete, in place and accepted by Traffic Engineering, shall be measured as lineal feet from and to centers of pull boxes, cabinets, and poles and shall be paid for at the contract unit price bid per linear feet for the conduit. This price and payment shall be full compensation for all excavation required; pulling string (in City fiber conduit), fiber locate cable (in City fiber conduit), conduit caps, hose clamps, backfilling and compacting; and for all labor, equipment, tools, materials, and incidentals required to complete the Work.

Pulling String and Fiber Locate Cable are subsidiary to City communication conduits. The installation of conduit stub outs as called for on the plans, including necessary couplings, elbows, sweeps and bends shall be considered part of those items for which payment is made and shall not be measured separately.

24.04 BLANK ON PURPOSE

24.05 PULL BOXES

A. GENERAL

Pull boxes, T6, T9, TR27, T48 and their lid are required to conform to all test provisions of ANSI/SCTE 77 “Specifications for Underground Enclosure Integrity” Tier 15 and labeled as such inside the pull box and on the top of the lid. All lids are required to have a minimum coefficient of friction of 0.5 in conformance with ASTM C1028. Independent third-party verification or test reports stamped by a registered Professional Engineer certifying that all test provisions of this Standard Specification have been met are required with each submittal. Pull Box, T48 shall have a split lid (2-piece).

Pull box shapes and nominal dimensions shall conform to LSP 81.

Pull box lids shall also be labeled “ELECTRIC”, “TRAFFIC”, or “FIBER” on top as indicated on the Plans.

B. INSTALLATION

Pull boxes shall be installed at the locations shown on the plans.

The excavation for the pull box, T6 and T9 shall extend at least 12" below the bottom and 6" beyond the sides of the pull box. The pull box shall rest firmly on an aggregate base, meeting all of the requirements of coarse aggregate for concrete as described in Chapter 3 of the City of Lincoln Specifications.

Pull Boxes T6 and T9 shall have aggregate base that extends 12" below the bottom and at least 6" beyond the outside edges of the pull box. In addition, the aggregate base shall extend 6" up on the outer sides of the pull box, measured from the bottom of the box. The aggregate base shall be placed in 6" lifts and compacted with mechanical or hand methods to the satisfaction of Traffic Engineering. See LSP 81 for aggregate placement detail.

The remaining excavation shall be backfilled with soil and shall meet the requirements for backfill in Chapter 20 of the City of Lincoln Specifications.
24.05 PULL BOXES (Continued)

B. INSTALLATION (Continued)

The excavation for the pull box, TR27 and T48 shall extend at least 12" below the bottom and 12" beyond the sides of the pull box. The pull box shall rest firmly on an aggregate base, meeting all of the requirements of coarse aggregate for concrete as described in Chapter 3 of the City of Lincoln Specifications.

Pull Boxes TR27 and T48 shall have aggregate base that extends 12" below the bottom and at least 12" beyond the outside edges of the pull box. In addition, the aggregate base shall extend 12" up on the outer sides of the pull box, measured from the bottom of the box. The aggregate base shall be placed in 6" lifts and compacted with mechanical or hand methods to the satisfaction of Traffic Engineering. See LSP 81 for aggregate placement detail.

The remaining excavation shall be backfilled with soil and shall meet the requirements for backfill in Chapter 20 of the City of Lincoln Specifications.

Pull boxes shall not be placed in concrete unless specifically indicated on the plans or otherwise directed by Traffic Engineering.

Do not install pull box lid bolts.

Pull box edges, lid and lifting eye shall be kept clear of concrete and foreign material.

C. BASIS OF PAYMENT

PULL BOX, _____, complete, in place and accepted by Traffic Engineering, shall be measured for payment as single units for each type and shall be paid for at the contract unit price bid per each for the item. This price and payment shall be full compensation for all excavation required; for furnishing and installing the pull box and lid; for conduit, conduit bends or long radius sweeps and aggregate base; and for all labor, equipment, tools, materials, and incidentals required to complete the work.
24.06 RISERS

A. GENERAL

A riser is a conduit vertically attached to a pole or a building used to hold cable. The riser shall be Galvanized Rigid Steel (GRS) conforming to the UL “Standard for Safety” UL-6 and PVC, Schedule 40, conforming to UL “Standard for Safety: UL-651.

B. INSTALLATION

All risers shall be the size specified in the plans, at the location shown on the plans. The riser shall be GRS a full 10' from grade up without joints, installed on standoffs and grounded. Risers mounted on the side of building shall be located as close as possible to any existing underground network riser as is practical in a manner acceptable to Traffic Engineering. The steel portion of the conduit riser shall be grounded at the top.

All pole risers shall be on standoff brackets provided by LES. These can be picked up at the LES store room. See 24.00.E for location and hours. See LSP 83 for spacing detail.

LES is to build the Riser above the 10' of GRS and provide the cable to the meter when a meter is required. If there is no meter, then the contractor is to build the riser to its needed height and provide the cables, including enough cable for LES to energize.

The bottom 3' of service risers installed on buildings shall be encased in concrete not less than 3" in thickness. Concrete shall be L3500 conforming to the requirements of Chapter 3 of these Standard Specifications.

C. BASIS OF PAYMENT

RISER, ___", complete, in place and accepted by Traffic Engineering, shall be measured for payment as single units for the various sizes and shall be paid for at the contract unit price bid per each for the item. This price and payment shall be full compensation for all excavation required; for furnishing and installing the riser; for picking up and installing standoff, provided by LES installation, for conduit pipe clamps, ground wire, ground rod, concrete encasement, steel riser guards, meter socket, and incidentals are considered part of the riser assembly.
24.07 ELECTRICAL METER PEDESTAL

A. GENERAL

When placing an Electrical Meter Pedestal, the Contractor shall supply the pedestal. LES shall furnish and install KWH meter, cable from source to the meter and the upper part of the riser, when applicable. Metallic pedestals shall be bonded to the service neutral. A ground rod shall be installed at the pedestal and bonded to the service neutral. Meter socket shall be ring style. Meter socket is to have lugs to receive a 120/240 volts single phase 3 wire service.

B. INSTALLATION

Meter Pedestals shall be installed at the locations shown on the plans. See LSP 83 for installation detail.

C. BASIS OF PAYMENT

ELECTRICAL METER PEDESTAL, complete, in place and accepted by Traffic Engineering, shall be measured as single units and shall be paid for at the contract unit price bid per each for the item. This price and payment shall be full compensation for the excavation and backfilling required, for furnishing and installing the pedestal, ground rod; for all labor, equipment, tools, materials, and incidentals necessary to complete the Work.
24.08 STEEL POLES

A. GENERAL

Street Light Pole Standard Specifications are found on **LSP 92**. Pedestal Pole Standard Specifications are found on **LSP 90**.

B. STREET LIGHT POLES

1. General

Poles shall conform in detail to the requirements set forth in this Standard Specification and as shown on the plans. Each pole shall consist of a steel shaft, grounding terminal, wire inlet, hand hole and handhole cover.

The following criteria shall be evaluated when designing these poles:

a. Total weight of each luminaire - 40 pounds. Effective projected area for each luminaire shall be 1.4 square feet.

b. Wind loads (gust factor of 104 MPH) shall be 23.5 pounds per square foot on all supported surfaces including projected area of luminaires, sign surface area of 8 square feet, and pole sections.

c. Ice loads (unit weight of ice equal to 56 pounds per cubic foot) shall be assumed to be 1" of ice on the horizontal projection of all exposed surfaces including sign surface area of 8 square feet. A 1/2" radial ice coating shall be assumed on the vertical projection of all exposed surfaces.

2. Shaft

The shaft shall be of steel and shall be a continuously tapered tube fabricated from not less than No. 11 manufacturer’s gauge thickness, best grade steel. The shaft shall have only 1 longitudinal welded joint and shall be free of intermediate horizontal joints or welds. Only 1 length of sheet steel shall be used which shall be formed into a continuously tapered shaft having a taper of approximately 0.14” per foot. The shaft shall then be cold rolled under enough pressure to flatten the weld and increase the physical characteristics of the shaft so that the metal will have a minimum guaranteed yield strength of 48,000 psi.

The cold rolling process shall form a round shaft with a top outside diameter of approximately 3". A 3" x 5" handhole with removable cover plate shall be centered approximately 18" above the ground line of the pole.

A grounding nut for accommodating a 1/2" 13 UNC threaded bolt shall be provided on the inside of the shaft so as to be easily accessible from the handhole opening.

The overall length of the shaft shall be such that the luminaire specified has its light center located per plan mounting height above the ground when mounted on the pole with the base of the pole to be a minimum of 4' below grade, when pole is embedded.

A wire opening with a minimum diameter of 1 1/2" shall be provided in the shaft. It shall be a grommeted, smooth surface opening to prevent damage to wire being drawn through the hole. The opening shall be approximately 24" below the ground line.
24.08 STEEL POLES (Continued)

B. STREET LIGHT POLES (Continued)

3. Pole Finish

After all welds have been completed on the pole shaft and arm, all parts shall be thoroughly cleaned of all loose scale and other foreign material and hot dip galvanized at the factory.

