

SECTION 209 - STREET LIGHTING AND TRAFFIC SIGNAL MATERIALS

209-1 GENERAL. The following material specifications set forth the requirements for components installed in conjunction with the construction of street lighting and traffic signal systems.

Manufacturer's warranties, guaranties, instruction sheets and parts lists supplied for materials used in the Work shall be submitted to the Engineer in accordance with 2-5.3.

209-2 REFERENCE SPECIFICATIONS. In addition to the requirements of the Plans, Specifications, and Special Provisions all components shall conform, where applicable, to the ~~current regulation and codes~~ following:

- a) NEMA
- b) UL
- c) EIA
- d) REA
- e) Aluminum Association Publication 30
- f) ANSI
- g) AASHTO "Standard Specification for Structural Support for Highway Signs, Luminaires and Traffic Signals"
- h) ETL
- i) IEEE
- j) IMSA
- k) MIL SPEC
- l) AWS D1.1 "Structural Welding Code"
- m) FCC
- n) California Administrative Code, Title 8, Chapter 4, Subchapter 5
- o) NEC

209-4 ~~MATERIALS FOR STREET LIGHTING SYSTEMS~~ MATERIALS.

209-4.6 High Pressure Sodium Lamps. High pressure sodium lamps shall conform to ANSI Standard C 78 "Lamp Specifications, Physical and Electrical Characteristics of High-Intensity Discharge Lamps" when tested in conformance with the requirements in ANSI Standard C78-388, "Methods of Measurement of High Pressure Sodium Lamp Characteristics." High-pressure sodium lamps shall have a minimum average rated life of 24,000 hours.

209-4.6.1 Lamp Size Identification Targets. Targets shall be:

- a) Constructed of noncorrosive material that will provide a durable and legible surface that is designed to endure for the life of the luminaire,
- b) have a stable color background and black block numerals,

- c) be 3 inches (75 mm) square, and
- d) have the identification numbers and background color shown in Table 209-4.6.1(A) and Table 209-4.6.1(B) respectively. The identifying numerals shall be 2 inches (50 mm) high, minimum, and have a stroke width of 1/4 inch (6mm).

TABLE NO. 209-4.6.1(A)

<u>Identifying Numeral</u>	<u>Lamp Wattage</u>
<u>1</u>	<u>18</u>
<u>3</u>	<u>35</u>
<u>5</u>	<u>50 or 55</u>
<u>7</u>	<u>70</u>
<u>9</u>	<u>90</u>
<u>10</u>	<u>100</u>
<u>13</u>	<u>135</u>
<u>15</u>	<u>150 – 55V</u>
<u>15H</u>	<u>150 – 100V</u>
<u>17</u>	<u>175</u>
<u>17B</u>	<u>175 Position Oriented</u>
<u>18</u>	<u>180</u>
<u>20</u>	<u>200</u>
<u>21</u>	<u>215</u>
<u>25</u>	<u>250</u>
<u>25B</u>	<u>250 Position Oriented</u>
<u>30</u>	<u>300</u>
<u>31</u>	<u>310</u>
<u>36</u>	<u>360</u>
<u>40</u>	<u>400</u>
<u>40B</u>	<u>400 Position Oriented</u>
<u>70</u>	<u>700</u>
<u>XI</u>	<u>1000</u>

TABLE NO. 209-4.6.1(B)

<u>Background Color</u>	<u>Lamp Type</u>
<u>GOLD</u>	<u>High Pressure Sodium</u>
<u>GREEN</u>	<u>High Pressure Sodium/Mercury Ballast</u>
<u>LIGHT BLUE</u>	<u>Mercury</u>
<u>RED</u>	<u>Metal Halide</u>

<u>Background Color</u>	<u>Lamp Type</u>
<u>PURPLE</u>	<u>Incandescent</u>
<u>AQUA</u>	<u>Fluorescent</u>

209-5 MATERIALS FOR TRAFFIC SIGNALS MATERIALS.

SECTION 307 - STREET LIGHTING AND TRAFFIC SIGNALS CONSTRUCTION SYSTEMS

~~307 CROSS REFERENCES~~

Electrical Components	209
Paint and Protective Coatings	210
Galvanizing	210-3
Removal and Disposal of Materials	300-1.3
Concrete Curbs, Walks, Gutters, Cross Gutters, Alley Intersections, Access Ramps, and Driveway	303-5

307-1 GENERAL.

~~307-1.1 Description.~~ The Work ~~work~~ shall consist of furnishing and installing, modifying, or removing one or more street lighting and/or traffic signal electrical systems, ~~all~~ as shown on the Plans and specified in the Specifications. The Work shall conform to the following codes:

- a) California Administrative Code, Title 8, Chapter 4, Subchapter 5, and
- b) NEC.

~~All materials furnished and used shall be new, except materials specified to be reused.~~

~~All incidental~~ Incidental parts ~~which that~~ are not shown on the Plans or specified in the Specifications and ~~which that~~ are necessary to complete ~~or modify the existing systems~~ Work, shall be furnished and installed as though such parts were shown on the Plans or specified in the Specifications. ~~All systems shall be in satisfactory operations at the time of completion of the Work.~~

~~307-1.2 Regulations and Codes.~~ ~~All work shall be performed in accordance with the regulations and codes listed in 209-1.~~

~~307-1.3~~ 307-1.1 Equipment List and Drawings. Unless otherwise approved ~~authorized in writing~~ by the Engineer, the Contractor shall, ~~within 10 days following execution of the Contract,~~ submit ~~to the Engineer for approval,~~ a list of equipment and materials ~~that it proposes to be installed~~ install in accordance with 2-5.3. The list shall ~~be complete as to~~ include the name of the manufacturer, size, and identifying number of each item. In addition, the Contractor shall, in accordance with 2-5.3, submit detailed drawings and wiring diagrams for all the electrical equipment to be used. ~~The Agency will not be liable for any material purchased, labor performed, or delay to the Work prior to review of documents required above.~~

If requested ~~ordered~~ by the Engineer, the Contractor shall submit for review ~~sample~~ samples ~~articles~~ of the material proposed for use. After review, ~~said sample~~ the samples ~~articles~~ will be returned to the Contractor.

Upon completion of the Work, the Contractor shall submit one complete set of ~~corrected~~ “as-built” Plans showing in detail all construction changes.

307-1.1.1 Payment. Payment for furnishing the list of equipment and materials, material samples and corrected Plans shall be considered as included in the Contract Unit Price or lump sum price in the Bid for the equipment and material required to make the street lighting or traffic signal system fully operational.

~~**307-1.4 Warranties, Guaranties, and Instruction Sheets.** Manufacturer's warranties and guaranties furnished for materials used in the Work and instruction sheets and parts lists supplied with materials shall be delivered to the Engineer prior to acceptance of the Work. The duration of the warranty or guaranty shall be the standard of the industry with a minimum of 1 year from the date of acceptance of the Work.~~

~~**307-1.5 307-2 Maintenance of Existing Systems**~~ **MAINTENANCE OF EXISTING AND TEMPORARY SYSTEMS.**

~~The Contractor, during the progress of the Work, shall maintain existing or temporary street lighting and traffic signal electrical systems or temporary replacements thereof, in effective operation.~~

307-3 COORDINATION WITH SERVING UTILITY.

307-3.1 General. Safety clearances between new or existing Standards (including luminaires, arms or signal heads) and overhead power and communication lines shall conform to the State of California Industrial Safety Orders, General Order 95. Construction in close proximity to high-voltage overhead lines shall be performed in accordance with the California Code of Regulations, Title 8 and the latest revision of Article 86, State of California High Voltage Electric Safety Orders. The Contractor shall inspect the location of each Standard for safety clearance requirements and notify the Engineer and the serving utility, in writing, of the locations where safety clearances are required. The Contractor shall be responsible for the necessary coordination with the serving utility.

The Contractor shall take the serving utility's schedule into account in preparing the construction schedule. Requests for safety clearances shall be made at least 21 days in advance of the date the Contractor will be working at each location requiring a safety clearance by the serving utility. If required, the Contractor shall make the necessary arrangements with the serving utility to raise their overhead facilities in order to provide for required clearances.

Coordination with the serving utility shall be shown as individual activities on the construction schedule specified in 6-1.

307-3.2 Payment. Payment for coordinating with the serving utility and temporary relocation of power and communication lines shall be considered as included in the Contract Unit Price or lump sum price in the Bid for the equipment and material required to make the systems fully operational.

307-4 DAMAGED EXISTING OR MODIFIED SYSTEMS.

307-4.1 General. Should any damage to an existing or modified system occur, the Contractor shall immediately notify the Engineer and arrange for the immediate repair and restoration of service. The Contractor shall commence repairs or replacements within 24 hours of damaging the system or receiving approval of the equipment and materials by the Agency, whichever takes longer. A licensed electrical contractor shall make all temporary or permanent repairs. Electrical safety clearance shall be obtained

~~from the serving utility before performing any work on existing energized circuits. Equipment and materials used for repairs shall conform to 209 and be approved by the Agency. The Contractor shall notify the Engineer at least 2 working days prior to performing work on existing systems. Should any damage to an existing system occur, the Contractor shall immediately notify the Engineer. The Contractor shall arrange for the immediate repair and restoration to service of the damaged lighting system at no additional cost to the Agency. Electrical safety clearance shall be obtained before performing any work on existing energized street lighting circuits. A licensed electrical contractor shall make all temporary or permanent repairs. All equipment and materials used for the repair be approved by the Agency. The Contractor shall perform the required repairs or replacements within 24 hours of damaging the system or receiving the approval of the equipment and materials by the Agency, whichever takes longer. If the repairs are not completed within this period the Agency will make the repairs or replacements and the cost thereof will be deducted from any monies due or that will become due the Contractor.~~

307-4.1.1 Traffic Detectors. ~~The Contractor shall replace and restore operation of any damaged detector (inductive loop, infrared or other) within 2 working days after the completion of construction on the portion of the roadway where the detectors were located.~~

~~Damaged inductive loops shall be replaced and reactivated within 7 calendar days of the construction of the surface course of asphalt concrete pavement, PCC pavement, or restoration of permanent pavement.~~

307-4.1.2 Payment for Damaged Existing or Modified Systems.

307-4.1.2.1 Street Lighting Systems. ~~If the repairs or replacements are not commenced within 24 hours of damaging the system or receiving approval of the equipment and materials, whichever comes last, the Agency may make the repairs or replacements and the cost thereof will be deducted from any monies due or that will become due the Contractor.~~

307-4.1.2.2 Traffic Signal Systems. ~~The cost of any immediate repairs, replacements, relocations or additional traffic controls that are required as a result of the Contractor's operations and that are performed by the Agency will be deducted from any monies due or that will become due to the Contractor.~~

307-4.1.2.3 Payment for Modifications Requested by the Contractor. ~~In cases where Modifications temporary removal or relocation of the to existing street lighting or traffic signal systems system or equipment, that are is not shown on the plans, and is requested by the Contractor shall it must be made in accordance with 3-1. Before the Contractor performs any work associated with the modifications, it shall submit a detailed plan showing all proposed modifications shall be submitted to the Engineer Agency for review and approval before performing any such work. This The plan shall show the changes modifications to be made. All such work shall be accomplished by a licensed electrical contractor at no additional cost to the Agency.~~

~~Temporary wiring described herein shall not apply to circuits exceeding 150 volts to ground.~~

~~Temporary wiring may be either overhead or underground conductors. All temporary overhead conductors shall be slack spanned with 6.1 m (20 foot) minimum overhead clearance across~~

~~thoroughfares and 3.7 m (12 foot) minimum clearance above sidewalk areas. No temporary conductor may run on top of the ground or across any sidewalk area unless adequately protected in an electrical raceway. Conductors less than 3.0 m (10 feet) above ground level must be protected in an electrical raceway. Overhead conductors shall be multi-conductor cable or single conductors, securely tied or taped at intervals not to exceed 1.5 m (5 feet). No spare conductors are required. All splices within 3.0 m (10 feet) above ground level shall be enclosed in metal junction boxes. Splices made at ground level shall be enclosed in pull boxes.~~

307-5 TEMPORARY STREET LIGHTING AND TRAFFIC SIGNAL SYSTEMS.