If painting is required as part of the project, after all welds have been completed on the pole shaft and arm, all parts shall be thoroughly cleaned of all loose scale and other foreign material and hot dip galvanized, then powder coated to specified paint color at the factory.

Care is to be taken during shipping and installation to protect the finish from any cuts or scrapes.

4. Modifications

The Contractor shall submit to the City’s Project Manager for approval the name of the manufacturer and the type of pole he proposes to furnish. The Contractor or his representatives shall make no field modifications on any pole, or part thereof, without the written permission of the City’s Project Manager.

Modifications shall be construed to mean any drilling, filing, tapping, cutting, bending, or any other operation that will change the physical, mechanical, or architectural qualities of the pole.

5. Festoon Outlet

Festoon outlet shall be wired with No 10 USE and fused at 2 amps at the base of the pole. Outlet covers shall be continuous use metal outlet covers.
C. FOUNDATIONS, POLES, AND MAST ARMS, AND LUMINAIRE ARMS

1. GENERAL

This work includes furnishing and installing mast arm poles, combination mast arm/lighting poles, and all miscellaneous items as indicated in the Contract Documents.

Street Light Pole Standard Specifications are found on LSP 92. Pedestal Pole Standard Specifications are found on LSP 90.

2. DESIGN CRITERIA

Mast arm poles, combination mast arm / lighting poles, shall be galvanized steel or aluminum structures designed in accordance with the 2013 AASHTO Specifications for the Design and Construction of Structural Supports for Highway Signs, Luminaires and Traffic Signals, 6th Edition. A Structural Engineer currently licensed to practice in the State of Nebraska shall seal all designs. The design wind velocity shall be ninety (90) miles per hour.

The following design factors shall be used in the design of mast arm pole and combination mast arm / lighting poles:

- Wind Speed: 90 mph wind speed. (AASHTO Section 3.8.2, Figure 3.8.3)
- Wind Recurrence Intervals: 50 year recurrence interval. (AASHTO Section 3.8.3)
- Unreinforced & Reinforced Holes and Cutouts: Design structure unreinforced and reinforced holes to conform to section 5.14.6 (AASHTO Section 5.14.6)
- Fatigue Category: Fatigue Category 2 (AASHTO Section 11.6)
- Galloping Loads: Structure shall not be designed to resist galloping-induced cyclic loads.
- Natural Wind Gust: Structure shall be designed to resist a natural wind gust load of 11.2 mph, based on the yearly mean wind velocity. (AASHTO Section 11.7.1.2)
- Truck Loads: Structure shall not be designed to resist truck-induced gust loads. (AASHTO Section 11.7.1.3)

Design structures to support the required signal heads, lighting systems, signal and lighting cables, signage, other required items, and ten (10) pounds of ice per linear foot per tube for the location and span indicated in the Contract Documents. Use the area of the signs shown or as noted on the Contract Documents for the design calculations. Design all metal poles to support a twelve (12) foot luminaire arm and forty (40) pound luminaire. Once selected, use the same design patterns, materials, and basic member shape throughout the project unless otherwise indicated in the Contract Documents. Design mast arms to support the required signal or luminaire load and required signal and lighting cables. The maximum design wind velocity shall be ninety (90) miles per hour after installation.
C. FOUNDATIONS, POLES, AND MAST ARMS, AND LUMINAIRE ARMS (Continued)

3. METAL POLES

Metal poles shall consist of a round, tapered pole shaft of galvanized steel fabricated in accordance with the Contract Documents. Metal poles shall have one (1) longitudinal automatic electric weld. After forming, flatten the weld. Steel shall be in accordance with ASTM A595, Standard Specification for Steel Tubes, Low Carbon, Tapered for Structural Use. Incorporate a lifting U-hook at the top of the shaft. The U-hook shall support the weight of the entire pole.

The pole shall be continuous from the base to the height necessary for luminaire arm attachment as indicated in the Contract Documents.

The pole manufacturer shall state the amount of pole rake necessary for the pole to set plumb under the required loading after installation. The manufacturer shall certify that the metal pole(s) and hardware meet the strength requirements for the anticipated loading. Secure a one (1) piece galvanized steel anchor base of adequate strength, shape, and size to the lower end of the shaft using two (2) continuous electric arc welds. The base shall telescope the shaft of the pole. Locate one (1) weld outside the base at the joint between the base top and the pole shaft.

Furnish all hardware necessary to complete the metal pole assembly in accordance with the pole manufacturer’s instructions. Hardware shall include, but not be limited to, bolts, nuts, washers, removable pole tops, anchor bolts, anchor bolt covers, and transformer bases. Galvanize all exposed metal hardware. Removable pole tops shall consist of a galvanized positioning cap screw and galvanized pole cap. Furnish one (1) rubber grommet of one (1) inch inside diameter for each signal arm mounting location. Galvanizing shall be in accordance with ASTM A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

4. ANCHOR BOLTS

Anchor bolts shall be in accordance with ASTM F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength, and the Contract Documents. The manufacturer shall certify that the anchor bolts meet the strength requirements for the anticipated loading of the pole(s). The minimum yield strength shall be fifty-five thousand (55,000) psi. Thread the bolts a sufficient length to allow for proper installation.

Threads shall be full and sounds. Galvanize all exposed portions of the anchor bolt. Supply two (2) galvanized hexagon nuts and two (2) galvanized flat washers with each anchor bolt. Galvanizing shall be in accordance with ASTM A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
5. MAST ARMS

Steel shall be in accordance with ASTM A595, Standard Specifications for Steel Tubes, Low Carbon, Tapered for Structural Use or ASTM 572, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel. Galvanizing shall be in accordance with ASTM A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products. Mast arms shall consist of galvanized steel shaft with a mounting device suitable for attaching the arm at the height specified in the Contract Documents. Mast arms less than fifty-five (55) feet shall be one (1) piece arms. Mast arms fifty-five (55) feet or longer may be one (1) or two (2) piece arms. The mast arm mounting shall be structurally sound and neat in appearance. The mast arm shall be field adjustable or provide a minimum of two (2) and the maximum of four (4) degree rise.

Supply a mast arm cap for the free end of the mast arm. Furnish one (1) rubber grommet of one (1) inch inside diameter for each signal mounting location. The manufacturer shall certify that the mast arm(s) meet the strength requirements for the anticipated loading.

6. LUMINAIRE ARMS

Luminaire arms shall consist of the galvanized steel shaft with a mounting device suitable for attaching the arm at the height specified. Steel shall meet the requirements for two (2) inch Grade A or Schedule 40 pipe in accordance with ASTM A53, Standard Specification for Pipe, Steel, Zinc (Hot-Dip Galvanized) Coated, Welded and Seamless. The mounting shall be structurally sound and neat in appearance. The mating arm and pole steel simplex attachments shall meet the requirements for Grade 65-35 steel castings in accordance with ASTM A27, Standard Specifications for Steel Castings, Carbon, for General Applications.

Channel scrolls shall be one and one-half (1 ½) inch by one-eighth (1/8) inch commercial grade steel the manufacturer shall certify the luminaire arm(s) meet the strength requirements for the anticipated loading.

Unless otherwise indicated in the Contract Documents, Lincoln Electric System (LES) shall supply the luminaire(s).

7. GROUT

Grout shall be non-shrinking and non-rusting and comply with the requirements for Grade A Pre-Hardening Volume-Adjusting Grout in accordance with ASTM C1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout.

8. ANCHORS AND ANCHOR RODS

Anchors shall be three-way (3-way) expanding malleable iron anchors having a minimum diameter of eight (8) inches. Malleable iron shall be in accordance with ASTM A47, Standard Specification for Ferritic Malleable Iron Castings. Anchor rods shall be eight (8) feet long, five-eighth (5/8) inch diameter galvanized steel rods with thimble eye end.

Galvanizing shall be in accordance with ASTM A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
24.08 STEEL POLES (Continued)

C. FOUNDATIONS, POLES, AND MAST ARMS, AND LUMINAIRE ARMS (Continued)

9. FOUNDATION CONSTRUCTION

The Engineer will provide a Foundation Design to the selected Bidder. It is anticipated that the Foundation Design will be provided to the selected Bidder prior to NTP. Construct reinforced PCC foundations in accordance with Standard Plans, Standard Specifications, Design, and Contract Documents. Excavate, dig, and/or bore holes at the locations indicated in the Contract Documents or as directed by the Engineer. The excavation shall be dry and free of any loose materials before placing PCC. Forms shall be used for any portion of the foundation that will be exposed above ground. Level and secure all forms before commencing PCC placement. Install and secure all reinforcing steel, conduit, and anchor bolts before commencing PCC placement.

Concrete shall be specified by the Contractor’s Foundation Engineer. Consolidate the PCC throughout the full depth of the foundation by inserting and withdrawing a vibrator multiple times during PCC placement.

Finish the top of the foundation to be approximately two (2) inches above the adjacent ground or structure unless otherwise indicated in the Contract Documents. Finish the top of the foundation to be flush with adjacent sidewalk.

Form removal and surface finishing and grout installation shall be in accordance with Lincoln Standard Plans and Specifications.

Backfill the excavation and restore any areas disturbed by the foundation construction.

a. POLE FOUNDATIONS

Metal pole foundations shall be round with a square cap. The minimum dimension for the mounting surface shall be two and one-half (2½) inches greater than the pole base or transformer base on all sides. Pole foundations shall be constructed in accordance with the Standard Plans.

Install and secure anchor bolts within the reinforcing steel before commencing PCC placement. Center the bolt circle in the middle of the foundation and set the anchor bolts plumb at a projection distance above the finished surface in accordance with the manufacturer's recommendations. Conduit bends shall be ninety (90) degrees and shall exit the foundation a minimum of thirty (30) inches below the surrounding surface. Plug the ends of the conduit before commencing PCC placement.
C. FOUNDATIONS, POLES, AND MAST ARMS, AND LUMINAIRE ARMS (Continued)

10. GROUND ROD INSTALLATION

Supply and install a ground rod in accordance with the Standard Plans, the Contract Documents, and NEC Article 250. Install a No. 6 AWG stranded copper wire attached to the ground rod using an appropriate clamp and connected to the splice box on the pole shaft. Use No. 6 AWG green insulated stranded copper wire for conduit installations.

Grounding shall be in accordance with the NEC, local ordinances, all applicable codes, and the requirements of the local utility company supplying electrical power. Do not connect any grounding connections to a breakaway device. The maximum measurable resistance between the ground rod and a test stake driven two (2) feet into the ground adjacent to the pole foundation shall not exceed twenty-five (25) ohms. If the resistance exceeds twenty-five (25) ohms, install additional ground rods greater than six (6) feet apart and connected using a No. 4 AWG bare copper wire. The number of additional ground rods shall be as needed to produce a measurable resistance of less than twenty-five (25) ohms.

11. MAST ARM SIGNAL POLE INSTALLATION

Install mast arm signal poles and mast arms at locations indicated in the Contract Documents and in accordance with the Standard Plans. The Contractor shall provide the required anchor bolts and hold down lugs as part of the cost to install a mast arm pole. Hold down lugs shall be provided for both the top and bottom sides of the bottom plate of the base. If the constructed foundation and anchor bolts do not fit the mast arm pole, then the Contractor shall construct a new foundation with the correct anchor bolt size and bolt circle at no additional cost to the City.

Install mast arms in accordance with the manufacturer's recommendations and such that the loaded arm has a minimum clearance of seventeen (17) feet from bottom of all signals to the crown of the street. Rake the pole back more than the calculated deflection, load the pole, and plumb the pole by adjusting the leveling nuts.
C. FOUNDATIONS, POLES, AND MAST ARMS, AND LUMINAIRE ARMS (Continued)

12. MEASUREMENT AND PAYMENT

The Engineer shall measure mast arm signal poles for payment by the type of each mast arm signal pole supplied, installed, and accepted.

The Engineer shall measure combination mast arm signal / lighting poles for payment by the type of each combination mast arm signal / lighting pole supplied, installed, and accepted.

The following items are considered subsidiary to items for which the Contract provides direct payment: licenses, or associated permits; tree or shrub trimming; loading, hauling, and installing all materials, mounting hardware, ground rod(s), and miscellaneous hardware; installing wire and/or conduit into an existing base/foundation/pad; installing guy wires and guy anchor assemblies; and restoration of the surrounding ground surface.

Mast arms and luminaire arms are subsidiary to mast arm signal poles and combination mast arm signal / lighting poles.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for furnishing all labor, materials, equipment, tools, transportation, permits, licenses, and all incidentals necessary to complete the work.

Contractor shall submit shop drawings for approval for all Poles prior to purchasing or performing work.

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<thead>
<tr>
<th>Description</th>
<th>Unit</th>
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<tbody>
<tr>
<td>Mast Arm Pole</td>
<td>Each</td>
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<tr>
<td>Combination Mast Arm Pole</td>
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<tr>
<td>Foundation Concrete</td>
<td>Cubic Yards</td>
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<td>Foundation Steel</td>
<td>Pounds (lbs)</td>
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<td>Foundation Design</td>
<td>Each</td>
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24.08 STEEL POLES (Continued)

D. INSTALLATION

Poles, pole arms and/or pedestals are to be installed at the locations shown on the plans, unless permission to change the locations is given by the Project Manager. Poles shall be placed so that modifications and/or attachments are carefully oriented, as indicated on the plans.

The Traffic Signal Pole handhole shall be opposite the mast arm.

The Street Light Pole festoon outlet shall be located on the side opposite the street and the hand hole shall be 90° right of the luminaire arm.

A ground rod shall be set in undisturbed earth as shown on LSP 82 and 92. A continuous bare copper ground wire shall be connected from the ground rod to the grounding lug on the pole. When transformer bases are used, the pole shaft section and the transformer base section shall also be bonded to the ground rod.

Pole shafts must be erected so that they are plumb with their entire load in place. The mast arms shall be correctly oriented, as shown on the plans. Plumbing of pole shafts shall be accomplished by adjusting the leveling nuts on the foundation anchor bolts. Shims or similar devices for plumbing or racking will not be permitted except for leveling of the transformer base as per the manufacturer. The Contractor is responsible for additional nuts and washers for the Pedestal Pole if needed.

The Contractor shall notify the City of any damaged poles or surfaces before they pick up poles from pole storage site. The Contractor shall handle all poles in a manner to prevent damage to pole surface. All poles shall be clean after erection, and damaged surfaces shall be repaired to Traffic Engineering’s approval.

If traffic signal pole construction requires the pinning of the mast arm to the vertical shaft, once the mast arms orientation and height are verified by Traffic Engineering, the Contractor shall pin the mast arms as soon as possible.
E. EMBEDDED STEEL POLE INSTALLATION

Embedded steel poles shall be backfilled with pole setting foam. The Contractor shall coat the entire vertical pole butt surface with foam from base 6" below ground line. The poles shall be masked to 1" above the ground line to prevent splattering and provide a uniform edge.

All holes for poles shall be drilled, augured or vacuumed. The soil shall be removed from the holes mechanically or vacuumed. The diameter of the finished hole shall not exceed the pole diameter at ground line more than 4" nor less than 2". Depths of holes shall be determined by embedment length requirements of the pole.

In case of over-drilling, the holes shall be backfilled to proper depth with compacted soil. The Contractor shall take every precaution to prevent surface drainage from entering the holes.

A 6" layer of crushed rock shall be placed in the base of each hole. The crushed rock shall have been sieved after crushing to remove excessive fines and shall be so graded to meet the following requirements:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Retention Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/2&quot;</td>
<td>0-5%</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>90-100%</td>
</tr>
</tbody>
</table>

A small section of PVC conduit shall be used during backfilling application to assure access to the underground wire inlet after the backfilling process has been completed to allow installation of the underground wire thru the pole setting foam.

Poles shall be plumbed and held in stationary position for no less than 20 minutes (or as recommended by the foam manufacturer) after the foam has been applied. The masking shall be removed as soon as the foam expansion reaction has ceased. The remainder of the hole shall be backfilled with clean earth and tamped.

Application and use of the foam shall be in strict adherence to the manufacturer’s instructions. A copy of the manufacturer’s instructions shall be present on the job site and available to the Project Manager. The age of the pole setting foam components shall not have exceeded the manufacturer’s recommended shelf life under the conditions by which the manufacturer defines shelf life.

After the recommended curing period, the foam shall have a core density of not less than 4.2 pounds per cubic foot and shall have a sheer strength not less than 38 psi. and shall have a compressive strength not less than 75 psi.

The foam shall be tested, when required by Traffic Engineering, in conformance with ASTM D 2856/ANSI K 65.152; ASTM D 1623/ANSI K65.32; and ASTM D 1621/ANSI K65.31.
F. BASIS OF PAYMENT

POLE, INSTALL _____ complete, in place, and accepted by Traffic Engineering, shall be measured for payment as single units and shall be paid for at the contract unit price bid per each for the item. This price and payment shall be full compensation for all excavation, for picking up and installing the pole, mast arm, luminaire arms, cable, conductors, span wire, tie wire, concrete, conduit stub-out, epoxy coated reinforcing steel, anchor bolts, concrete foundation, anchor bolt covers, power installed foundations, transformer base, breakaway base, pole setting foam, ground rods and clamps, and for all labor, equipment, tools, materials, and incidentals necessary to complete the Work.

INSTALL MAST ARM, complete, in place, and accepted by Traffic Engineering, shall be measured for payment as single units and shall be paid for at the contract unit price bid per each for the item. This price and payment shall be full compensation for picking up and installing the arm, all labor, equipment, tools, and incidentals necessary to complete the Work.