307-5.1 General. The Contractor shall provide temporary street lighting and/or traffic signal systems whenever the existing systems are removed or relocated. Temporary systems shall be in operation prior to the removal or relocation of the existing systems. Temporary street lighting systems shall provide an average illumination and uniformity ratio (avg./min.) that matches or exceeds the existing lighting levels utilizing standard roadway lighting optics. The Contractor shall submit working drawings in accordance with 2-5.3. Construction of the temporary systems shall be shown as an individual activity on the construction schedule specified in 6-1.

Should any damage occur to a temporary system, the Contractor shall immediately notify and arrange for repair and restoration of service in accordance with 307-4.

307-5.2 Temporary Wiring. Temporary wiring specified herein shall not apply to circuits exceeding 150 volts to ground. Temporary wiring for circuits exceeding 150 volts to ground shall be as specified in the Special Provisions.

Temporary wiring may utilize either overhead or underground conductors. Temporary overhead traffic circuit runs shall be 28-conductor cable (except service wire).

Temporary overhead conductors shall be slack-spanned with 20-foot (6 m) minimum overhead clearance above thoroughfares and 12-foot (4 m) minimum clearance above sidewalk areas. Temporary conductors may not run on top of the ground or across any sidewalk area unless adequately protected in an electrical conduit. Temporary conductors less than 10 feet (3 m) above ground level must be protected in an electrical conduit. Temporary overhead conductors shall be multi-conductor cable or single conductors, securely tied or taped at intervals not to exceed 5 feet (2 m). No spare conductors are required.

Splices within 10 feet (3 m) above ground level shall be enclosed in metal junction boxes. Splices made at ground level shall also be enclosed in pull boxes. All splices shall be made in accordance with 307-13.3. All circuits shall be grounded in accordance with 307-13.4.

307-5.3 Temporary Standards, Signals, Luminaries and Lamps. Temporary Standards shall be installed adjacent to existing Standards. Combination poles that allow mounting of both street lighting luminaries and traffic signal heads shall not be utilized for temporary Standards.

For street lighting systems, the mounting height shall be a minimum of 30 feet (9 m). The lamp size shall be 200 watts. Luminaries shall be cutoff with a type 3 distribution pattern.

Temporary traffic signal heads shall provide a minimum of 2 clearly visible signal faces, for each phase, for traffic from each direction. One signal face shall be adjacent to the left side of the traveled way and the other signal face shall be adjacent to the right side of the traveled way. Temporary mast

arms shall be installed as necessary. Additional signal faces and their location will be determined by the Engineer and paid for in accordance with 3-3.

Temporary traffic signals shall be securely mounted approximately 10 feet (3 m) high, on wood poles, platform standards, or semi-permanent structures. Mast arms, where required, shall provide a minimum clearance of 17 feet (5 m) from the traveled way to the bottom of the traffic signal head. Primary and mast arm traffic signals shall have backplates. Mast arm traffic signals and arrow indications shall be 12- inch (300 mm) in size and other signals shall be 8-inch (200 mm) in size.

Traffic signal shutdown periods shall be as specified in the Special Provisions. Preliminary work associated with the shutdown shall be performed prior to the actual shutdown in order to minimize the amount of time necessary for the completion of the Work.

Shutdowns, flashing operations, and turn-ons shall be requested at least 24 hours in advance and will be overseen or performed by the Engineer.

307-5.4 Payment. Payment for furnishing and installing temporary systems complete and in place shall be considered as included in the Contract Unit Price or lump sum price in the Bid for the work that required a temporary system.

307-6 ORDERING MATERIALS.

The Contractor shall submit a letter to the Engineer stating that the Contractor-furnished street lighting and/or traffic signal materials have been ordered. The letter shall contain the names and addresses of the suppliers and the estimated delivery dates. The letter shall be submitted to the Engineer within 5 working days after acceptance of the submittal for materials specified in 2-5.3.

307-2 CONSTRUCTION GENERAL.

307-2.1 307-7 Excavation and Backfill EXCAVATION AND BACKFILL.

307-7.1 General. ~~The excavation~~ Excavation required for the installation of conduit, foundations, and other equipment shall be performed in such a manner as to cause the least possible damage to the streets, sidewalks, and other existing improvements. ~~Prior to the start of excavation, the Contractor shall comply with all of the requirements of 5-1. The trenches shall not be excavated wider than necessary for the proper installation of the electrical equipment or foundations.~~ Excavation ~~Excavating~~ shall not be performed until just prior to installation of equipment. ~~The material~~ Material generated from ~~the excavation~~ excavations shall be placed in a location ~~to~~ that will cause the least obstruction to surface drainage and vehicular and pedestrian traffic.

~~Where excavations are required in parkways and lawns, existing sod shall be removed and preserved by the Contractor. After backfilling, the sod shall be replaced in accordance with 308-4.8.3, and the entire area restored to original grade and condition.~~

~~Where excavations~~ Excavations that are required in concrete sidewalk, cuts and joints shall conform to the applicable provisions of 300-1.3.

At the end of each working day, and at ~~all~~ other times when construction operations are suspended, ~~all~~ equipment, material, and debris shall be removed from that portion of the ~~right-of-way~~ right of way open for vehicular and pedestrian traffic. Barricades shall be erected at ~~all~~ excavations not backfilled or finished to final grade.

~~All excavations~~ Excavations that are required shall be kept backfilled filled and maintained in a smooth and well-drained condition until permanent repairs are completed. Excavations, including those resulting from removal of existing equipment as specified on the Plans, shall be backfilled, compacted, and the surface restored to match existing improvements in conformance with the applicable requirements of 7-9, 306-1.3.4, and 306-1.5 and 7-9, respectively.

307-7.2 Trenches. Trenches shall not be excavated wider than necessary for the proper installation of the conduit. Trenches for conduit shall be 4 inches (100 mm) wide. Trenching is not permitted through portland cement concrete improvements, such as bus pads, spandrels and cross gutters. When encountered, galvanized rigid steel conduit shall be jacked, or rigid non-metallic conduit shall be bored beneath the improvements.

~~The work in the street or highway shall be performed in such a manner that not more than one lane of traffic is restricted in either direction at any time, unless approved by the Engineer.~~

307-7.3 Payment. Payment for excavation and backfill of trenches shall be considered as included in the Contract Unit Price or lump sum price in the Bid for the work that required excavation, and backfill of trenches.

~~307-2.2~~ **307-8 Foundations** **FOUNDATIONS, FOUNDATION CAPS AND SLABS.**

307-8.1 General. ~~All work~~ Work shall conform to the lines, elevations and grades as shown on the Plans or as established by the Engineer. Construction of concrete foundations, caps and slabs construction shall conform to 303-1, 303-5, and 305-1.3. Forms shall be constructed in accordance with 303-1.3, and removed in accordance with 303-1.4.

307-8.2 Foundations. Foundations shall be constructed in a single placement of portland cement concrete of the class specified in 201-1.1.2. The bottom of the foundations shall rest securely on firm, unyielding soil. When firm, unyielding soil cannot be obtained at the depth shown on the Plans, or Standard Plans, or where the foundation cannot be constructed to the dimensions shown on the Plans or Standard Plans due to obstructions, the foundation shall be constructed as directed by the Engineer and paid for in accordance with 3-3.

Foundations shall cure for 24 hours before erecting Standards and 72 hours before erecting mast arms. Pile foundations shall cure for 48 hours before erecting Standards and 7 days before erecting mast arms.

Foundations constructed within the sidewalk or parkway shall pose no hazard to pedestrian traffic. The above-ground portion of a foundation, if any, and/or anchor bolts, conduits etc. shall be protected with protection devices (i.e. cones, delineators, barricades etc.) approved by the Engineer. The Contractor shall connect the protection devices to the foundation. Protection devices shall protect pedestrians from the above ground portion of the foundation, and/or exposed anchor bolts, conduit, etc. Access meeting ADA requirements shall be provided adjacent to the foundations. Protection devices shall remain and be maintained in place until the related equipment is installed on the foundation.

307-8.3 Foundation Caps. Foundation caps shall be the same color, finish, and material as the adjacent sidewalk, and be a minimum of 3 inches (75 mm) thick or unless otherwise specified in the

Special Provisions. Foundation caps shall be placed after the Standard is set in its final position. The longitudinal grade shall be the same as the grade for the top of the existing curb. If there is no curb, the longitudinal grade will be established by the Engineer.

The transverse grade shall be established as follows:

- a) Existing curb and no sidewalk - by sloping upward from the top of the back face of curb at the rate of 1/4 inch/foot (20 mm/m).
- b) Existing curb and sidewalk – by straight grade from the top of the back face of curb to the top of the near edge of sidewalk, and shall join all around in full-width sidewalk or sidewalk constructed adjacent to the curb.
- c) Service road parkways – by a straight line between the top of the back face of one curb to the top of the back face of the other curb.
- d) If the lateral grade of the existing parkway exceeds a slope of ± 1 inch/foot (80 mm/m), the Contractor shall construct retaining curbs and sidewalk as directed by Engineer. Retaining curbs not shown on the Plans will be considered as Extra Work per 3-3.

307-8.4 Concrete Slabs. Wherever the edge of a concrete foundation extends within 18 inches (450 mm) of any existing concrete improvement, a concrete slab with a minimum thickness of 3 inches (75 mm) or as specified in the Special Provisions shall be extended to meet the existing improvement.

~~The longitudinal grade for the foundation cap shall be the same as the grade for the top of the existing curb. If there is no curb, the longitudinal grade will be established by the Engineer.~~

~~The transverse grade shall be established as follows:~~

- a) ~~Existing curb and no sidewalk – The grade shall slope upward from the top of the back face of curb at the rate of 20 mm per meter (1/4 inch per foot).~~
- b) ~~Existing curb and sidewalk – The grade shall be a straight line from the top of the back face of curb to the top of the near edge of sidewalk, and shall join all around in full width sidewalk or sidewalk constructed adjacent to the curb.~~
- c) ~~Service road parkways – The grade shall be a straight line between the top of the back face of one curb to the top of the back face of the other curb.~~
- d) ~~If the lateral grade of the existing parkway exceeds a slope of plus or minus 80 mm/m (1 inch per foot), the Contractor shall install retaining walls and aprons as directed by Engineer. Retaining walls not shown on the Plans will be considered as extra.~~

~~The foundations shall be constructed in a single placement of concrete of the class specified in 201-1. The bottom of the foundations shall rest securely on firm, undisturbed ground. When a firm footing cannot be obtained at the depth shown on the Plans, or where the foundation cannot be constructed to standard dimensions because of an obstruction, the foundation shall be installed as directed by the Engineer.~~

~~Where forms are required because of soil conditions or grade, they true to line and grade, firmly braced and secured in place, and shall not be removed until the concrete has set.~~

~~Foundations shall cure for 24 hours before erecting standards and 72 hours before erecting arms. Pile foundations shall cure for 48 hours before erecting standards and 7 days before erecting arms.~~

~~Wherever the edge of a concrete foundation extends within 450 mm (18 inches) of any existing concrete improvement, a concrete slab with a minimum thickness of 75 mm (3 inches) shall be extended to meet such improvement.~~

~~The foundation cap shall be of similar color, finish, and material as the adjacent sidewalk. It shall be a minimum of 75 mm (3 inches) thick and shall be placed after the standard is set in final position.~~

~~Concrete foundation and sidewalk construction shall conform to 303-1, 303-5, and 305-1.3.~~

307-8.5 Measurement. Foundations shall be measured by the lump sum or by the cubic yard (m³) for each type and size.

307-8.6 Payment. Payment for foundations, including protection devices, bolt circles, reinforcement and foundation cap, shall be at the Contract Unit Price or lump sum price in the Bid for each size and type. Payment for concrete slabs shall conform to 303-5.9.

307-9 ANCHOR BOLTS, NUTS AND WASHERS.

307-9.1 General. ~~All anchor~~ Anchor bolts, nuts, and washers, including those required for the relocation of existing standards to be relocated, shall be furnished by the Contractor, and shall conform to 209-2.2. Anchor bolts, nuts and washers shall be of the type and size shown on the Plans or Standard Plans and shall conform to 209-3.2.

307-9.2 Payment. Payment for furnishing and installing anchor bolts, nuts and washers shall be considered as included in the Contract Unit Price or lump sum price in the Bid for foundations or for the work that required the anchor bolts, nuts or washers.

~~307-2.3~~ **307-10 Standards and Steel Pedestals STANDARDS, PEDESTALS AND MAST ARMS.**

307-10.1 General. Street lighting, and traffic signal Standards, pedestals for cabinets, mast arms and other similar equipment furnished shall be as shown on the Plans and/or Standard Plans and conform to 209.

Plumbing of standards shall be accomplished by adjusting the nuts on the anchor bolts before the foundation cap is placed. Shims or other similar devices for plumbing or raking shall will not be used permitted.

If base covers or foundation caps are not used, anchor bolts shall be cut ~~6 mm (1/4 inch)~~ 1/4 inch (6 mm) above the nuts. If anchor bolts are cut, the cut surfaces shall be repaired in accordance with 210-3.5.

Holes left in the shafts of existing standards, due to removal of equipment, shall be repaired as follows:

- a) **Steel shafts** – by welding ~~Welding~~ a suitable disc, grinding smooth, and painting as specified provided for repairing damaged galvanized surfaces in 210-3.
- b) **Concrete shafts** – by grouting ~~Grouting~~ to match the existing texture and color.

307-10.2 Mast Arms. Mast arms for Standards shall conform to the dimensions shown on the Plans or Standard Plans and 209-3.4. The joint between a Standard and a mast arm shall be rain-tight.

307-10.3 Measurement. Standards and/or mast arms or pedestals shall be measured by each type and size.

307-10.4 Payment. Payment for Standards and/or mast arms or pedestals shall be at the Contract Unit Price or lump sum price in the Bid for each size and type.

307-2.4 307-11 Pull Boxes PULL BOXES.

307-11.1 General. Pull boxes, covers, and extensions shall be of the type, size, and details shown on the Plans or Standard Plans, or as specified in the Special Provisions, and shall conform to 209-3.7.

Covers for pull boxes shall be marked as shown on the Plans, or Standard Plans or as specified in the Special Provisions. Where the surrounding sidewalk surface is composed of a special material (terrazzo, pavers etc.), pull box covers shall be made of matching material unless otherwise shown on the Plans or specified in the Special Provisions.

Pull boxes shall be installed at the locations shown on the Plans. If not shown, they shall be approximately equally spaced, but not over further apart than:

- a) 300 feet (90 m) ~~60 m (200 feet)~~ for traffic signal interconnect, Traffic Signal Intereconnect,
- b) 200 feet (60 m) ~~90 m (300 feet)~~ for street lighting systems, and ~~not over~~
- c) ~~183 m (600 feet)~~ 600 feet (180 m) apart for fiber optic cable systems.

Pull boxes shall be placed:

- a) ~~Adjacent to standards with a 3 feet (900 mm) clearance from the side of the foundation unless otherwise directed by the Engineer.~~
- b) ~~A minimum of 5-feet (1500 mm) from the top of the "X" dimension of driveways and access ramps. Pull boxes shall not be installed in any part of a driveway, curb ramp area or other traveled way unless otherwise specified in the Special Provisions. Pull boxes shall be a minimum of 1.5 m (5 feet) 5 feet (150 cm) from the top of the "X" dimension of driveways and access ramps.~~
- c) ~~At least 6 inches (150 mm) from any substructure or back of curb unless otherwise approved by the Engineer. Pull boxes shall be installed with the long side parallel to the curb unless otherwise approved by the Engineer.~~

~~It shall be the option of the Contractor, at its expense and subject to the approval of the Engineer, to install additional pull boxes that it may desire to facilitate the work.~~

~~The bottom of the pull box shall rest firmly on a ~~300 mm (12 inch)~~ 12-inch (300 mm)-thick bed of ~~25 mm (1 inch)~~ 1 inch (25 mm) crushed rock conforming to 200-1.2, extending ~~150 mm (6 inches)~~ 6 inches (150 mm) beyond the outside edges of the pull box. The grade for the top of pull boxes shall be established as ~~provided for specified in 307-2.2 8.3.~~ Where practical, pull boxes shown in the vicinity of curbs shall be placed adjacent to the back of curb. Pull boxes where practical shall be installed with the long side parallel to the curb.~~

Where ballasts or transformers are installed in a pull box, a pull box extension shall be used.

The Contractor may, at its own expense and subject to the approval of the Engineer, install additional pull boxes to facilitate the Work.

307-11.2 Measurement. Pull boxes shall be measured by each type.

307-11.3 Payment. Payment for pull box shall be at the Contract Unit Price or lump sum price in the Bid for each type.

307-2.5 307-12 Conduit CONDUIT.

307-12.1 General. All conductors shall be run in conduit except where they are inside standards, or for overhead and temporary installations or otherwise specified. Conduit shall conform to 209-3.5 and shall be of the type and size indicated on the Plans, or as specified in the Special Provisions. If so specified in the Special Provisions, galvanized pipe or rigid non-metallic conduit may be substituted for galvanized electrical conduit. Conduit shall be installed by trenching, jacking or directional boring methods as specified in the Special Provisions.

All conduit shall be the rigid galvanized steel type unless otherwise specified.

Conduit shall be placed, bored or jacked, to a depth of not less than 30 inches (750 mm) nor more than 60 inches (1500 mm) below the flowline grade. Conduit placed behind a curb shall not be less than 14 inches (350 mm) nor more than 36 inches (900 mm) below the top of curb. Conduit placed under railroad tracks shall not be less than 36 inches (900 mm) nor more than 60 inches (1500 mm) below bottom of the ties, unless otherwise required by the jurisdictional railroad. Conduit shall be placed directly behind the curb if approved by the Engineer. If there are obstructions such as foundations, pull boxes, water meter vaults, etc., the conduit may be placed further behind the curb. In no case shall the conduit be placed more than 36 inches (910 mm) behind the curb unless otherwise approved by the Engineer. Conduit may be laid on top of the existing pavement within curbed medians being constructed on top of said pavement.

Pavement shall not be disturbed without permission from the Engineer, except at potholes to expose utility lines in accordance with 5-1. Jacking or drilling pits shall be kept 2 feet (600 mm) clear of the edge of any type of pavement unless otherwise approved by the Engineer. Excessive use of water, such that the pavement may become undermined, or softened, will not be permitted.

Jacking pits adjacent to railroad tracks shall be constructed not less than 15 feet (4.6 m) from the centerline of track. When a jacking pit or open trench is left overnight, it shall be covered with steel plates as specified in the Special Provisions.

Conduit laid in an open trench shall not be covered nor shall any trench or inspection hole be backfilled until the Engineer has approved the installation.

Detector, telephone interconnect, or street lighting conduit shall be 1-inch (25 mm) nominal size unless otherwise specified in the Special Provisions. Direct interconnect, utility service, inductive loop detector or traffic signal conduit shall be 2-inch (50 mm) nominal size unless otherwise specified in the Special Provisions. The Contractor may use conduit of a larger size than that shown or specified, provided the larger size is used for the entire length of the run. Reducing couplings shall not be used. If the Contractor chooses to use a larger size conduit it shall be at no additional cost to the Agency.

Conduit entering a pull box shall enter not less than:

- a) 5 inches (125 mm) below the top of the box,
- b) 2 inches (50 mm) above the bottom of the box.

Conduit shall terminate within 2 to 4 inches (50 to 100 mm) inside the box wall. The prolongation of the conduit shall pass through the top of the pull box. Conduits shall enter from the direction of the run.

Spare conduit stubs from foundations shall extend a minimum of 6 inches (150 mm) from the face and a minimum of 14 inches (360 mm) below the top of foundation and shall be capped on each end.

The ends of the conduit, whether shop or field cut, shall be reamed to remove burrs and rough edges. Cuts shall be made so that the ends will come together for the full circumference thereof. Slip joints or running threads shall not be used for coupling conduit. Threads shall be treated with the approved joint compound specified in the Special Provisions before fittings are placed thereon.

Conduit installed on the surface of poles or structures or other exposed locations or in concrete structures and foundations shall be unpainted, except that exposed conduit installed on a painted structure shall be painted the same color as the structure. Conduit runs on the surface of structures shall be secured with galvanized malleable iron clamps spaced not more than 5 feet (1500 mm) apart.

A No.12 AWG pull wire, or a tape or rope conforming to 209-3.6 shall be installed in all complete conduit runs that are to receive future conductors. A minimum of 2 feet (600 mm) of pull wire, tape or rope shall be secured and extended beyond each end of the conduit run.

Conduit ends shall be capped until the pulling of conductors is started. The conduit shall be blown clean with compressed air prior to installing conductors. In the presence of the Engineer, the Contractor may be required to pass a proper size-testing mandrel through the conduit. Existing conduit that is being incorporated into a new or modified system shall be cleaned with a mandrel or cylindrical wire brush and blown clean with compressed air.

A minimum of 1-foot (300 mm) length of continuous oakum or other sealant as specified in the Special Provisions shall be securely packed into all uncapped conduit ends. Oakum, if used, shall be string oakum that is tar or oil saturated to be water resistant. The oakum or sealant shall be packed into the uncapped conduit immediately after the installation of conductors in the conduit. The oakum or sealant shall be packed around the conductors in such a manner that no visible gaps remain between the conductors and conduit, and with sufficient care to avoid damage to conductors, bushings or conduit.