POLE, _____ complete, in place, and accepted by Traffic Engineering, shall be measured for payment as single units and shall be paid for at the contract unit price bid per each. This price and payment shall be full compensation for all excavation, for furnishing and/or installing the pole, luminaire arms, cable, conductors, span wire, tie wire, concrete, conduit stub-out, epoxy coated reinforcing steel, anchor bolts, concrete foundation, anchor bolt covers, power installed foundations, transformer base, breakaway base, pole setting foam, ground rods and clamps, and for all labor, equipment, tools, materials, and incidentals necessary to complete the Work.
**24.09 GROUND RODS**

**A. GENERAL**

Ground rods shall be high strength steel rods with chemically-bonded copper coverings to provide high-conductivity and to prevent electrolytic action. The copperweld ground rods shall be placed as shown on the plans, 2' from the pole base, and oriented on the same side as the hand hole or in a pull box, if called for on the plans or LSPs; they shall have a nominal diameter of 5/8" and 15' long, except to a Street Light Pole shall be 10' long. For worker safety 5' lengths of ground rod screwed together are allowed. Ground wires shall be connected to ground rods with one-piece non-ferrous clamps which employ set screws as tightening devices. Connections to ground rods shall not be taped.

All ground wires shall be No. 6 AWG, bare solid annealed copper wire unless otherwise specified on the plans.

**B. INSTALLATION**

Each pole, or pedestal or traffic signal cabinet shall be firmly connected to the ground rod provided for each using the grounding terminal or terminal lugs. Placing the ground wire under an anchor bolt nut, anchor bolt cover, or similar device will not be permitted. The Contractor shall attach ground wire to base using terminal lugs. To attach the ground to the pedestal pole base, drill a hole in the pedestal base to accept the terminal lug.

Each pole or pedestal shall be connected to the traffic signal cabinet and the ground rod using a circuit grounding conductor of the size required on the LSP.

Each steel pole shall be connected to both the pole ground and a separately installed circuit grounding conductor of the size called for on the plans.

Ground Rods shall be installed in Pull Boxes where specified on the plans. Ground rods shall be centered on the side opposite the curb and installed 3" away from pull box side walls. The top of the ground rod shall be 10" below the bottom of the pull box lid. Ground Rods in Fiber pull Boxes shall include a Fiber Locate Cable attached to the Ground Bar and attached to the 15' ground rod in the pull box.

**C. BASIS OF PAYMENT**

GROUND ROD, complete, in place and accepted by Traffic Engineering, shall be measured as single units and shall be paid for at the contract unit price bid per each for the item. This price and payment shall be full compensation for furnishing and installing the Ground Rods; and for all labor, equipment, Fiber Locate Cable, tools, materials, and incidentals required to complete the work.

No measurement or direct payment will be made for ground rods, ground wire, attachments to existing ground, or grounding clamps installed in conjunction with wood or steel poles, pedestal poles, or the pull box nearest the traffic signal cabinet. Ground rods and ground wire shall be considered subsidiary to and included in the bid price for the items for which direct payment is made.
24.10 DETECTORS

A. GENERAL

Detectors shall be inductance loops, detector cameras, non-intrusive detectors, emergency detectors or pedestrian push buttons as called for on the plans. All loop locations shall be marked on the pavement by the Contractor prior to installation and approved by Traffic Engineering. All camera detector, non-intrusive detector, and emergency detector locations shall be located as indicated on the plans. The locations for these detectors shall be coordinated with Traffic Operations and approved by Traffic Engineering. The pedestrian push button locations shall be marked on the pole shaft by the Contractor prior to installation and approved by Traffic Engineering. The Contractor shall review the installation drawing prior to scheduling operations, so as to expedite the installation process and cause a minimum of traffic interference and to ensure correct placement of loops.

The Contractor shall adhere to the specified detector locations including the leads and conduit as shown on the plans. Loops shall always be centered in their respective lanes as identified by final pavement markings shown on the plans. Care should be taken to ensure loops are centered properly within through lanes and left-turn lanes should variable lane widths exist. If some unforeseen condition necessitates repositioning a loop, the change must be approved by Traffic Engineering.

B. LOOP DETECTORS

Loop Detectors are described as either Sawed Under Overlay or Preformed Under Street. Sawed Under Overlay are placed in base of existing streets in a 3/8” wide slot. Preformed Under Street Loops may be placed in or on the subgrade prior to placing the surface, or placed beneath surfacing material, as shown on the plans. All loops shall be 6’ x 6’.

1. Sawed Under Overlay

After identification of the loop locations, the Contractor shall perform the actual layout by means of either a template or chalk line. All Work related to the installation of a particular loop, with the exception of the layout task, shall be complete in the same Work day.

a. Saw Cutting

Saw cutting will be allowed only when the temperature is 32° F and rising. The concrete cutting equipment shall make use of a tank supplied water source which has sufficient pressure to act as a blade coolant, lubricant, and slot cleaner. Diamond cutting blades utilized for the saw cut shall, without damaging the adjacent areas, provide a clean, well-defined slot having a 3/8” width. On milled surfaces to be overlaid, depth of the saw cut shall be 2” from the lowest groove. The perpendicular saw cuts shall not meet at the corners. Diagonal cuts shall be required at all corners and where the loop wire exits from the actual loop. The saw cut waste shall be collected in a manner to keep from storm drainage.

b. Cleaning the Saw Cut

After the cutting operation, the slots shall be free and clear of moisture and debris, and the presence of any jagged edges or other protrusions which might damage the loop wire.
24.10 DETECTORS (Continued)

B. LOOP DETECTORS (Continued)

c. Wire Installation

Loop detectors shall consist of three turns of wire. Loop wire shall go directly from the loop to a pull box. IMSA 51-5 No. 14 AWG wire shall be used. The loop wire shall be a continuous length, no splicing allowed. The wire brought to the pull box shall be clearly tagged, identifying the loop number using the labeling method as shown in 24.12.D. During installation, the loop wire shall be held in place by lengths of compressible polyethylene or polyurethane foam sealant backer rod, not to exceed 6". The backer rod shall be of sufficient number and size to hold the wire in place while the sealant cures and is resilient over the temperature range of -40° to +160° F. The top of the backer rod shall be at least ½" beneath the surface of the pavement. On milled surfaces, the backer rod shall be at least ½" from the lowest groove.

d. Sealing the Saw Cut

The sealant used to cover the wires in the slots shall be an elastic epoxy resin compound. The epoxy shall have a tack-free curing time of not more than 1 1/2 hours at 75° F. The sealant shall be applied into the slot to half depth.

When both the loop and lead-in slots are half filled, a check shall be made for air bubbles and material pile-up and then the slots shall be filled to street level. Excess sealant shall be removed by means of squeegee. There shall be neither a trough nor a mound formed. The sealant, when applied into the saw cut, shall displace all the air, and completely fill the area of the slot. Sufficient time for sealant curing shall be allowed before traffic is permitted to move over the area.

2. Preformed Under Street Loop Detector

The Contractor shall furnish and install preformed under street loop detector loop detectors at a depth of 0" to 6" under new pavement. Care should be taken to prevent damage to the loop and lead in before and during the paving operation.

The preformed under street loop detector loop may be formed to be rigid or flexible, with 3 turns specified. The wire shall be a continuous length, no splicing allowed. The end of the wire brought to the pull box shall be clearly tagged identifying the loop number using the labeling method as shown in 24.12.D.

3. Loop Acceptance

Each loop shall be tested at the cabinet prior to termination and acceptance. All tests shall have the following result prior to acceptance.

\[
\text{New Loop} = \text{infinity} \\
\text{New Loop and New Feeder Cable} = \text{infinity}
\]

C. PEDESTRIAN PUSH BUTTONS

The pedestrian push button assembly will be furnished to the Contractor by Traffic Engineering. Each pedestrian push button shall consist of push button assembly, instruction sign, frame, instruction sign screws and shims that shall only be used on the smaller poles to stabilize the Pedestrian Push Buttons. The shims shall not be used if they cause any separation from the pole to the Pedestrian Push Button.
24.10 DETECTORS (Continued)

C. PEDESTRIAN PUSH BUTTONS (Continued)

Pedestrian push buttons shall be mounted on the correct pole face as shown on the plans, 3'-6" above the adjacent walk surface, taking care to place so that the flat side of pole is flush with the Pedestrian Push Button. The Contractor shall supply brass mounting screws for mounting the assembly to the pole. The pole shaft wire entrance shall be a 7/8" diameter deburred hole. When 2 push buttons are on the same pole shaft, the common (white) cables are spliced in the hand hole or base, not jumpered together at the push buttons.

D. CAMERA DETECTOR

Camera Detector shall be installed on the mast arm at the location shown on the plans. The attachment to the arm shall be by use of the clamp kit, as specified in these Standard Specifications. The Contractor shall aim and adjust the camera under the supervision of Traffic Engineering. The pole mast arm wire entrance shall be a 1" diameter deburred hole with a 1" inside diameter rubber grommet.

E. NON-INTRUSIVE DETECTOR

Non-Intrusive Detector shall be installed at locations shown on the plans. The mounting bracket for the detector shall be furnished by Traffic Engineering. The Contractor shall aim and adjust the detector in coordination with Traffic Engineering personnel. The pole wire entrance shall be a 1" diameter deburred hole with a 1" inside diameter rubber grommet. Changes in mounting or adjustment to locations shall be approved by Traffic Engineering.

F. EMERGENCY DETECTOR

The Emergency Detector shall be installed on the mast arm at the location as shown on the plans. The attachment to the arm shall be by use of the clamp kit furnished by Traffic Engineering. The pole mast arm wire entrance shall be a 1" diameter deburred hole with a 1" inside diameter rubber grommet.

G. BASIS OF PAYMENT

DETECTOR, LOOP, PREFORMED UNDER STREET; DETECTOR, LOOP, SAWED UNDER OVERLAY; DETECTOR, INSTALL NON-INTRUSIVE; DETECTOR, INSTALL PEDESTRIAN PUSH BUTTON; DETECTOR, INSTALL CAMERA; and DETECTOR, INSTALL EMERGENCY, complete, in place, tested, and accepted by Traffic Engineering, shall be measured for payment as single units and shall be paid for at the contract unit price bid per each for the item.

This price and payment shall be full compensation for the furnishing and installing the Preformed Under Street Loop Detector and for furnishing and installing Sawed Under Overlay Loop Detector, including epoxy, and sawing, and for installing furnished Pedestrian Push Buttons with Contractor supplied mounting screws, Camera Detectors, Non-Intrusive Detectors, and Emergency Detectors with Emergency Detector Clamp Kit, clamp kits not included, pull-box, conduit as specified, loop wire, and for all labor, equipment, tools, testing, materials, and incidentals required to complete the Work.

In the event a Preformed Under Street Loop Detector does not meet requirements or was not placed as per plan, the Contractor shall remove the street to the nearest joint, place a new Preformed Under Street Loop Detector as per plan and replace street, all at Contractors expense.
24.11 CABINETS

A. GENERAL

This section refers to pole and pad mount Cabinets.

Upon completion of the Work, each cabinet shall be properly placed, mounted, wired, and connected to operate as per Traffic Engineering.

Unless otherwise noted, the cabinet, auxiliary equipment, and mounting hardware will be furnished to the Contractor by the City, ready for installation by the Contractor.

B. INSTALLATION

The Contractor shall mount or place each cabinet, base, and concrete pad as shown on the plans in conformance with the LSPs. Pad mounted cabinets shall have a 4'-2" x 4' x 4" concrete pad in front of the main door. If stated on the plans the cabinet shall also have a 4'-2" x 4' x 4" concrete pad on the opposite side of the main door. The Cabinet pad/s shall be level in both directions.

The Contractor shall connect all conductors for signal heads, detectors, grounds, Fiber Locate Cables, service cables, and fiber optics into the traffic signal cabinet. The Contractor shall connect the service cables and have the power panel energized.

All cables shall be routed to the cabinet and neatly trained to their destination in the cabinet utilizing industry standard Velcro ties, and shall be clearly identified using the labeling method as shown in 24.12.D.

The Contractor shall work closely with Traffic Engineering in scheduling cabinet installations so as to minimize intersection down time.

Pole mounted cabinets shall be mounted on the designated pole with the top at 7' above the ground.

C. BASIS OF PAYMENT

CABINET, INSTALL, ____, installed, connected, cables labeled, tested and accepted by Traffic Engineering, shall be measured as a single unit and shall be paid for at the contract unit price bid per each for the item. This price and payment shall be full compensation for picking up and installing the cabinet, concrete pad, base, all connections, epoxy coated reinforcing steel, concrete, ground rod and for all labor, equipment, tools, materials, excavation, and incidentals required to complete the Work.
24.12 CABLE

A. TYPES AND CLASSES OF CABLE

All classes of cable shall be on substantially constructed reels, plainly marked as to size, type, and insulation identification. Only 1 length of cable shall be shipped on each reel. All cable must be new. Damaged cable or repairs on damaged cable will not be permitted. All cables shall be stranded copper, unless otherwise noted.

1. Traffic Signal Cable

Traffic signal cable shall be IMSA Specification No. 19-1, No. 14 AWG.

2. Lead-In Cable

Lead-In Cable shall be IMSA Specification No. 50-2, No. 14 AWG.

3. Loop Detector Wire

Loop Detector wire shall be IMSA Specification No. 51-5, No. 14 AWG.

4. Service, Street Lighting, Circuit Grounding Cable and Pole Grounding Wire

The cable for underground circuits and pole grounding shall be single conductor, the size specified on the plans, type XLP USE-2, RHH/RHW-2 600 Volt, Copper Cable. UL 44 and UL 854, IEA S-95-658/NEMA WC-70, C (UL) US Federal spec. A-A-59544. Pole ground wire shall be bare No. 6 AWG solid copper.

5. Emergency Detector Cable

Emergency Detector Cable shall be a shielded 3/c. The conductors shall be 20 AWG 7/25 BC 600Vac insulated. The colors shall be blue, orange, and yellow. The outside jacket shall be UV stabilized black polyethylene jacket, and have a total nominal outside diameter of 0.51".

6. Ethernet Communications Cable

Ethernet Communications Cable shall be Cat 6 or Cat 5E CMXT, Direct Burial, LSZH jacket, Shielded, w/Drain Wire, Waterproof Tape, 8-Conductor, Outdoor Jacket, 24AWG, Solid-Bare Copper and include connectors on each end of the cable.

7. RRFB Cable

RRFB Cable shall be IMSA Specification No. 19-1, 4 Conductor No. 18 AWG.

B. INSTALLATION

The installation of power cables shall, in general, conform to the NESC insofar as it applies, subject to the conditions and instruction of Traffic Engineering.

1. In Conduit

Prior to installation of underground cable, the Contractor shall insure that the conduit is open, continuous, free of water, and clear of debris.
24.12 CABLE (Continued)

B. INSTALLATION (Continued)

The cable shall be installed in such a manner and by such methods ensuring against harmful stretching of the conductor, injury to the insulation, or damage to the outer protective covering of the cable. An approved cable lubricant may be used to aid in pulling through conduit, when necessary.

Where more than 1 cable is to be installed in the conduit, all shall be pulled at the same time. 2' of extra cable shall be left on each lead extending beyond the hand hole in the base of all poles, above the top of all pull boxes, power pedestals, and each side of any splice. 6' of extra cable shall be left in the cabinet.

Under no circumstance will any cable be taped to another cable.

2. Pole Cable

The jacket of all pole shaft cables shall extend through the pole.

3. Direct Buried

Direct buried cable shall be installed in place with an approved cable plow at a depth of 30". In areas where trenching or plowing may damage utilities or the health of mature plants, the boring procedure shall be required.

C. SPLICES AND CONNECTIONS

No splices or joints will be permitted to be drawn inside the conduit, nor shall any splices or joints be made in any cable outside of pull boxes, pole bases or traffic signal heads.

Splices are not allowed in City furnished cable, Lead In Cable, Service Cable, Emergency Detector Cable, RRFB Cable and Ethernet Communications Cable. The only splice allowed in Traffic Signal Cable to heads or push buttons is at the pole hand hole. Street Lighting Cable and Circuit Grounding Cable shall be spliced only when a change in size or split of cables is shown on the plans.

Any cable end unused in a pull box shall be weather proofed with shrink tube or approved sealant, not tape.

All Traffic Signal splices and Street light splices below grade shall be made for continuous immersion in water.

Cable connections in signal heads or controller cabinets shall be made at the terminal boards provided for this purpose. All stranded wires inserted under a binder head screw shall be equipped with a solderless pressure-type spade connector with a pre-insulated shank. A crimping tool for insulated connectors shall be used. No bare wire or bare stud shall be exposed.

Service connections to the Cabinet shall be continuous from the power source.

All direct buried street lighting cable splices shall be inspected by LES before backfilling.
24.12 CABLE (Continued)

C. SPLICES AND CONNECTIONS (Continued)

1. Heat Shrink Splices

This splice shall be used to connect Traffic Signal Conductors in poles and Loop Detector splices in pull boxes. This splice shall be mechanically and electrically sound with bronze compression sleeve connection encapsulated in a permanent seal, waterproofing and insulating the electrical connection.

Wire ends must be thoroughly cleaned after the insulation is stripped off to ensure complete contact with another wire or the connector. If strands are damaged when the insulation is removed, the section of cable must be discarded. Nicked or damaged conductor strands will not be permitted inside of connectors. Loose wire ends shall not be used as “shims” to make a connection.

All connectors shall be designed for copper to copper connections. Only new connectors may be used. Connectors for compression sleeve splicing shall be of a type that when installed, the heat shrink products with proper mechanical and electrical properties may be utilized for all in-line splices of traffic signal control cable, loop feeder cable, traffic signal power supply cable, and other such applications.

The black heat shrink tubing shall be made of “thermally stabilized modified polyolefins” capable of minimum continuous use of 10,000 hours over an operating temperature range of -65° to +130° F.

The tubing shall be industry standard “thick wall type”, and shall have the ability to conform to severe configuration changes without splitting. It shall have a 3:1 shrink ratio.

The tubing shall be supplied with a factory applied sealant. When heat is applied, the sealant inside the product softens and flows around and over any irregularly-shaped configurations, filling voids and completely water sealing. The sealant shall remain in a semi-flexible state, assuring a complete moisture seal.

Heat sources for the shrinking process can be an electric heat gun or propane/butane gas torch capable of delivering at least 250° F. Scorched or burned splice components and/or sheathing will not be accepted.

2. Block Connectors

Street Light connectors to be used in poles shall be an approved 3- or 4-hole encapsulated connector.