Conduit terminated without a pull box shall be capped and identified by chipping the standard “†” at a minimum of 3 inches (75 mm) in height on the curb or as specified in the Special Provisions.

Conduit abandoned in place shall be terminated a minimum of 1-foot (300 mm) below finished grade.

307-12.2 Rigid Metallic Conduit.~~All threads shall be treated with approved joint compound before fittings are placed thereon. Rigid metallic conduit shall conform to 209-3.5.2. Where the galvanized coating of conduit or fittings has been damaged in handling or installing (other than by jacking operations), such damaged areas shall be thoroughly painted with a rust preventive paint.~~

~~Detector, telephone interconnect, or street lighting conduit shall be 25 mm (1 inch) nominal size unless otherwise specified. Direct interconnect, utility service, or Traffic Signal conduit shall be 50 mm (2 inch) nominal size unless otherwise specified.~~

~~The Contractor may, at its expense, use conduit of a larger size than that shown or specified, provided the larger size is used for the entire length of the run. Reducing couplings shall not be used.~~

~~Conduit installed on the surface of poles or structures or other exposed locations or in concrete structures and foundations shall be unpainted, except that exposed conduit installed on a painted structure shall be painted the same color as the structure.~~

~~The conduit run on the surface of structures shall be secured with galvanized malleable iron clamps spaced not more than 1.5 m (5 feet) apart.~~

Expansion fittings, as detailed on the Plans and/or specified in the Special Provisions, shall be installed where the conduit crosses an expansion joint in a structure. Each expansion fitting shall be provided with a No. 8 AWG copper bonding jumper.

~~Conduit shall be placed to a depth of not less than 750 mm (30 inches) nor more than 1500 mm (60 inches) below the flowline grade, except that conduit placed behind a curb shall not be less than 350 mm (14 inches) nor more than 900 mm (36 inches) below top of curb; and conduit placed under railroad tracks shall not be less than 900 mm (36 inches) nor more than 1500 mm (60 inches) below bottom of ties. Conduit shall be placed directly behind the curb. However, when there are obstructions such as foundations, pullboxes, water meter vaults, etc., the conduit may be placed further behind the curb. In no case shall the conduit be placed more than 900 mm (36 inches) behind the curb unless otherwise approved by the Engineer.~~

~~Conduit may be laid on top of the existing pavement within curbed medians being constructed on top of said pavement.~~

~~Conduit laid in open trench shall not be covered nor shall any trench or inspection hole be backfilled until the Engineer has approved the installation.~~

~~Conduit shall be placed under existing pavement by jacking, drilling, or directional boring methods. Pavement shall not be disturbed without permission from the Engineer, except at potholes to expose utility lines in the street as required by 5-1. Jacking or drilling pits shall be kept 0.6 m (2 feet) clear of the edge of any type of pavement wherever possible. Excessive use of water, such that pavement might be undermined, or softened, will not be permitted. In no case shall any water used in the Work be allowed to enter any storm drain system.~~

~~Jacking pits adjacent to railroad tracks shall be constructed not less than 3.7 m (12 feet) from the centerline of track. When the jacking pit is left overnight, it shall be covered with substantial planking.~~

Rigid metallic conduit ~~Conduit~~ shall be bent without crimping or flattening, and shall have a radius of not less than ~~six~~ 6 times the inside diameter of the conduit.

~~Spare conduit stubs from foundations shall extend at least 150 mm (6 inches) from the face and at least 350 mm (14 inches) below the top of foundation and shall be capped on each end.~~

~~The ends of all conduits, whether shop or field cut, shall be reamed to remove burrs and rough edges. Cuts shall be made so that the ends will come together for the full circumference thereof. Slip joints or running threads shall not be used for coupling conduits.~~

All Rigid metallic conduit ~~conduit~~ fittings shall be galvanized steel unless otherwise specified in the Special Provisions. Couplings shall be securely tightened to provide a ~~good~~ electrical and mechanical connection throughout the entire length of the conduit run. When a standard coupling cannot be used, a UL or ETL listed threaded union coupling approved by the Engineer shall be used.

~~A No.12 AWG pull wire or equivalent strength cord shall be installed in all complete conduit runs that are to receive future conductors. At least 0.6 m (2 feet) of pull wire shall be extended beyond each end of the conduit run and secured.~~

~~All conduit ends shall be capped until the pulling of conductors is started. When rigid metallic conduit is capped and the caps are removed, the ends of metallic type the conduit shall be provided with threaded conduit bushings. Caps and bushings may be manufactured of metal or plastic, threaded or push-on as specified in the Special Provisions.~~

~~Conduit shall be blown clean with compressed air prior to installing conductors. In the presence of the Engineer, The Contractor may be required to pass a proper size testing mandrel through all conduit.~~

~~Conduit terminating in street lighting standards shall not be transposed and shall terminate as near the door of the standard as possible with the end of the conduit below, but within 25 mm (1 inch) of the lower edge of the door. The prolongation of the conduit shall pass through the door opening.~~

~~Conduit terminating in traffic signal standards of pedestals shall extend vertically approximately 25 mm (1 inch) above the foundation cap and shall be centered within the bolt circle.~~

~~All conduit entering concrete pull boxes shall terminate within 50 to 100 mm (2 to 4 inches) inside the box wall and not be less than 50 mm (2 inches) above the bottom nor be less than 125 mm (5 inches) below the top. The prolongation of the conduit shall pass through the top of the box. Conduits shall enter from the direction of the run.~~

~~All conduit ends in pull boxes and standards shall be securely packed with an approved sealant after conductors are installed.~~

~~All conduit terminated without a pull box shall be capped and identified by chipping the standard "4" at least 75 mm (3 inches) in height on the curb.~~

307-12.3 Galvanized Pipe. Galvanized pipe used as conduit shall conform to 209-3.5.3. Should "necking" occur when any length of pipe is installed, the length of pipe where the "necking" occurred shall be removed.

Couplings shall have a uniform thread which ensures that the ends of the pipe to be joined are in full surface contact when the couplings are in place. Couplings with tapered threads shall not be used.

307-12.4 Rigid Non-Metallic Conduit. Rigid non-metallic conduit shall conform to 209-3.5.4. Rigid non-metallic conduit shall only be installed in underground locations. A separate No. 8 AWG, solid bare ground wire and a pull rope or tape conforming to 209-3.7 shall be inside at the time of installation. A pull box shall be installed whenever an underground conduit changes from a metallic type to a non-metallic type. The Contractor shall pull a mandrel, approved by the Engineer, through all rigid non-metallic conduit.

307-12.5 Measurement. Measurement of conduit shall be the horizontal plane distance plus the minimum depth to grade by the foot (meter).

307-12.6 Payment.

Payment for conduit shall be at the Contract Unit Price or lump sum price in the Bid for each size and type of conduit.

307-12.7 Abandonment of Conduit. Conduit that is to be abandoned in place shall have all wires or cable removed. The conduit shall then be removed to a minimum depth of 1 foot (300 mm) below the surface and have both ends crimped or capped.

307-12.7.1 Payment. Payment for abandoning conduit in place shall be considered as include in the price the Contract Unit Price or lump sum price in the Bid for the Work that required the conduit to be abandoned.

307-2.6 307-13 Wiring WIRES, CONDUCTORS AND CABLES.

307-13.1 General Wiring ~~Wires, conductors and cables shall be done in conformance with 307-1.2 conform to 209-4.2 for street lighting systems and 209-5.3 for traffic signal systems and the requirements of this subsection.~~ Conductors shall be run in conduit except when they are inside Standards, pedestals or for overhead and temporary installations unless otherwise specified in the Special Provisions. Temporary wiring shall conform to 307-4.2.

~~Connectors and terminals for use with aluminum utility power service conductors shall be aluminum and shall be greased with an approved inhibitor.~~

Where low-voltage conductors are run in ~~standards~~ Standards containing high-voltage conductors, either the low-voltage or the high-voltage conductors shall be encased in flexible or rigid metallic conduit to a point where the two types of conductors are no longer in the same raceway.

Conductors/cables shall be pulled by hand. Winches or other power-actuated pulling equipment shall not be used. Only ~~approved~~ specified in the Special Provisions or approved by the Engineer shall ~~may be used in pulling~~ placing conductors/cables in conduit.

~~Splices shall be made only in pull boxes and standard bases. Conductors shall be joined by the use of a connector as approved by the Engineer. The splice shall be capable of satisfactory operation under continuous submersion in water.~~

~~Conductor insulation shall be well penciled, trimmed to conical shape, and roughened before applying splice insulation. Splice insulation shall consist of layers of vinyl chloride electrical insulating tape, conforming to ASTM D 2301, Type I, applied to a thickness equal to and well lapped over the original insulation.~~

A total of ~~0.6 m (2 feet)~~ 2 feet (600 mm) of slack shall be left at each ~~Standard~~ standard, and within each pull box sufficient slack shall be left to extend ~~450 mm (18 inches)~~ 18 inches (450 mm) above the top of the pull box ~~grade~~.

Small, permanent identification bands shall be marked as specified in 209-4.2, 209-5.3 or herein. The bands shall be securely attached to conductors in pull boxes and near the termination of each conductor. Where circuit and phase are clearly indicated by conductor insulation, bands need not be used. Permanent identification bands shall be embossed, ~~0.15 mm (6 mil)~~ 6 mil (150 μm), oil-resistant polyvinyl chloride tape with pressure-sensitive backing. Tape shall be of a type such that symbols contrast with the background color.

307-13.2 Splices Splices shall conform to the details shown on the Plans unless otherwise specified in the Special Provisions. Splices shall only be made in pull boxes and Standard bases. Splices shall be capable of operation under continuous submersion in water. Multi-conductor cables shall be spliced and insulated to provide a watertight joint and to prevent absorption of moisture by the cable. Where more than 1 conductor enters the sleeve of a ballast installed in a pull box, the insulation and taping shall be applied between the conductors in such a manner as to provide a watertight joint.

Splice insulation shall conform to 209-3.8 unless otherwise specified in the Special Provisions and shall be applied to a thickness equal to, and well-lapped over, the original insulation.

Wire/conductor insulation shall be well-penciled, trimmed to a conical shape, and roughened before applying the splice insulation. Tape shall be applied to a thickness equal to, and well-lapped over, the original insulation.

When 3 or more conductors are to be enclosed within a single splice using heat-shrink tubing, mastic shall be placed around each conductor prior to being placed inside the heat-shrink tubing. The mastic shall be of the type recommended by the manufacturer of the heat-shrink tubing.

After contraction, the ends and seams of heat-shrink tubing shall be painted with an electrical insulating coating recommended by the manufacturer. Heat-shrink tubing shall not be heated with an open flame. A heating device designed for the purpose is required.

The Contractor may, at the Contractor's option, use either of the following splice insulation methods:

- a) A minimum of 2 thicknesses of electrical insulating pad shall be used. Pads shall be applied to the splice in conformance with the manufacturer's recommendations,
- b) Heat-shrink tubing conforming to 209-3.8.3.

Conductors shall be joined together by connectors conforming to 209-4.3, unless otherwise specified in the Special Provisions or approved by the Engineer. Connectors and terminals used with aluminum utility power service conductors shall be aluminum and shall be greased with an inhibitor as specified in the Special Provisions or approved by the Engineer.