3. Waterproof Block Connectors

This splice shall consist of a mechanically and electrically sound block connector encapsulated in a permanent gel capsule, waterproofing and insulating the electrical connection.

Splice connectors shall be an approved connector for use in a pull box. This connector shall be used only to connect tap wires to service cable, circuit ground and “in run” street light cables. Connectors shall be sized for the appropriate wire size and number of branch circuits.
C. SPLICES AND CONNECTIONS (Continued)

4. Direct Buried Splice

This splice shall consist of a mechanically and electrically sound compression sleeve encapsulated in an inline splice kit, waterproofing and insulating the electrical connection.

Splice the cable with a compression sleeve and wrap with an approved gel wrap for use in direct buried and secure with tie. This connector shall be used only to connect tap wires to service cable, circuit ground and “in run” street light cables.

5. Secondary Fuses and Fuse Holders

Secondary fuses for single luminaire circuits or in street light poles shall be an approved type KTK, 10 ampere. Secondary fuses for multiple luminaire circuits shall be an approved type KTK, 30 ampere. Fuse holders shall be an approved type HEB.

D. LABELING

Cables shall be identified by several wraps of colored tape at all access points. An approved colored tape shall be non-fading. Color code as follows:

<table>
<thead>
<tr>
<th>Cable Type</th>
<th>Color Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circuit Ground Cable</td>
<td>Green</td>
</tr>
<tr>
<td>Traffic Service Cable</td>
<td>Yellow White</td>
</tr>
<tr>
<td></td>
<td>Yellow Blue</td>
</tr>
<tr>
<td>Street Light Cable</td>
<td>Red White</td>
</tr>
<tr>
<td></td>
<td>Red Blue</td>
</tr>
<tr>
<td></td>
<td>Red Blue Blue</td>
</tr>
<tr>
<td>Festoon Cable</td>
<td>Violet White</td>
</tr>
<tr>
<td></td>
<td>Violet Blue</td>
</tr>
<tr>
<td></td>
<td>Violet Blue Blue</td>
</tr>
<tr>
<td>Metered Cable</td>
<td>Orange White</td>
</tr>
<tr>
<td></td>
<td>Orange Blue</td>
</tr>
<tr>
<td></td>
<td>Orange Blue Blue</td>
</tr>
<tr>
<td></td>
<td>Orange Blue Blue</td>
</tr>
</tbody>
</table>

All other cables shall be identified with easy to read, good quality outdoor cable labeler.

Lead-In Cables shall be identified with phase and amplifier designation, both in the cabinet and the pull box where the loop detector is spliced. Traffic signal cables, push button cables, Ethernet Communication Cables, emergency detector cables shall be identified in the cabinet with the corresponding pole number using just the last digit (i.e. “POLE 1”). Communication cable and Fiber Locate Cable shall be identified in the cabinet with the direction of cable from the cabinet (i.e. “FIBER EAST”).
D. LABELING (Continued)

Since Fiber Locate Cable is so thin, labeling tape shall be placed on wire perpendicular to the wire like a flag.

E. BASIS OF PAYMENT

CABLE, _____ complete, in place and accepted by Traffic Engineering shall be measured as lineal feet from and to centers of pull boxes, cabinets, and poles, of such material of the size and type required and number of fibers or conductors. Cable shall be paid for at the contract unit price bid per linear feet.

This price and payment shall be full compensation for furnishing and installing cable, all necessary slack, testing, documentation, splices, connections, cable labeling, fuses and fuse holders, and all other materials, hardware, labor, equipment, tools, and incidentals necessary to complete the work.

Cable inside loops, foundations, poles, pull boxes, cabinets, and other such devices or structures shall be subsidiary to those items and shall not be measured for payment.

CABLE, INSTALL complete, in place and accepted by Traffic Engineering shall be measured as lineal feet from and to centers of pull boxes, foundations, cabinets, and poles, of such size and type of material furnished by Traffic Engineering. Cable shall be paid for at the contract unit price bid per linear feet.

This price and payment shall be full compensation for installing cable, all necessary slack, testing, documentation, splices, connections, cable labeling, and all other materials, hardware, labor, equipment, tools, and incidentals necessary to complete the work.

Cable inside loops, foundations, poles, pull boxes, cabinets, and other such devices or structures shall be subsidiary to those items and shall not be measured for payment.
24.13 SIGNAL HEADS AND OVERHEAD SIGNS

A. GENERAL

Signal heads and street name Overhead Signs are furnished to the Contractor by the City, ready for installation by the Contractor. The Contractor shall furnish the directional Overhead Sign for installation by the Contractor. The Contractor shall furnish mast arm clamp kit, shaft clamp kit, and down nipple extensions.

Overhead signs are furnished by the Contractor or furnished to the Contractor by the City, ready for installation by the Contractor. The Contractor shall furnish the mast arm clamp kit, shaft clamp kit, and down nipple extensions.

Traffic signal head adjustments shall be accomplished by adjusting the clamp kit and the connection from the signal head arm to the Head or Sign. The set screws in the aluminum pipe shall never be adjusted.

The clamp kit shall be high tensile aluminum alloy with a high strength galvanized aircraft cable and stainless-steel swaged fittings. The Contractor shall take care in selecting the length of cable required. If there is cable remaining, the Contractor shall tie wrap the excess in a tight coil.

The clamp kit shall have 2 sides with 1 1/2” IPS (iron pipe size) signal hardware on one side, and shall be adjustable on the other side to fit the traffic signal pole shaft or mast arm. The clamp kit shall attach to the pole shaft or mast arm by use of an adjustable stainless-steel cable and be able to rotate from horizontal to vertical in order to make the signal heads plumb or level. Installation shall be as per manufacturer’s instructions.

B. INSTALLATION

Traffic Signal Heads, Pedestrian Signal Heads, Rectangular Rapid Flashing Beacons, Overhead Signs, and advanced flashers shall be installed as shown in the plans to the approval of Traffic Engineering. Each signal assembly shall be erected so that it is plumb, securely attached with all fittings tight, and present a neat appearance. Traffic signal heads shall be installed in line and all the same relative heights above the crown of the street. Pedestrian Signal Heads shall be aimed at the center of the appropriate ramp for which a person would wait for walk indication.

The pole shaft wire entrances for the Pedestrian Push Buttons and Pedestrian Signal Heads shall be a 7/8” diameter deburred hole with none of the hole exposed outside of the Pedestrian Signal Head. The pole shaft wire entrances for the Traffic Signal Heads shall be a 1” diameter deburred hole with a 1” inside diameter rubber grommet. The pole mast arm wire entrances for the Traffic Signal Heads shall be a 1” diameter deburred hole with a 1” inside diameter rubber grommet.

The pole shaft wire entrance for the cable to the arm shall be a 1 1/2” diameter deburred hole with a 1 1/2” inside diameter rubber grommet.

Down nipple extension 1 1/2” in diameter, and of appropriate length, shall be furnished and installed by the Contractor so that all signals on the span will hang at the same elevation as illustrated on the LSPs.
24.13 SIGNAL HEADS AND OVERHEAD SIGNS (Continued)

B. INSTALLATION (Continued)

If, after the signal assemblies are erected and the street is open to public travel, the signal is not put immediately into operation, the signal faces shall be covered securely with signal covers specifically designed for all signal heads. Burlap, cardboard, or plastic ‘trash style’ bags shall not be accepted. All signal covers shall be approved by Traffic Engineering prior to use. No inoperative signals on a street which is open to the public shall be left uncovered under any circumstances. Traffic Signal Heads shall stay covered until the signal is ready to be placed in flash operation. Pedestrian Signal Heads shall stay covered until the signal is ready to be placed in full operation.

C. BASIS OF PAYMENT

HEAD, INSTALL TRAFFIC SIGNAL, _____ SECTION, complete, in place and accepted by Traffic Engineering, shall be measured for payment as single units and shall be paid for at the contract unit price bid per each for the item. This price and payment shall be full compensation for picking up and installing the signal head and assembly (pipe and brackets), for furnishing and installing clamp kits, nipples, banding, pipe fittings, for all pole and mast arm modifications; and for all labor, equipment, tools, materials, and incidentals necessary to complete the Work.

SIGN, INSTALL OVERHEAD, complete, in place and accepted by Traffic Engineering, shall be measured for payment as single units and shall be paid for at the contract unit price bid per each for the item. This price and payment shall be full compensation for picking up and installing the street name Overhead Sign and assembly (pipe and brackets) provided by City or installing the directional Overhead Sign provided by Contractor and assembly (pipe and brackets), clamp kits, nipples, banding, pipe fittings, for all pole and mast arm modifications; and for all labor, equipment, tools, materials, and incidentals necessary to complete the Work.

SIGN, INSTALL OVERHEAD; ADVANCED FLASHER ON MAST ARM, INSTALL; ADVANCED FLASHER ON SHAFT, INSTALL; INSTALL SPEED INDICATOR ON SHAFT and RECTANGULAR RAPID FLASHING BEACON, INSTALL complete, in place and accepted by Traffic Engineering, shall be measured for payment as single units and shall be paid for at the contract unit price bid per each for the item. This price and payment shall be full compensation for picking up or furnishing and installing the Overhead Sign, and assembly (pipe and brackets), picking up and installing Advanced Flasher on Mast Arm and assembly (pipe and brackets), picking up and installing Advanced Flasher on Shaft and assembly (pipe and brackets), picking up and installing Speed Indicator on Shaft, and assembly (pipe and brackets), for furnishing and installing clamp kits, nipples, banding, pipe fittings, for all pole and mast arm modifications; and for all labor, equipment, tools, materials, and incidentals necessary to complete the Work.

The furnishing, installing, maintaining and removal of any temporary covering for the signals during construction is considered subsidiary to the installation of the head. Such coverings remain the property of the Contractor after removal. All mounting hardware shall be considered subsidiary to the installation of the signal heads.
24.14 STREET LIGHTING AND LUMINAIRES

A. GENERAL

The luminaire and components shall have been designed for street lighting and shall conform to all the applicable requirements of the National Electrical Safety Code.

B. MATERIAL AND DESIGN

1. General

The street luminaires shall be similar in appearance to the ‘cobra head’ type luminaire. The following Standard Specification detail the mechanical, electrical, and optical properties required for each style of luminaire.

All parts, exterior and interior, when in contact with one another shall have a potential difference no greater than 0.25 volts in order to prevent corrosion due to electrochemical reaction.

Non-aluminum metal parts shall also be treated with corrosion resistant finish.

The external finish of the luminaire shall be gray and shall be of such quality that it will not, under normal environmental conditions, blister, crack, fade, or peel for the functional life of the luminaire.

The finish shall not have runs, streaks or foreign materials on the surface and have been evenly and thoroughly applied.

2. Luminaire Housing Assembly

The luminaire housing shell shall be constructed from pressure die cast aluminum. There shall be no rough or jagged edges protruding in either the interior or on the exterior body or edges of the shell.

The luminaire shall be provided with a field identification marker on the lower external surface of the unit. The marker shall conform to the NEMA Standards for Field Identification of High-Intensity Discharge Lamps in Luminaires, Publication No. OD 150-1977.

The luminaire shall consist of 2 sections readily separable from one another. In general, this shall be an upper body and a lower body. All sections shall be well matched to one another and when fully assembled, the luminaire shall be solidly and tightly composed.

The lower body shall be hinge mounted to the upper body and when in the open positions shall allow access to the electrical and/or the optical compartments. The hinge shall be capable of retaining the lower body to the upper body unsupported under full ice load (1" on all horizontal properties) and wind loads with maximum gust velocity of 110 miles per hour.

The upper and lower bodies shall be locked in the closed position with a vibration proof latch which is readily accessible, designed to prevent accidental opening, and may be opened without the aid of tools.
24.14 STREET LIGHTING AND LUMINAIRES (Continued)

B. MATERIAL AND DESIGN (Continued)

2. Luminaire Housing Assembly (Continued)

The luminaire shall include an EEI-NEMA Standard 7-pin, twist lock type photo electrical control receptacle. The receptacle shall be an integral part of the luminaire and shall be gasketed.

All electrical components and connections shall have been pre-wired at the factory so the luminaire is ready for immediate installation.

3. Photometric Requirements

The luminaire shall have a ‘cut-off’ type light distribution characteristic as follows:

1) Vertical distribution: IES - Medium
2) Lateral distribution: IES - M.C. III as required on the plans
3) Control of the candlepower distribution: Maximum candlepower shall fall between 66°-75° (degrees projected angles above nadir).

4. Electronic Photoelectric Controls

a. General
All controls must meet or exceed ANSI C136.10 - 1988.

b. Electrical Rating
1) Line Voltage Operating Range 105-305 VAC 60 HZ (240 Volt)
2) Load Rating 1000 Watt
1800 VA Ballast
3) Contact Rated Life 15,000 Operations Minimum
4) Contact Chatter on Opening Less than 5 milliseconds
5) Dielectric Strength 5000V Between Current Carrying Parts & Metal Mounted Surfaces
6) Photocontrol Power Consumption 1.5 Watts Maximum

c. Time Delay & Failure Mode
1) On Delay None
2) Off Delay 2-4 Seconds
3) Failure Mode Fail On

d. Photosensor & Level Setting
1) Type Sealed Cadmium Sulphide or Silicon
2) Turn On 1.5 +/- 0.3 Footcandles
3) Turn Off - Turn on Ratio 1.5:1

e. Surge Protection
1) Type Metal Oxide Varistor
2) Joules Rating 640 Minimum
B. MATERIAL AND DESIGN (Continued)

5. Electronic Photoelectric Controls (Continued)

f. Housing and Markings
   1) Color        Black
   2) Cover Material High Impact & UV Stabilized
   3) Base Material High Impact
   4) Housing Skirt Size 3" + 1/8" Diameter
   5) Base Markings and Provisions Year & Month of Manufacture, Provisions
   6) Cover Markings Manufacturer’s Logo & Year of Manufacture
   7) Cover/Base/Receptacle Seal Cross-Linked Polyethylene Gasket
   8) Plug Blades Brass, 3 Blade NEMA Twist Lock
   9) Cover Window Clear, UV Stabilized & Sealed

g. Quality Control & Calibration
   1) Production Calibration - 100%
   2) Inspection After Final Assembly - 100%

h. Other Type Tests
   1) Ambient Temperature Range - -40º C to +65º C
   2) Moisture Resistance - 98%
   3) Drop Test       Drop of 3 ft. to Concrete Floor Without Damage to Housing or Electrical Operation

i. Warranty
   1) Length        12 Years Minimum
   2) Replacement    One for One

Contact Lincoln Electric System for current list of approved vendors.

j. Circuit Board       Silicone Coated

C. LED STREET LUMINAIRE SPECIFICATIONS


Luminaires shall be of uniform quality and appearance. Manufacturers of LED luminaires shall provide a report or certification from a testing laboratory detailing a suitable testing program incorporating high heat, water, and thermal shock test regimens to ensure system reliability and to substantiate lifetime claims. The use of IESNA LM-80 data to predict luminaire lifetime is not accepted. At time of manufacture, each luminaire shall be tested for functionality and shall utilize a unique serial numbering scheme.
24.14 STREET LIGHTING AND LUMINAIRE SPECIFICATIONS (Continued)

C. LED STREET LUMINAIRE SPECIFICATIONS (Continued)

Each luminaire shall utilize a unique serial numbering scheme. Luminaires shall be provided with a minimum of 10-year warranty against manufacturing defects covering LEDs, dimmable drivers, surge protectors, photo control receptacles, and mechanical components. Warranty period shall begin at date of delivery.

If a manufacturer other than the approved vendors is to be considered, they must conform to LES Specifications. Submittals shall include luminaire cut sheets, cut sheets for LED light sources; cut sheets for LED dimmable driver(s); diagrams illustrating light output and input power as a function of control for dimmable LED driver; cut sheets for surge protection device; instructions for installation and maintenance; summary of luminaire recyclability per the FTC Green Guides, expressed by percentage of luminaire weight; description of luminaire, LED light sources(s) and LED dimmable driver(s)and manufacturer shall supply part number for light bars, drivers, and surge protectors of the luminaires supplied. Calculations and supporting test data indicating a lumen maintenance life of not less than 100,000 operating hours. Lumen depreciation curve for each driver. A completed Appendix B for each Appendix A. If proposed luminaires are on the LES Standards Approved List, only the catalog cut of the luminaire with catalog number must be submitted.

Each luminaire shall consist of an assembly that utilizes LEDs as the light source. In addition, a complete luminaire shall consist of housing, LED array, 7-pin photo receptacle, terminal block, surge protector, and electronic dimmable driver (power supply).

Each luminaire shall be rated for a minimum operational life of 100,000 hours at an average operating time of 11.5 hours per night. This life rating must be conducted at 25° C ambient temperature. The rated operating temperature range shall be -30° C to +40° C. Each luminaire must be capable of operating above 100° F (37° C), but not expected to comply with photometric requirements at elevated temperatures.

Photometry must be compliant with IESNA LM-79 and shall be conducted at 25° C ambient temperature.

The LED array should be constructed such that each individual LED has a dedicated lens assembly. Chip on Board (i.e. multiple LED’s clustered under a single lens assembly) shall not be permitted, except for high mast applications. A catastrophic failure of one LED shall not result in the loss of the entire luminaire or more than a 10% total reduction in illuminance.

Each luminaire shall be listed with Underwriters Laboratory, Inc. under UL1598 for luminaires.

Luminaires must have an external label per ANSI C136.15 and an internal label per ANSI C136.22.

Electrically test fully assembled luminaires before shipment from factory.

Luminaires shall be designed for ease of component replacement and end-of-life disassembly. Manufacturer shall submit information regarding recycling and proper disposal of luminaire and all individual components as well as name and address of nearest recycling location for materials.

Painted or finished luminaire components exposed to the environment shall exceed a rating of six per ASTM D1654 after 1000 hours of testing per ASTM B117 and the coating shall exhibit no greater than 30% reduction of gloss per ASTM D523, after 500 hours of QUV testing at ASTM G154 Cycle 6.
C. LED STREET LUMINAIRE SPECIFICATIONS (Continued)

Mechanical design of protruding external surfaces (heat sink fins) shall facilitate hose-down cleaning and discourage debris accumulation.