307-13.3 Payment. Payment for wire, conductor or cable and splicing wire, conductor or cable shall be considered as included in the Contract Unit Price or lump sum price in the Bid for conduit.

~~**307-2.7 307-13.4 Bonding and Grounding.** Metallic cable sheaths, metal pull box covers, metallic conduit, equipment grounding conductors, nonmetallic conduit grounding wire, ballast and transformer cases, service equipment, sign switches, anchor bolts, and metal standards that form a continuous system shall be effectively grounded with materials conforming to 209-3.9. Bonding and grounding jumpers shall be copper wire or copper strap of the same cross sectional area as No. 8 AWG for all systems, except where noted herein.~~

At service points, grounding of metallic conduit, service equipment, and neutral conductors at service points shall conform to be accomplished as required by the applicable code and the requirements of the serving utility, except that grounding electrode conductors shall be No.6 AWG solid copper wire or larger.

Each multiple service disconnect location shall be grounded. Ground electrodes shall be installed in accordance with the provisions of the Code and the materials utilized shall conform to 209-3.9. The service equipment shall be bonded to the ground electrode by use of a ground clamp or exothermic weld and No. 6 AWG or larger solid copper wire enclosed in a size 16 or larger diameter conduit.

For equipment grounding purposes in rigid non-metallic conduit, a No. 6 AWG solid copper wire shall be run continuously in circuits used for series street lighting, and a No. 8 AWG minimum solid copper wire shall be run continuously in all other street lighting and traffic signal circuits. The bonding wire size shall be increased to match the circuit breaker size, unless otherwise shown on the Plans or as specified in the Special Provisions. Whenever rigid non-metallic conduit is to be installed for future conductors, the solid copper wire may be omitted. Equipment bonding and grounding conductors are not required in conduit which contain only loop lead-in cable or signal interconnect cable or both.

~~For bonding purposes in all nonmetallic type conduit, a bare No.8 AWG copper wire shall be run continuously in all circuits.~~

Bonding of Standards ~~standards~~ shall be accomplished by means of a No. 8 AWG bonding wire attached from a grounding bushing to a foundation bolt or a ~~4.5 mm (3/16 inch)~~ 3/16 inch (4 mm), or larger, brass or bronze bolt installed in the lower portion of the ~~standard~~ Standard. The bonding jumper in Standards with handholes and traffic signal pull box lid covers shall be attached by a 3/16 inch (4 mm) or larger brass bolt and shall be run to the conduit or bonding wire in the adjacent pull box. Standards without handholes shall be bonded by a jumper attached to each anchor bolt, and shall be run to the conduit or bonding wire in the adjacent pull box. The grounding jumper shall be visible after the cap has been placed on the foundation.

Bonding of metallic conduit in metal pull boxes shall be by means of locknuts, 1 inside and 1 outside of the pull box.

Bonding of metallic conduit in nonmetallic pull boxes shall be by means of copper strap or galvanized grounding bushing and bonding jumpers conforming to 209-3.9.

For ~~Series Circuits~~ series circuits, the metallic conduit or bonding conductor system shall be securely grounded; at intervals not to exceed ~~150 m (500 feet)~~ 500 feet (150 m) by ~~to~~ one of the following:

- ~~1a) A 25 mm (1 inch) galvanized~~ galvanized pipe conforming to 209-3.9 driven to a depth of ~~2.4 m (8 feet)~~ 8 feet (2 m) and having its upper end not more than ~~75 mm (3 inches)~~ 3 inches (75 mm) above the conduit; or,
- ~~2b) A minimum 13 mm by 2.4 m (1/2 inch by 8 foot) copper~~ copper-coated (minimum thickness of rod coating 0.3 mm (0.01 inch) steel rod conforming to 209-3.9, driven to a depth of ~~2.4 m (7 feet 9 inches)~~ 8 feet (2 m); or,
- ~~3c) A metal~~ metal water service pipe on the street side of the meter, with the approval of the owner. The water pipe shall be thoroughly scraped and cleaned prior to connection.

For ~~Multiple Circuits~~ multiple circuits, the metallic conduit or bonding conductor system shall be grounded at the service points.

On wood poles, all equipment mounted less than ~~2.4 m (8 feet)~~ 8 feet (2 m) above the ground ~~surfaces~~ surface shall be grounded.

307-13.4.1 Payment. Payment for furnishing and installing equipment for bonding and grounding circuits shall be considered as included in the Contract Unit Price or lump sum price in the Bid for conduit.

307-2.8 307-14 SERVICES.

307-14.1 General. Before any work is begun, the Contractor shall obtain daily circuit clearance from the serving utility.

The Contractor shall furnish and install all material and equipment necessary to complete the electrical connection between the terminating point of the serving utility and the electrical system, as shown on the Plans. Electrical service installation and materials shall conform to the requirements of the serving utility and 209-3.10. ~~Prior to the expiration of the first 10 percent of the working days, the Contractor shall install the necessary facilities to receive utility service connection.~~ Installation of

service equipment shall be scheduled so as to enable the serving utility to complete its work in advance of the completion of the Work.

Upon the Contractor's written request, the Engineer will arrange with the serving utility to complete service connections for permanent installations. The Agency will pay all costs and fees required by the serving utility for the service connections for permanent installations unless otherwise specified in the Special Provisions.

307-14.2 Services on Utility-Owned Poles. When service equipment is to be installed on a utility-owned pole, the Contractor shall furnish and install conduit, conductors and other necessary material to complete the installation of the service. The position of the riser and equipment will be determined by the serving utility unless otherwise shown on the Plans or specified in the Special Provisions. ~~The Engineer shall arrange with the serving utility to complete service connections.~~

Each service shall be provided with an in-line fuse holder on each non-grounded service conductor, except the neutral conductor. The in-line fuse holder shall conform to 209-4.3.2.

307-14.3 Services in Vaults. The Contractor shall contact the serving utility to determine the location of stub outs for vault service points.

Thirty feet (9 m) of slack in each conductor entering a vault shall be provided for the serving utility to "rack" the conductor on the walls of the vault.

In the service pull box, the Contractor shall furnish and install 2 disconnect splices for each circuit. Disconnect splices shall conform to 209-4.3.1. Disconnect splices shall be installed so that the 2 service wires may be connected together.

307-14.4 Measurement. Services shall be measured by each unit.

307-14.5 Payment. Payment for connection between the "service point" and the nearest pull box will be paid at the Contract Unit Price or lump sum price in the Bid for each service point.

Where the "service point" is indeterminate or shown on the Plans as an "approximate location" or "service point not yet established", payment for the connection between the "service point", when established, and the nearest pull box shown on the Plans will be paid for as Extra Work in accordance with 3-3.

307-2.9 307-15 CIRCUIT BREAKERS.

307-15.1 General. Circuit breakers conforming to 209-3.11 shall be constructed at the locations shown on the Plans. Circuit breakers used as service disconnect equipment shall be enclosed in a NEMA raintight enclosure with a dead-front panel and hasp with a 7/16 inch (11 mm) hole for a padlock. The padlock will be furnished by the Agency.

307-15.2 Payment. Payment for circuit breakers shall be considered as included the Contract Unit Price or lump sum price in the Bid for the equipment requiring circuit breakers.

307-~~3~~16 STREET LIGHTING CONSTRUCTION.

307-~~3.1~~16.1 General. Street lighting materials construction shall conform to ~~the requirements of 209-3 307-2 and 307-3~~ 209-4.

307-~~3.2~~16.2 Pull Box Covers. Pull box covers shall conform to 209-3.7 and be inscribed “STREET LIGHTING HIGH VOLTAGE.”

307-16.3 Conduit. Conduit shall conform to 307-11. Conduit terminating in street lighting Standards shall not be transposed. Conduit shall terminate as near the door of the Standard as possible with the end of the conduit below, but within 1 inch (25 mm) of the lower edge of the door. The prolongation of the conduit shall pass through the door opening.

307-16.4 Wiring/Conductors. Single conductors shall be used for all circuits. Conductors shall be copper of the gauge and color specified in 209-4.2 unless otherwise specified in the Special Provisions.

For series-circuit ~~lighting~~ conductor splices, sufficient synthetic oil-resistant rubber tape, conforming to the requirements of ASTM D 119, shall be applied over the conductor to fill all voids before placing the vinyl chloride tape specified in 209-3.8.2. herein and The splice shall then be well covered with a coating of approved insulating material paint specified in the Special Provisions or similar material.

For multiple circuits, ~~an approved~~ fused disconnect splice connectors conforming to 209-4.3 unless otherwise specified in the Special Provisions shall be installed in each ungrounded conductor between the line and the ballast. The connector shall be installed in the base of the luminaire standard or in an adjacent pull box and be readily accessible.

307-16.5 Fused Splice Connectors. Fused splice connectors shall conform to 209-4.3.2.

In the pull box adjacent to each Standard, a fused disconnect splice connector shall be installed on each ungrounded conductor between the line and the ballast. The connector shall be readily accessible in the pull box regardless of whether the ballast is remote or integral with the luminaire.

Terminals shall be rigidly crimped, using a tool of the type recommended by the manufacturer of the fused splice connector, onto the line conductors and the conductors to the ballasts. Terminals shall be insulated, waterproof and conform to the splice connector manufacturer’s recommendations.

Fused splice connectors shall not be used in series circuits.

307-16.6 Terminal Blocks Terminal blocks shall conform to 209-4.3.3 unless otherwise specified in the Special Provisions. Barrier type terminal blocks rated for 40A minimum shall be provided in each service equipment enclosure. Field conductors shall be terminated using crimped, insulated loop connectors.

~~307-3.2~~ **307-16.7 Services.** Services shall conform to 307-7.14. For series street lighting systems served from overhead circuits, a switch of 5,000-volt rating shall be connected to control each circuit. The switch shall be enclosed in a NEMA Type 3R, 450 mm x 600 mm x 150 mm (18 inch x 24 inch x 6

~~inch~~ 18-inch x 24-inch x 6-inch (450 mm x 600 mm x 150 mm) terminal box. The terminal box shall be fitted with a cover permanently inscribed “DANGER – HIGH VOLTAGE.” The cover shall be attached to the box to form a raintight plate and shall require tools for removal. The terminal box shall be installed not less than ~~3 m (10 feet)~~ 10 feet (3 m) above the ground.

307-16.8 Luminaries.

307-16.8.1 General. Luminaries shall conform to 209-4.4 unless otherwise specified in the Special Provisions.

~~307-3.3~~ **307-16.8.2 Lamp Size and Identification.** Lamps shall conform to 209-4.6 unless otherwise specified in the Special Provisions.

Each lamp shall be identified with a tape target conforming to 209-4.6.1. Targets shall be affixed to the underside of the horizontal luminaire or on the body facing oncoming traffic for upright luminaries.