Minimum color rendering index (CRI): 70. Correlated Color Temperature (CCT) shall conform to table below.

<table>
<thead>
<tr>
<th>Manufacturer-Rated Nominal CCT (K)</th>
<th>Allowable LM-79 Chromaticity Values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Measured CCT (K)</td>
</tr>
<tr>
<td>4000</td>
<td>3710 to 4260</td>
</tr>
</tbody>
</table>

All internal components shall be assembled and pre-wired using modular electrical components.

Luminaire shall have three-hole terminal blocks for incoming #10 AWG AC lines and a 7-pin photo control receptacle.

Access to internal components shall be latched and hinged in a manner to prevent accidental opening. Luminaire shall have ingress protection.

Maximum power consumption allowed for the luminaire shall be determined by application. The luminaire shall not consume power in the off state.

The luminaire shall operate from a 60 HZ AC line over a voltage ranging from 108 VAC to 305 VAC. The fluctuations of line voltage shall have no visible effect on the luminous output. The luminaire shall have a power factor of 0.90 or greater. Total harmonic distortion (current and voltage) induced into an AC power line by a luminaire shall not exceed 20 percent. The luminaire circuitry shall include fused surge protection devices (SPD) to withstand high repetition noise transients as a result of utility line switching, nearby lightning strikes, and other interference. The SPD shall protect the luminaire from damage and failure for common mode transient peak voltages up to 10kv (minimum) and transient peak currents up to 5ka (minimum). SPD shall conform to UL 1449. SPD performance shall be tested per the procedures in ANSI/IEEE C62.41-1992 (or current edition) for category C (standard). The SPD shall fail in such a way that the luminaire will no longer operate. The SPD shall be field replaceable.

Each luminaire shall have integral UL listed Class I power supplies.

The LED circuitry shall prevent visible flicker to the unaided eye over the voltage range specified above.

Dimmable LED drivers must meet Class A emission limits referred in Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise.

Dimmable drivers shall have a Class A sound rating.

LEDs shall be provided with optical elements to provide IESNA Type II, III, IV or V distributions. Optical assemblies shall have a minimum efficiency of 85% regardless of distribution type. For Type II and Type III distributions, street side efficiencies shall be a minimum of 70%. All LEDs and optical assemblies shall be mounted parallel to the street surface. All LEDs shall provide the same optical pattern such that catastrophic failures of individual LEDs will not constitute a loss in the distribution pattern.
24.14 STREET LIGHTING AND LUMINAIRES (Continued)

C. LED STREET LUMINAIRE SPECIFICATIONS (Continued)

The luminaire shall have a minimum B.U.G. rating of 3-0-4 or better.

The luminaire shall not allow more than 10% of the rated lumens to project above 80° nor 2.5% above 90° from vertical.

Thermal management shall be passive by design. The use of fans or other mechanical devices shall not be allowed. The luminaire shall have a minimum heat sink surface such that LED manufacturer’s maximum junction temperature is not exceeded at maximum rated ambient temperature. The heat sink shall be aluminum.

Luminaires shall be capable of withstanding cyclical loading in (G = Acceleration of Gravity) a minimum level of 3.0 G peak sinusoidal loading with the internal driver installed, for a minimum of 100,000 cycles without failure of any luminaire parts. Testing is to be performed in three planes: a horizontal plane parallel to the direction of mounting, a horizontal plane perpendicular to the direction of mounting, and the vertical plane.

The housing shall be designed to prevent the buildup of water on the top of the housing. Exposed heat sink fins shall be oriented so that water can run off the luminaire freely, and carry dust and other accumulated debris away from the unit.

The optical assembly of the luminaire shall be protected against dust and moisture intrusion per the requirements of IP-66 (minimum) to protect all optical components.

The electronics/power supply enclosure shall meet the requirements for NEMA/UL wet locations.

Housing shall be fabricated from materials that are designed to withstand a 3,000-hour salt spray test as specified in ASTM Designation B117.

Each refractor or lens shall be made from UV inhibited high impact plastic such as acrylic and be resistant to scratching.

Polymeric material of enclosures containing either the power supply or electronic components of the luminaire shall be made of UL94VI flame retardant materials. The lens of the luminaire is excluded from this requirement.

All electronics and materials shall be lead free.

Luminaire shall have tool less entry.

Manufacturer or local sales representative shall provide installation and troubleshooting support via telephone and/or email and supply onsite support when requested.

Manufacturers must be a street luminaire manufacturer and have a minimum of 5 years documented experience in LED street luminaire manufacture. References shall be provided upon request of at least 3 municipalities that currently have manufacturer’s fixtures installed and operating.

D. INSTALLATION

Unless otherwise indicated in the plans or directed by the City’s Project Manager, luminaires shall be installed level in both horizontal axes.
24.14 STREET LIGHTING AND LUMINAIRES (Continued)

D. INSTALLATION (Continued)

Each completed street light circuit shall have a 72 hour burn test prior to acceptance.

E. BASIS OF PAYMENT

LUMINAIRE, ____, complete, in place and accepted by the City’s Project Manager, shall be measured as single units and shall be paid for as at the contract unit price bid per each for the item. This price and payment shall be full compensation for furnishing and installing the Luminaires and for furnishing bulbs, labor, equipment, tools, materials, and incidentals necessary to complete the Work.

24.15 CONCRETE POLES

A. GENERAL

Concrete Pole Standard Specifications are found on LSP 94.

B. INSTALLATION

Concrete Poles are to be installed at the locations shown on the plans, unless otherwise approved by Traffic Engineering. Poles shall be placed such that modifications and/or attachments are carefully oriented, as indicated on the plans.

The Concrete Pole hand hole shall be located on the side opposite the street.

Concrete Pole must be erected so that they are plumb with their entire load in place.

Poles shall be set to a depth and backfilled as per LSP 94. No frozen earth shall be used in tamping holes.

The excavation for Concrete Pole shall be 36" in diameter and extend 6" below the butt of the pole. The Concrete Pole shall rest level and firmly on an aggregate base and be backfilled 42" from bottom of excavation with aggregate material. Aggregate material shall satisfy all of the requirements of coarse aggregate as described in Chapter 3 of the City of Lincoln Specifications.

The remaining excavation shall be backfilled with soil that satisfies City of Lincoln Specifications for backfill material and shall be tamped every 4".

The Contractor shall notify Traffic Engineering of any damaged poles or surfaces before they pick up poles from pole storage site. The Concrete Pole shall be lifted and supported during transportation and erection operations as per Concrete Pole manufacturer recommendations. Ensure that transportation, site handling, and erection are performed with acceptable equipment and methods, and by qualified personnel. All poles shall be clean after erection.

C. BASIS OF PAYMENT

POLE, INSTALL CONCRETE, DIRECT BURY complete, in place and accepted by the City’s Project Manager, shall be measured as a single unit and shall be paid for at the contract unit price per each for the item. This price shall be full compensation for the excavation required; pole installation; backfilling and backfill material; conduit long radius sweeps; for ground rod and ground wire connections; and for all labor, equipment, tools, materials, and incidentals necessary to complete the Work.
24.18 WOOD POLES

A. GENERAL

Wood poles shall be dense Southern Yellow Pine, and shall meet all ASA requirements for the length and class shown on the plans. Preparation of the timber for treatment, the method and result, shall conform to the requirements of “Standard Specifications for Pressure Treatment of Timber Products”, ASTM Designation D-1760. The finished poles shall be sufficiently dry on the surface so that no preservative will bleed out and drip off the poles.

Poles shall be approved by an independent commercial laboratory.

B. INSTALLATION

Poles shall be set to a depth of 10% of the pole length plus 24". When earth fill is specified, earth around the hole shall be tamped solid, and to the satisfaction of Traffic Engineering. No frozen earth shall be used in tamping holes. Holes shall be of sufficient size to permit tamping completely around the pole.

Fill, other than earth fill, shall be as specified in the Special Provisions.

Guy wires shall be of the same diameter and tensile strength as the messenger cable supporting attachment to which they are linked, and shall conform to the requirements of “Standard Specifications for Zinc-Coated Steel Wire Strand”, ASTM Designation A-475.

Ground anchors shall be power screw-type, having an 8" minimum diameter and using a 7' x 5/8" diameter rod to minimize soil disturbance, unless otherwise shown on the plans.

All ferrous metal line hardware items shall be galvanized and shall conform to the requirements of “Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware”, ASTM Designation A153.

Guy guard shall be high visibility plastic 8' in length.

Down guys shall not enter the ground less than 24" from the edge of the sidewalk unless otherwise shown on the plans.

C. BASIS OF PAYMENT

WOOD POLE, ____ complete, in place and accepted by Traffic Engineering, shall be measured as a single unit and shall be paid for at the contract unit price per each for the item. This price shall be full compensation for the excavation required; for furnishing and/or installing the wood pole; for concrete as required, pole hardware, cable, conductors, span wire, tie wire, down guy, overhead guy; for ground rod and ground wire connections; and for all labor, equipment, tools, materials, and incidentals necessary to complete the Work.