Existing ~~tape~~ targets shall be removed and disposed of or covered as directed by the Engineer specified in the Special Provisions. ~~The target shall be made of noncorrosive material to provide a durable and legible surface that is designed to endure for the life of the luminaire. The target shall have a stable color background and black block numerals. The target shall be 7.62 cm (3 inches) square. The targets shall have the identification numbers and background color shown in Table 307-3.5(A) and Table 307-3.5(B) respectively. The identifying numerals shall be 5.08 cm (2 inches) high, minimum, and have a stroke width of 0.64 cm (1/4 inch).~~

TABLE NO. 307-3.5(A)

Identifying Numeral	Lamp Wattage
4	18
3	35
5	50 or 55
7	70
9	90
10	100
13	135
15	150 – 55V
15H	150 – 100V
17	175
17B	175 Position Oriented
18	180
20	200
24	215
25	250
25B	250 Position Oriented
30	300
31	310
36	360
40	400
40B	400 Position Oriented
70	700

Identifying Numeral	Lamp Wattage
XI	1000

TABLE NO. 307-3.5(B)

Background Color	Lamp Type
GOLD	High Pressure Sodium
GREEN	High Pressure Sodium/Mercury Ballast
LIGHT BLUE	Mercury
RED	Metal Halide
<u>PURPLE</u>	<u>Incandescent</u>
AQUA	Fluorescent

307-16.8.3 Lamp Ballasts. A Certificate of Compliance conforming to 4-1.5 shall be submitted by the Contractor with each lot of integral ballast luminaires and with each lot of ballasts designed for use outside of luminaires. The certificate shall state that the lot of ballasts conform, in every respect, to 209-4.5, the lamp-ballast specifications of the lamp manufacturer or the Special Provisions.

309-16.8.4 Photoelectric Units. Photoelectric electric units shall be installed as shown on the Plans or as specified in the Special Provisions. Photoelectric electric units shall conform to 209-4.7 unless otherwise specified in the Special Provisions.

307-16.8.4 Measurement. Luminaires shall be measured by each type and size.

307-16.8.6 Payment. Payment for luminaires, including ballasts and photoelectric units, shall be at the Contract Unit Price or lump sum price in the Bid for each size and type of luminaire.

307-417 TRAFFIC SIGNAL CONSTRUCTION.

307-417.1 General. Traffic signal construction materials shall conform to the requirements of 209-3 and 307-2 and 307-4 209-5.

~~**307-4.2 Temporary Signal Systems.** Temporary traffic signal heads shall provide a minimum of two clearly visible signal faces for traffic from each direction, one being adjacent to the left side of the traveled way and one being adjacent to the right side of the traveled way. If a mast arm is required, then a temporary mast arm shall be installed. The approved location and any additional signal faces shall be determined by the Engineer. All temporary signals shall be securely mounted at approximately a 3 m (10 foot) height on wood poles, platform standards, or semipermanent structures. Mast arms, where required, shall provide a minimum clearance of 5.2 m (17 feet) from the traveled way to the bottom of the signal. All primary and mast arm signals shall have backplates.~~

~~All mast arm signals and arrow indications shall be 300 mm (12 inch) size and other signals shall be 200 mm (8 inch) size.~~

~~When traffic signal shutdown is permitted by the Engineer, it will be for a 2 hour period between 9 a.m. and 2 p.m. Work necessitating longer periods of time may be authorized by the Engineer.~~

~~Preliminary work associated with the shutdown shall be done prior to the actual shutdown in order to minimize the amount of time necessary for the completion of the work. Sufficient manpower and equipment shall be employed by the Contractor to minimize the shutdown period. Once a shutdown is effected, all work shall be diligently pursued without interruption until the signals are back in normal operation. Delays in effecting the shutdown by the Engineer shall not constitute shutdown time for the Contractor.~~

~~In all cases, shutdown, flashing operation, and turn on must be requested at least 24 hours in advance and will be supervised or performed by the Engineer.~~

307-4.317.2 Controllers Cabinet Wiring Diagrams.

307-17.2.1 General. Controllers, cabinets and auxiliary equipment shall conform to 209-5.4 and the Standard Plans. The Contractor shall supply the controller, cabinet and all auxiliary equipment required to provide a complete functioning controller unless otherwise specified in the Special Provisions..

307-17.2.2 Controller Cabinet Wiring Diagrams. A wiring diagram for field modifications to the existing controller cabinet including, but not limited to, the installation of sensor units, switch packs, etc. shall be submitted to the Engineer at least 10 working days prior to performing work in the controller cabinet.

Controller cabinet documentation, labeling, and placards shall be corrected/updated to reflect any changes made within the controller cabinet that are the result of all current and past modifications.

Prior to acceptance of the Work, the Contractor shall furnish five sets of traffic signal controller cabinet schematic wiring diagrams conforming to which shall have the same phase designations as shown on the Plans for the intersection. The diagrams shall show the location of the installation and shall list all equipment installed in each cabinet. In addition, for each signal installation, the Contractor shall furnish an intersection sketch showing ~~standards~~ Standards, detectors, and phasing. One copy of the controller cabinet diagram and the intersection and phase diagram, as reviewed by the Engineer, shall be placed in a heavy-duty plastic envelope and attached to the inside of the door of each controller cabinet.

307-17.2.3 Controller Cabinet Wiring. Wiring shall conform to 209-5.4.2 unless otherwise specified in the Special Provisions.

307-17.2.4 Service Checks. Service checks shall be performed by the Contractor. The Contractor shall measure the service voltage at the live AC terminal before the main circuit breaker in the controller assembly. If the voltage is less than 110 volts, the Contractor shall notify the Engineer. A resistance measurement shall also be made between the service neutral terminal and the chassis ground terminal. If the resistance is more than 4 ohms, the Contractor shall notify the Engineer. The Engineer will notify the serving utility to rectify the problem.

307-17.2.5 Measurement. Controllers shall be measured by each type and size.

307-17.2.6 Payment. Payment for controllers shall be at the Contract Unit Price or lump sum price in the Bid each size and type of controller.

307-4.17.34 Pull Box Covers. Pull box covers to be installed in traffic signal systems, or combined traffic signal and low-voltage multiple circuit street lighting systems conforming to 209-4.2.3, shall conform to 209-3.7 and be inscribed "TRAFFIC SIGNALS." Pull box covers for underground service points, where both traffic signals and street lighting jointly occupy the same box, shall be inscribed "TS-SL."

307-17.4 Conduit. Conduit shall conform to 209-3.5 and 307-11. Conduit terminating in traffic signal standards shall extend vertically 1 inch (25mm) above the foundation cap and be centered within the bolt circle. Traffic signal conduits shall be separated from street lighting conduits.

Rigid non-metallic conduit shall be installed in open trenches, except in the vicinity of pullboxes where it may be bored in, pre-drilled, augured or through air blown holes.

307-417.5 Wiring, Conductors and Cable.

307-17.5.1 General. Multi-conductor cable shall be used for all circuits in lieu of individual conductors. Multi-conductor cable shall be as shown on the Plans and conform to 209-5.3 and 307-13 unless otherwise specified in the Special Provisions. Conductors Wires shall be solid copper of the gauge shown in Table 209-5.3.1(A), on the plans Plans, or as otherwise specified in the Special Provisions. Suffieient conductors shall be provided to perform the functional operation of the signal system and three spare No. 14 AWG conductors shall be provided throughout the signal light system. End of spare conductors shall be doubled back and taped. Traffic signal multiconductor cable may be utilized when approved by the Engineer.

The neutral for pedestrian push-button circuits shall be separate from the signal light circuit neutral. Interconnect conductors shall be continuous from controller to controller unless splices are specifically authorized approved by the Engineer. Splices shall be made only in pull boxes.

Where telephone circuits are installed adjacent to other electrical circuits, the telephone conductors shall be encased in UL approved metallic conduit conforming to 209-3.5.2.

Wiring Multi-conductor cable entering controller cabinets shall be neatly arranged, secured, and tagged. Each cable shall be identified in all controller cabinets by a plastic tag 1/2 inch x 2 inches (13 mm x 50 mm) in size, stamped with the cable run identification characters in 1/4 inch (6 mm) letters and secured to the conductor with 2 nylon tie-wrap devices.

Each multi-conductor cable shall be identified in all communication cabinets by an aluminum tag, 1 inch x 4 inches (25 mm x 100 mm) in size, stamped with the cable run identification characters in 1/2 inch (13 mm) letters and secured to the cable with 2 nylon tie-wrap devices.

Whenever new conductors are to be installed in a conduit with existing individual conductors (service wire excepted), all individual conductors shall be removed and replaced with multi-conductor cable. A 28-conductor cable conforming to 209- 5.3.2.6 shall be installed in new cross street runs unless otherwise shown on the Plans.

All stranded Stranded conductors shall be terminated with approved terminal lugs.

307-17.5.2 Conductor Splicing and Termination

Field spliced solid wires shall be twisted together and secured using vinyl, water-tight, spring-tensioned, silicone-filled, direct-burial wire connectors as specified in the Special Provisions. The Contractor shall provide a minimum of 3 feet (1 m) of slack. The slack shall be neatly coiled in a clockwise direction within each pullbox. Splice insulation shall conform to 209-3.8.

Stranded conductors shall be terminated with a terminal connector as specified in the Special Provisions. Stranded conductors shall be properly compressed for minimum resistance at the attachment.

Where optimum operation of circuits requires minimum resistance, the connections and/or terminals shall be soldered.

307-17.5.3 Ground Rods. Ground rods shall conform to 209-3.9. Copper ground rods shall be installed in controller foundations and service pull boxes unless otherwise directed by the Engineer.

307-17.5.4 Interconnect.

307-17.5.4.1 Direct Wire/Conductor. Conductors shall conform to 209-5.3.3.1 unless otherwise specified in the Special Provisions. Conductors shall be continuous from the controller, unless splices are specifically approved by the Engineer. Splices, where approved, shall be soldered and shall be secured using vinyl, water-tight, spring tensioned, silicone filled, direct burial wire connectors, unless otherwise specified in the Special Provisions. A minimum of 3 feet (1 m) of slack shall be provided at each splice and 7 feet (2 m) at each controller cabinet. Spliced conductors shall be insulated with heat-shrink tubing of the appropriate size and overlap the conductor insulation at least 19/32 inch (15 mm). The overall cable splice shall be covered with heat-shrink tubing with at least 1- 9/16 inches (40 mm) of overlap of the cable jacket. Heat-shrink tubing shall conform to 209-3.8.3.

307-17.5.4.2 Filled Telephone Cable. Filled telephone cable shall conform to 209-5.3.3.2 unless otherwise specified in the Special Provisions. Cable splices shall be made at communication or controller cabinets or other splice points specified in the Special Provisions. Splices shall conform to 209-3.8.

307-17.5.4.3 Identification. Each cable shall be identified in the communication cabinet by an aluminum or plastic tag 1 inch x 4 inches (25 mm x 100 mm) in size, stamped with the cable run identification characters in 1/2 inch (13 mm) letters and secured to the cable with 2 nylon tie-wrap devices.

Each cable shall be identified in all controller cabinets or other specified splice points by a plastic tag 1/2 inch x 2 inches (13 mm x 50 mm) in size, stamped with the cable run identification characters in 1/4 inch (6 mm) letters and secured to the cable with 2 nylon tie-wrap devices.

307-17.5.5 Fiber Optic Cable.

307-17.5.5.1 General. Fiber optic cable shall conform to 209-5.3.4 unless otherwise specified in the Special Provisions.

307-17.5.5.2 Installation. Fiber optic cable installation and handling procedures shall conform to the manufacturer's recommendations.

In pullboxes with outside dimensions of 22 inches x 34 inches (550 mm x 850 mm), there shall be 10 feet (3 m) minimum of additional looped cable. In splice cabinets and vaults, there shall be 100 feet (30 m) minimum of additional looped cable for each cable entering or leaving the splice cabinet or vault.

307-17.5.5.3 Splicing of Fiber Optic Cable. Splicing shall be performed by the fusion technique. Cables shall be prepared and spliced in accordance with the cable manufacturer's recommendations. Completed splices shall be protected by either heat shrinkable tubing conforming to 209-3.8.3, or metal protective sleeves unless otherwise specified in the Special Provisions.

~~The completed~~ Completed splices shall be enclosed in re-enterable splice enclosures that seal to form a moisture resistant enclosure. The splice case or enclosure shall contain a removable splice organizer or crib that shall secure the individual fibers and protect the splices. The splice organizer or crib shall be attached to the steel strength members in the fiber optic cable and shall be bonded to a ground stud on the exterior of the splice case or enclosure. There shall be adequate space inside the enclosure to hold at least ~~1 meter (3.28 feet)~~ 3 feet (1 m) of cable. ~~No splices shall be made, except as authorized by the Engineer.~~ Splice enclosures shall be as specified in the Special Provisions by the Agency or authorized by the Engineer. Fiber optics interconnect cable shall may only be spliced at the locations shown on the Plans or specified in the Special Provisions. ~~at special fiber optics splice boxes. Video fiber optics may be spliced at either the communication cabinet or at the controller.~~

307-17.6 Signal Heads.

307-17.6.1 General. Signal heads shall conform to 209-5.5.

~~All new~~ New vehicle signal heads installed at any ~~one~~ individual intersection shall be of the same style and from the same manufacturer, except for programmed visibility heads.

~~All mast~~ Mast arm and arrow indications shall be a minimum of ~~300 mm (12 inch)~~ 12 inches (300 mm). ~~All other~~ Other signal indications shall be ~~200 mm (8 inches)~~ 8 inches (200 mm). ~~Visors are required on all signal heads.~~

Backplates, ~~of an approved type~~ conforming to 209-5.5.10, shall be installed unless otherwise shown the Plans or specified in the Special Provisions. ~~All pedestrian~~ Pedestrian heads shall ~~have~~ be equipped with a glare reduction device approved by the Engineer conforming to 209-5.6.2.6 unless otherwise specified in the Special Provisions to reduce sun glare.

Signal heads shall not be installed at any intersection until all other signal equipment, including the controller, is in place and ready for operation ~~at that intersection~~, except that signal heads may be mounted if the faces are turned away from traffic or are covered as specified in the Special Provisions.

Signal heads shall be located and aimed as shown on the Plans or as directed by the Engineer. Mounting and location on ~~standards~~ Standards shall be as shown on the Plans or as specified in the Special Provisions ~~directed by the Engineer.~~

307-4.7 307-17.6.2 Signal Head Mountings. Fittings for signal head mountings shall conform to 209-5.7. Heads shall be supported by assemblies of 38 mm (1 1/2 inch) standard steel pipes with malleable iron or bronze fittings. All assemblies Assemblies shall be installed plumb or level, as

applicable, ~~shall~~ be symmetrically arranged, and securely tightened. Top horizontal members shall be approximately ~~300 mm (12 inches)~~ 12 inches (300 mm) in length. Construction shall be such that all conductors are concealed within standards or pipe assemblies.

Unless otherwise ~~specified herein or shown~~ on the Plans or specified in the Special Provisions, heads shall be installed with terminal compartment mountings. For top mounting of a one-way head and mast arm mountings, a slip-fitter without a terminal compartment shall be used. Clamp-type mounting may be used for installation of heads on existing concrete standards if inserts for terminal compartment ~~mounting~~ mountings have not been provided. The terminal compartment shall be mounted on the ~~standard~~ Standard on the side away from traffic and parallel with the prolongation of the nearest curb face.

307-17.6.3 **Visors.** Visors shall conform to 209-5.5.8. Vehicle signal indications at signalized intersections shall be provided with removable beveled or long visors if shown on the Plans, and shall conform to the Standard Plans.

~~307-4.8~~ **307-17.6.4** **Directional Louvers.** Directional louvers shall conform to 209-5.5.9. Where shown on the Plans or ~~standard drawings~~ Standard Plans, louvers shall be furnished and installed in the visors of the signal head sections ~~designated~~.

307-17.6.5 **Measurement.** Signal heads shall be measured by each type and size.

307-17.6.6 **Payment.** Payment for each signal head shall be the Contract Unit Price or lump sum price in the Bid for each type and size.

~~307-4.9~~ **307-17.7** **Vehicle Detectors.**

307-4.9.1 **307-17.7.1** **General.** Vehicle detectors shall conform to 209-5.8. Vehicle detectors shall be of the type or types shown on the Plans or specified in the Special Provisions. The location of each detector shall be as shown on the Plans or as specified in the Special Provisions ~~directed by the Engineer~~.

~~307-4.9.2~~ **307-17.7.2** **Sensor Units.** Sensor units shall conform to 209-5.8 unless otherwise specified in the Special Provisions. A minimum of ~~at least one~~ 1 sensor unit shall be provided for each approach for each separately controlled phase of operation unless otherwise specified in the Special Provisions. Sensor units shall be housed in the controller cabinet unless otherwise specified in the Special Provisions.

~~307-4.9.1~~ **307-17.7.3** **Inductive Loop Detectors.**

307-17.7.3.1 **General.** Inductive loop detectors shall conform to 209-5.8.2 and the Standard Plans unless otherwise specified in the Special Provisions. Inductive loop detectors shall be installed at the locations shown on the Plans. Unless otherwise specified, each loop shall consist of 3 turns of conductor.

The Contractor shall install and activate ~~all inductive loop detectors~~ ~~detector loops~~ within 14 days of the activation of the controller. ~~Detector loops damaged during removal of pavement or other related work shall be replaced and reactivated within 7 days of the placement of permanent pavement. This Work shall be done at no additional cost to the agency. Detector loops shall conform to the following:~~

- a) ~~Detector loops, and their leads to the nearest pull box, shall be formed from a continuous conductor of No.12 AWG solid or seven strand minimum tinned copper wire; having 600 volt Type USE cross linked polyethylene insulation with a minimum thickness of 1.2 mm (3/64 inch).~~

~~The two leads for each loop shall be installed as a pair, twisted at a rate of 360^o per 0.30 meters (one foot) in a common saw slot. The detector loop leads may share a common saw slot with leads from other detector loops. However, the detector loop leads shall not cross any loops and shall not be installed within 500 mm (20 inches) of any other loop. The lead in cable shall consist of No.12 AWG UF twisted pair and be continuous from the pull box where connections are made to the inductive detector loops to the cabinet containing the sensor units for the loops.~~

- b) ~~The Contractor shall make continuity and insulation resistance tests after installation on both inductive detector loops and lead in cables, as specified in 307-5.2. The measurement shall be made using the conduit system as ground and with the shield (if any) of the lead in grounded.~~

~~Slots 6 mm (1/4 inch) minimum width shall be cut in the pavement, blown clean, and dried before installing inductive loop detectors. Eighteen inch corner cutoffs shall be provided on all loops.~~

~~After conductors are installed in the slots cut in the pavement, the slots shall be filled with epoxy sealant, or hot melt adhesive. The epoxy sealant is the "Epoxy Sealant for Inductive Loops" and the hot melt adhesive is the "Hot Melt Bituminous Adhesive" specified in the CalTrans Standard Specifications. The sealant or hot melt adhesive shall fill the slots to within 3 mm (1/8 inch) of the pavement surface. The sealant or adhesive shall be at least 13 mm (1/2 inch) thick above the top conductor in the saw cut. Before setting, surplus sealant or adhesive shall be removed from the adjacent road surfaces without the use of solvents.~~

~~The loops shall be joined in the pull box in combination of series and parallel so that optimum sensitivity is obtained at the sensor unit. Final splices between loops and lead in cable shall not be made until the operation of the loops under actual traffic conditions is approved by the Engineer.~~

307-17.7.3.2 Installation Details. Each loop shall be installed entirely within one continuous type of paving material. Slots 1/4 inch (6 mm) minimum in width shall be cut in the pavement, washed or blown clean, and thoroughly dried before installation. Triangular corner cutoffs, 18 inch (450 mm) long on 2 adjacent sides shall be provided on all loops. Residue resulting from slot cutting operations shall not be permitted to flow across lanes occupied by traffic. Residue shall be removed from the pavement surface by vacuuming or other methods approved by the Engineer.

Installation shall conform to the following:

- a) Two leads for each loop shall be installed as a pair, twisted at a rate of 360^o per foot (300 mm) in a common saw slot. Inductive loop detector leads may share a common saw slot with leads from other loops. However, inductive loop detector leads shall not cross any loops and shall not be installed within 20 inches (500 mm) of any other loop.

- b) Lead-in cable shall consist of No.12 AWG-THW [45 mil (1 mm)] twisted pair and be continuous from the pull box where connections are made to the loops to the cabinet containing the sensor units for inductive loop detectors.
- c) Continuity and insulation resistance tests shall be performed after installation on both inductive detector loops and lead-in cables, as specified in 307-7.7. Measurements shall be made using the conduit system as ground and with the shield (if any) of the lead-in grounded.

Unless otherwise specified in the Special Provisions, loops shall be wound in a clockwise direction. The input (or start) wire shall be tagged with an odd number, the output (or finish) wire with the next higher even number. A plastic tag 1/2 inch (13 mm) by 2 inches (50 mm) shall be wrapped around each loop pair to identify each pair by timing phase and number of individual conductors.

Where circuits are to be spliced, each splice shall be crimped and soldered with resin core solder. Splices shall be taped and sealed with an Agency-approved electrical waterproofing compound conforming to 209-5.8.2.4 unless otherwise specified in the Special Provisions. Acid core solder or acid paste shall not be used.

Loop conductors shall be installed without splices and shall terminate in the pull box shown on the Plans. In addition to the requirements for splices in detector circuits, the open end of the cable jackets or tubing shall be sealed in a manner similar to the splicing requirements. Loops shall be joined in the pull box in a combination of series and parallel so that optimum sensitivity is obtained at the sensor unit. Final splices between loops and lead-in cable shall not be made until the operation of the loops under actual traffic conditions is approved by the Engineer. Loop conductors for each direction of travel, for the same phase of a traffic signal system, and in the same pull box, shall be spliced to a detector lead-in cable.

Loop conductors for inductive loop detector traffic signal and traffic monitoring installations shall be identified and banded, in pairs, by lane, in the pull box adjacent to the loops. The pull box shall be near the termination of the conductor in the controller or traffic monitoring station cabinet. Bands shall conform to 209-5.3.

Loop conductors for traffic monitoring shall terminate in a pull box or terminal strip in the traffic monitor station cabinet when a cabinet of that type is installed.

Inductive loop detector lead-in cable shall extend from the pull box adjacent to the loop detector to a sensor unit mounted in the controller cabinet. Inductive loop detector lead-in cable from the pullbox to the controller cabinet shall have 4 conductors (consisting of 2 twisted pairs). Detector lead-in cable connections and/or terminations shall be soldered.

After the loops have been installed in the slots cut in the pavement, the slots shall be filled with sealant to within 1/8 inch (3 mm) of the pavement surface. The sealant shall be a minimum of 1 inch (25 mm) above the top conductor in the saw cut. Before setting, surplus sealant shall be removed from the adjacent road surface without the use of solvents.

If specified in the Special Provisions, the loops shall be installed prior to placing the asphalt concrete surface course. The loops shall be installed, as shown on the Plans, in the compacted layer of asphalt concrete pavement immediately below the asphalt concrete surface course. Installation details shall be as shown on the Plans, except the sealant shall fill the slot flush to the surface.

307-17.7.3.3 Sealants. Sealants shall conform to 209-5.8.2.4. Hot-melt rubberized asphalt sealant shall be melted in a jacketed, double boiler type melting unit. Temperature of the heat transfer medium shall not exceed the flash point of the sealant or 475° F (240° C), whichever is less.

Sealants shall be applied with a pressure-feed applicator or pour pot. Sealants shall be applied when the pavement surface temperature is greater than 40° F (4° C).

307-4.9.4 307-17.7.4 Magnetometer Detectors. All magnetometer Magnetometer detectors shall be as shown on the Plans or specified in the Special Provisions. Magnetometer detectors that are to be installed at in a particular intersection shall be of the same make and type.

Where an existing system is being modified and existing magnetometer detectors are to remain in use, new detection equipment shall be of the same make and type as the existing, or an Agency-approved alternate.

A separate channel shall be provided for each lane. Separate control units shall be provided for each approach.

A separate cable shall be provided for each magnetometer sensing element placed in the pavement. The cable shall be run continuously (without splices) to the lead-in cable.

Slots, 1/4 inch (6 mm) minimum in width by 1 inch (25 mm) minimum in depth, shall be cut in the pavement between the sensing element holes and the nearest pull box for lead-in conductor cables. Slots and holes cut in the pavement shall be blown clean and dried before installing lead-in conductor cables and sensing elements.

~~The sensing~~ Sensing elements shall be placed in vertically cut holes in the roadway at locations shown on the Plans plans. Each hole shall be of a diameter large enough to accept the ~~particular~~ type of sensing element ~~being~~ used, with adequate space for the lead-in conductor cable. Holes shall be cut to a depth sufficient to provide a mounting depth of the sensing element as recommended by the manufacturer ~~of the unit provided~~. Sensing elements shall be placed in the bottom of the holes in a vertical position. Holes shall be filled with clean, dry sand to approximately 3 inches (75 mm) below the pavement surface.

~~Slots, 6 mm (1/4 inch) minimum width by 25 mm (1 inch) minimum depth, shall be cut in the pavement between the sensing element holes and the nearest pull box for the lead in conductor cables.~~

~~Slots and holes cut in the pavement shall be blown clean and dried before installing lead in conductor cables and sensing elements.~~

~~The sensing elements shall be placed in the bottom of the holes, in a vertical position, and the holes shall be filled with clean, dry sand to approximately 75 mm (3 inches) below the pavement surface.~~

~~The epoxy~~ Epoxy sealant for the slots and holes shall ~~be as provided for in conform to 307-4.9.3 307-9.7.3.2,~~ except the top ~~75 mm (3 inches)~~ 3 inches (75mm) of the holes shall be filled with ~~the epoxy sealant conforming to 209-5.8.2.4.~~

307-17.7.5 Magnetic Detectors. Magnetic detectors shall conform to 209-5.8.3 and be located as shown on the Plans or specified in the Special Provisions. Magnetic detectors shall consist of:

- a) a sensing element or group of sensing elements installed in the roadway as shown on the Plans or specified in the Special Provisions,
- b) a lead-in cable, and

c) an amplifier with integral power supply installed in a controller cabinet.

Magnetic detector sensing elements and amplifiers to be installed at any single intersection or any traffic count station shall be of the same manufacturer and type.

Magnetic detector sensing elements shall be installed within conduit conforming to 307-7.6 unless otherwise specified in the Special Provisions. The conduit shall extend across the full-width of the traveled way (pull box to pull box) as shown on the Plans. The bottom of the conduit shall be placed 12 inches (300 mm) below the top of the pavement.

307-17.7.6 Measurement. Detectors complete and in-place shall be measured by each type.

307-17.7.7 Payment. Payment for constructing each detector shall be the Contract Unit Price or lump sum price in the Bid for each type.

307-17.7.8 Removing or Abandoning Existing Pressure-Sensitive Detectors. When a foundation for a pressure-sensitive vehicle detector is to be removed, the trench left by removing the detector frame and foundation shall be backfilled and resurfaced in accordance with 306-1.2.1 unless otherwise specified in the Special Provisions.

When a foundation for a pressure-sensitive vehicle detector is to be abandoned in place, the top of the foundation, anchor bolts, frame and conduits shall be removed to a depth of not less than 6 inches (150 mm) below the surface of existing pavement. The resulting trench shall be backfilled and resurfaced in accordance with 306-1.2.1 and 306-1.5 respectively, unless otherwise specified in the Special Provisions.

307-17.8 Pedestrian Signals.

307-17.8.1 General. The Contractor shall provide one visible operating pedestrian head at all times for each direction of each signalized crosswalk while modifying the pedestrian head. Non-functioning pedestrian heads at a signalized crosswalk shall be covered in conformance with 7-10.2.5 as specified in the Special Provisions. Pedestrian signal heads shall conform to 209-5.6 or be as specified in the Special Provisions and be installed as shown on the Plans.

307-4.10 307-17.8.2 Pedestrian Push Buttons. Where shown on the Plans, pedestrian push button assemblies conforming to 209-5.9 and signs shown on the Plans or specified in the Special Provisions shall be furnished and installed. Pedestrian push button assemblies shall be equipped as shown on the Plans or specified in the Special Provisions. Pedestrian push button assemblies and signs shall be installed on the crosswalk side of the Standard or pedestal unless otherwise shown on the Plans. Arrows on push button signs shall point in the same direction as the corresponding crosswalk.

Where a pedestrian push button is attached to a pedestal, the housing shall be shaped to fit the curvature of the pedestal and secured to provide a rigid installation. Saddles shall be provided to make a neat fit when required. Where a pedestrian push button is mounted on the top of a pedestal, the housing shall be provided with a slip-fitter fitting and the screws required to secure it rigidly to the pedestal.

~~307-4.10 Pedestrian Push Buttons.~~ Pedestrian push buttons and signs shall be installed on the crosswalk side of the standard unless otherwise specified.

307-17.8.3 Measurement. Pedestrian signals and push buttons shall be measured by each type.

307-17.8.4 Payment. Payment for pedestrian signals and push buttons shall be at the Contract Unit Price or lump sum price in the Bid for each type.

~~307-4.11~~ 307-17.9 Controller Slabs. In unpaved areas, a ~~100 mm (4 inch)~~ 4-inch (100 mm)- thick portland cement concrete slab shall be constructed in front of each controller cabinet. The slab shall extend the full width of the cabinet foundation and extend out ~~1 m (3 feet)~~ 3 feet (1 m) from the face of ~~said~~ the foundation.

307-5 INSPECTION AND 307-17 TESTING.

~~307-5.1 General.~~ Inspection or sampling of certain materials may be made at the factory or warehouse prior to delivery to the Work site, when required by the Engineer.

~~307-5.2 Testing.~~ Prior to acceptance ~~to~~ of the ~~completed work~~ Work, the Contractor shall ~~cause~~ perform the following tests ~~to be made~~ on all electrical circuits, in the presence of the Engineer.:

~~307-5.2.1~~ a) Continuity. Each circuit shall be tested for continuity.

~~307-5.2.2~~ b) Ground. Each circuit shall be tested for unintentional ground.

~~307-5.2.3~~ c) Megger. A megger test at 500 volts DC shall be ~~made~~ performed on each circuit between the circuit and a ground. The insulation resistance shall be not less than 10 megohms on all circuits, except for inductive loop detector circuits which shall have an insulation resistance value of not less than 100 megohms.

~~307-5.2.4~~ d) Functional. A functional test shall be ~~made~~ performed which shows that in which it is demonstrated that each and every part of the system functions as specified or intended. The test shall not ~~may~~ commence ~~only with the approval of~~ until approval is received from the Engineer.

The functional test for each new or modified electrical system shall consist of not less than 5 days of continuous, satisfactory operation. If unsatisfactory performance of the system develops, the condition shall be corrected and the test shall be repeated until the 5 days of continuous satisfactory operation are obtained. Functional tests shall not start nor turn-ons be made on a Friday, or on the day preceding a legal holiday. Shutdown caused by factors beyond the Contractor's control shall not constitute discontinuity of the functional test.

~~307-5.3~~ Faults. Any material revealed by these tests to be faulty in any part of the installation shall be replaced or corrected by the Contractor at its expense in a manner approved ~~permitted~~ by the Engineer, and the same test shall be repeated ~~until no fault is evident.~~

307-18.9.1 Payment. No separate payment will be made for testing.

~~307-6~~ 307-19 PAINTING AND GALVANIZING. New equipment to be painted or galvanized shall be as shown on the Plans or specified in the Special Provisions. ~~All painted~~ Painted or galvanized

equipment that has been relocated shall be repainted or galvanized as shown on the Plans or specified in the Special Provisions. ~~All paint used on the Work site shall be provided in the original container identifying the grade, trade name, number, and manufacturer, and The paint~~ Paint or galvanizing material shall conform to the requirements of Section 210. Painting shall conform to 310.

~~All paint~~ Paint shall be applied evenly and smoothly ~~by skilled craftsmen~~ by either hand brushing or spray methods as specified in the Special Provisions. ~~approved spraying equipment, allowing no surplus to accumulate, except that no Spraying spraying shall not be done at the Work site worksite. The work shall be done in a neat and workmanlike manner, and the~~ The use of brushes for the application of paint shall be required when paint spraying does not result in a finish conforming to the Specifications proves to be unsatisfactory or otherwise objectionable.

~~The thickness of each paint coat (two required) shall be limited to that which will result in uniform drying throughout the paint film. Skips, "holidays", thin areas, or other deficiencies in any one coat of paint shall be corrected before the succeeding coat is applied.~~

~~The final coat of paint shall present a smooth surface, uniform in color, free of runs, sags, or excessive brush marks.~~

307-19.1 Payment. Full compensation for painting or galvanizing shall be considered as included in the Contract Unit Price or lump sum price in the Bid for each item that requires painting.

307-7 307-20 SALVAGE. Unless otherwise specified in the Special Provisions, wires/conductors, Standards, pedestals, standards, electrical equipment, and foundations not to be reused that are not identified to be salvaged shall become the property of the Contractor and shall be removed from the Work site. Any salvage value shall be reflected in the Bid. All conduit abandoned in place shall be terminated at least 125 mm (5 inches) below finished grade.

Care shall be exercised in removing equipment to be ~~reused or~~ salvaged so that it will remain in the condition existing prior to its removal. ~~The Contractor will be required to replace, at its expense, any equipment that has been damaged or destroyed by its operations.~~

307-8 PAYMENT. Payment for street Lighting or traffic signal work will be as shown on the Bid.